Packing 10-pound Sacks of Idaho Potatoes

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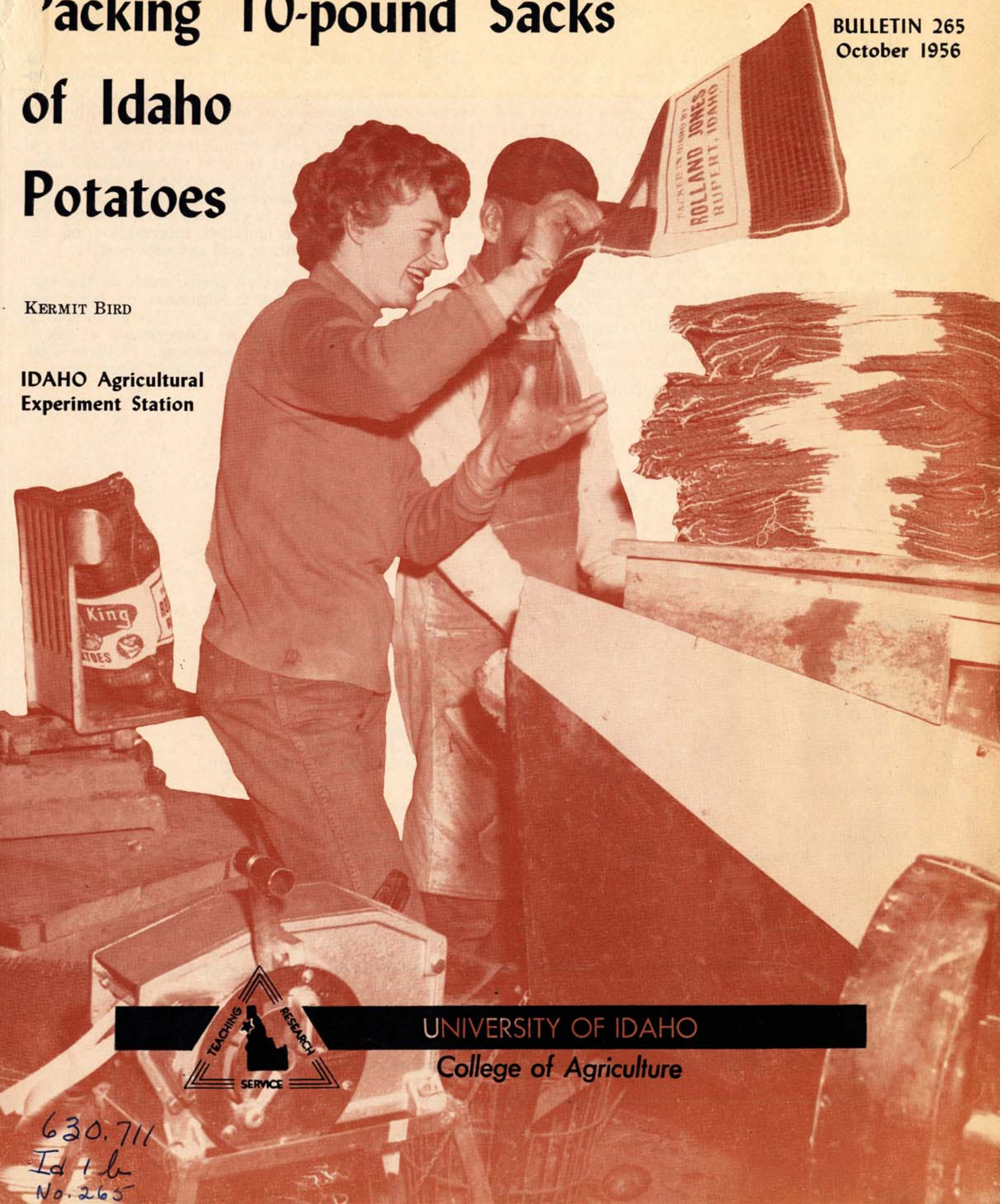

KERMIT BIRD

IDAHO Agricultural
Experiment Station

UNIVERSITY OF IDAHO
College of Agriculture

WHAT'S COVERED

COSTS involved in packing 10-pound containers are a primary concern of Idaho potato packers. Ten-pound operations, which use much labor, have become more important in recent years and many packers are uncertain about the type of machine they should use.

This is a survey of various 10-pound potato packing operations. The advantages of several machines and methods of packing are analyzed in order to select operations to fit appropriate needs.

The purpose of this bulletin is to help packers reduce labor and equipment costs in packing 10's. Compared are six methods of packing. Costs of baling and handling loose 10's are discussed. Methods and machines are illustrated. Analyzed are several methods of car loading. Outlined are some general principles on adjusting crew size to output, running machines at capacity, and the economy of running a long season.

The packing of 10-pound sacks is usually integrated with grading and the packing of other size containers. For purposes of this study, however, the 10-pound operation was isolated and analyzed as though it were completely independent of other operations. The data pertaining to equipment capacities and rates of worker output on different jobs were derived from studies of actual plant operations. General principles and ideas are given in the text. More specific information regarding production standards, crew organization, and equipment cost build-up is given in the appendix. The appendix also includes detailed information on the source of data, procedures, and assumptions.

A study of Idaho packing sheds, made in the winter of 1955-56, provided information on labor and equipment requirements. Some of the recommendations are judgments based on observations of plants and discussions with plant managers. Pictures illustrating various machines and methods were taken in Idaho plants.

WHERE TO FIND IT

THIS bulletin is the second in a series on costs and efficiency in the marketing of Idaho potatoes.

The first report, Bulletin No. 247, "Packing Idaho Potatoes—a Study of Plant Design, Equipment, and Costs," dealt with building and machinery costs and layout. The present report deals with the narrower problem of costs involved in 10-pound operations.

MAIN POINTS

- Costs in packing 10-pound sacks vary with
  - Packing method used
  - Volume packed per hour
  - Length of packing season
  - Efficient use of labor and equipment

• Six packing methods are analyzed and the three methods showing low costs are illustrated in Figures 3, 4, and 6. Packing costs of these most efficient methods were $.01 per 10-pound sack at an output of 1000 sacks per hour. At 3000 sacks per hour, packing costs were about 10 percent lower. But at 500 sacks per hour, costs were about 30 percent higher.

• Hand trucking offers a low cost, versatile method of car loading 10-pound sacks and is more economical than conveyor car loading. Conveyor car loading, however, is good where the operation is below ground level. It also works well in plants having a high, steady volume.

• Baling labor costs were $5.00 to $6.00 per car. Total costs of baling, however, should include the cost of the bale and take into consideration differences in bruising damage.

• Costs may be lowered through full use of equipment and labor. If a 10-pound crew were on the job to pack 1000 sacks per hour in a plant of that capacity, and for some reason they had only enough potatoes to pack 500 sacks per hour, costs would be double the minimum level. Both crew and machines would be used inefficiently.

• Economies are possible through operating the 10-pound equipment over a long season. Costs may be cut 20 percent by increasing the packing season from 6 weeks to 6 months.

THE following general statements may help packing plant managers pack 10's more efficiently.

• Pick the 10-pound equipment suited to needs. This choice depends on anticipated volume and on the amount of teamwork present among employees.

• Run machines at capacity. A less-than-capacity operation increases costs.

• If forced to operate at less than capacity, decrease crew size accordingly. In many instances this can be done by shifting workers to the grading table. When volume increases, workers may be shifted back to the 10-pound operation.

• Operate as long a season as possible. This spreads fixed costs over more sacks of potatoes.

THIS study was a phase of western regional marketing research project WM-19, "Economic and Engineering Studies of Fruit and Vegetable Packing." It was supported in part by funds allocated to the western region under the Hatch Act, amended. Other states cooperating in this study are Washington, Oregon, and California.

Packing Methods

TEN-pound operations may be broken down into sub-operations: sack-filling (including weighing, closing sack), baling, and car loading. This section is background material, and serves to acquaint the reader with the various machines and methods being analyzed. Following are descriptions of six methods and machines under study. Each method differs in the way sacks are filled. Other operations, such as weighing sacks, closing them, baling, closing the bale, and car loading, may or may not be different from method to method.

Filling Sacks

Pictured in Figure 1 is a **manual** operation. The operator (sack filler) presses a foot lever to start the belt and potato flow. The sack is filled to about 10 pounds, the foot lever is released and the flow of potatoes stops. The operator sets the filled sack aside for weighing and fills the next sack.

Figure 2 shows **semi-automatic heads located on the side of a conveyor belt.** The 10-pound sack is attached to this head, a button is pushed by the operator and a door opens, allowing the sack to be filled. A scale, attached to the head, closes the door and stops the potato flow into this sack when a weight of 10 pounds has been reached. The weight of the potatoes is then adjusted by the operator; the sack is unhooked from the head and placed aside for closing. In one plant studied the sacks were reweighed after being unhooked from the head.

The **scoop** machine is similar to the previous method and is shown in Figure 3. This machine has scoops which hold and weigh the potatoes before they go into the sack. The particular scoop machines studied had an even-flow hopper feeding the whole 10-pound operation.

In these first three methods, sack fillers work as individuals rather than as a team.

Figure 1—(Upper) The "manual" method uses this machine, which is hand operated. A view of this machine in use is shown on the front cover.

Figure 2—(Center) Another method analyzed is this machine, which has "semi-automatic heads on a belt."

Figure 3 — (Lower) Scoops on semi-automatic heads hold the potatoes while they are being weighed. Another feature of this machine is the hopper providing a steady flow.

A modern type **wheel** is shown in Figure 4. One or more workers attach empty sacks. One person rotates the wheel, filling the sack with potatoes coming from the end of a conveyor belt. One or more workers detach sacks from the wheel and weigh them. This particular wheel has several unique features. The sack filler turns it with his feet, allowing him the use of both hands to adjust the fill-level. Also, it has a return belt which brings spilled potatoes back to the main flow. This prevents potatoes from cluttering the floor. This type wheel may be used for polyethylene, mesh, or paper sacks. The wheel is essentially a team operation.

Figure 5 shows a machine and method somewhat similar to the "automatic heads on a belt" method shown in Figure 2. The difference is that in this machine a **sliding gate** directs the flow of potatoes from the belt into the attached sacks. This gate, or knife blade as it is sometimes called, is mounted on a slide above the conveyor belt and at an angle to direct the flow of potatoes. The flow is guided first through one opening on the side of the belt into an attached sack, then through the next opening, and so on. One or more workers attach sacks, another worker fills sacks, and one or more detach them. The workers generally work in teams on this machine, dividing up the work —thus team work is important.

A **tub** machine is shown in Figure 6. Here automatic heads are supplied by individual belts feeding from a tub, one tub to each double unit. The empty sack is attached and a button is pushed to start the flow. The flow stops when a weight of 10 pounds has been reached. A foot button is pushed to release the sack, which is then tied by the operator or by another person. A variation of this machine has a head with a scoop. These two machines are analyzed together because the output of the two is the same. These machines generally come in double units; that is, two sack-fillers operate the machine and fill two sacks at one time. Greater output is obtained by adding more double units. Each sack-filler is independent of the others, so teamwork is not so essential as with the "wheel" or "sliding gate" methods.

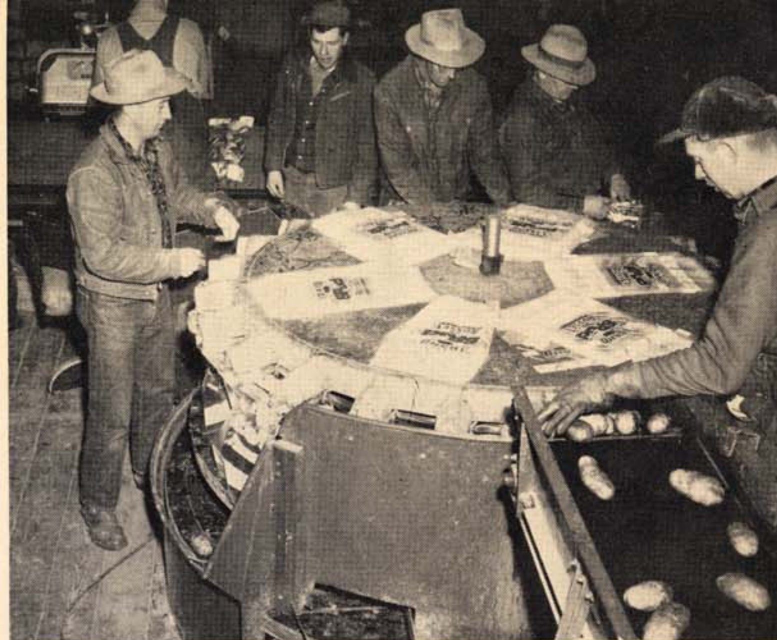

Figure 4—(Upper) Wheel 10-pound sack filling method. Employees must work together to obtain a high output.

Figure 5—(Center) Sliding gate sack filling crew. Teamwork is essential.

Figure 6—(Lower) Automatic tub machines in operation. Each tub holds a small reservoir of potatoes for the two sack fillers. This was found to be a low cost method of filling sacks.

Closing Sacks

THREE common methods of closing mesh sacks are shown in Figures 7 through 9. An automatic stapling machine used with a monorail is pictured in Figure 7. Mesh sacks are hooked on the monorail after being weighed, carried through the stapler, and automatically dropped from the hook to the baling crew. This machine has a high capacity rate, somewhat over 3000 sacks per hour.

Figure 8 shows a hand stapler in use. An advantage of this operation is that a monorail is not needed and a conveyor belt may be used. A disadvantage is that hand stapling uses more labor than an automatic stapler. One person doing this stapling job can close about 1300 10-pound sacks per hour.

Some crews tie mesh sacks by hand, as shown in Figure 9. Many workers become adept at this and tie a sack with little lost motion. The production standard for hand tying is 1300 sacks per hour.

The common method of closing polyethylene sacks is with a heat-sealing machine. One type is shown in Figure 10. This machine and accompanying belt cost $1350 to $1800. The one shown in the picture was running at an output of 2000 sacks per hour and required two workers to guide the sacks through the machine.

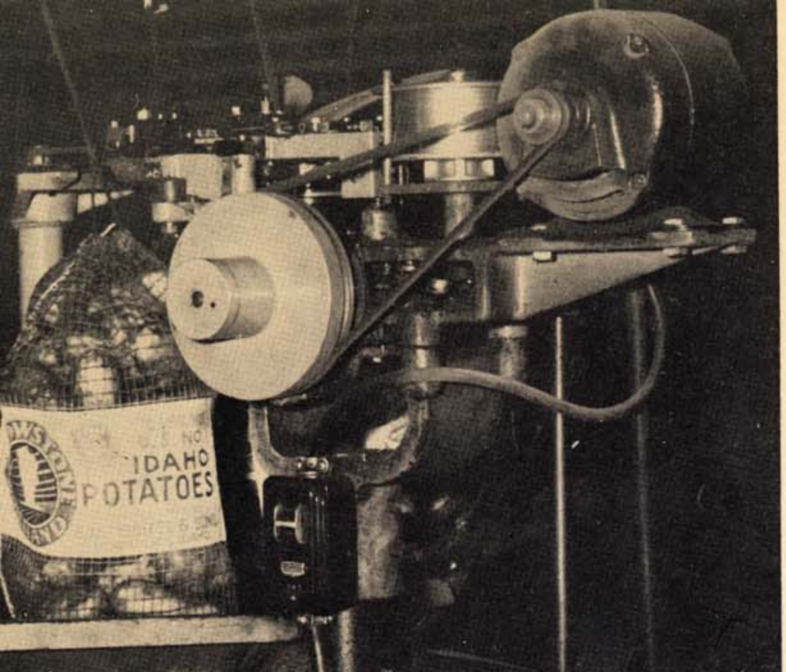

Figure 7—Automatic stapling operation on a monorail. This is a fast, low-cost method of closing mesh sacks.

Figure 8—A hand stapling operation. For a low volume plant this is the economical method of closing sacks.

Figure 9—Hand tying of mesh sacks.

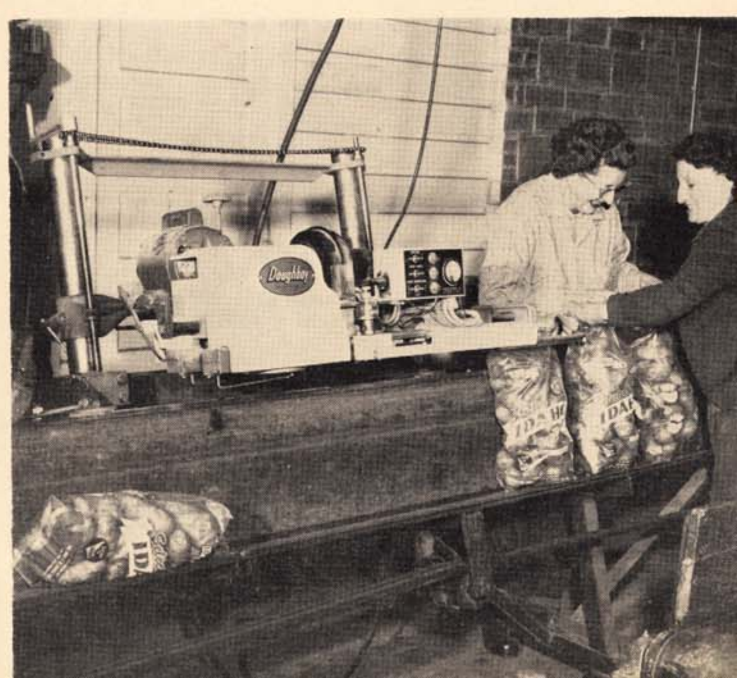

Figure 10—Heat sealing machine. This is the common method of closing polyethylene sacks.

Baling

THERE are many ways of organizing a baling crew, depending on output, crew size, and kinds of machines available. However, all bales were filled by hand in the plants studied. Generally it takes a minimum of two men to do the job, one man to open and hold the bale while the other man fills it. The bale is then closed and moved to the car. With higher outputs, additional men may be added to the crew, and, usually with larger crews, each worker does a more specialized job. Figure 11 shows sacks being released from monorail hooks and sliding down to the baling crew.

Bales may be closed by machines, as with the stapler or sewing machine. Or they may be closed by hand, using a hand wire-tie, hand stapler, or tape. Figure 12 shows a hand wire-tire operation. This is a fast, efficient way of closing bales.

Some baling crews do not try to tie and load bales while filling them; they let the tying go until the crew has a rest stop, then tie and load. This is a practical way of operating the baling crew if the output is low. However, for higher outputs it is better to fill, tie, and load bales as a continuous process. Generally, batch methods are less efficient than flow methods.

One bale-closing method used in high output plants is machine sack-sewing. Figure 13 shows one sack being guided into a sack-sewing machine and another sack being removed and loaded onto a hand truck.

Figure 11—Mesh sacks dropping to baling crew from monorail hooks. Little automatic devices such as this save much hand labor.

Figure 12—Closing bales with a hand wire-tie.

Figure 13—Bales being closed with machine sack-sewer.

Car Loading

CAR loading methods vary from plant to plant. The most common method of loading baled 10's is the hand truck (Figure 14). In spite of the degree of mechanization present in the potato packing industry, hand trucking has offered a flexibility and low cost which mechanization has not provided. Hand trucking is versatile and, for most operations, more economical than conveyor loading.

Hand trucks may be used for conveying loose 10's to the car. One way is to have a box built for the hand truck and to pack the 10's by hand in the box. The hand truckers then wheel these potatoes to the car and load them.

Another method of hand trucking loose 10's is shown in Figure 15. Here loose 10's drop from a monorail into a padded box mounted on a hand truck. The hand truck is wheeled to the car and car loading is done in the usual manner. Labor is saved because the hand trucks are filled with little labor.

Some plants use conveyors to move bales or loose 10's to the car. Figure 16 shows a car being loaded with bales from a conveyor. This packing operation was below track level and hand trucks could not have been used.

Figure 17 shows a crew loading loose 10's from a conveyor. Car loading with a conveyor works well if the car is to be packed with one type of package or grade and its output is high and steady.

Figure 14—Car loading of baled 10's is done primarily with hand trucks.

Figure 15—Sacks drop from monorail to hand truck. They are wheeled to car and packed loose.

Figure 16—Conveyors are convenient for car loading if the car is on a different level than the packing shed.

Figure 17—Conveyors may be used for car loading of loose 10's. A high, steady volume is necessary for this type of operation.

Yearly Equipment Costs

YEARLY equipment costs for the six methods are shown in Table 1 (Appendix). Equipment included is all the sacking and other machinery needed in a 10-pound operation. The method of building up models, from which these costs are derived, is given in the Appendix section.

The plant models used in this analysis have equipment sufficient to handle both mesh and polyethylene type sacks. The two larger size capacity model plants use a monorail and automatic stapler for handling and closing mesh sacks. Small-capacity plants use hand closing methods such as hand-stapling or hand-taping.

The "wheel" has the lowest yearly equipment costs, $403 at a capacity of 1000 sacks per hour, $1054 at a capacity of 2000, and $1192 at a capacity of 3000. The main reason for the big increase in equipment costs between 1000 and 2000 capacities is that the plant models with capacities of 2000 and over have the monorail, automatic stapler, and heat sealing machines. The small plants of 1000 capacity have lower machinery costs and higher labor costs.

The "manual" and "sliding gate" methods also have low equipment costs comparable with the wheel method.

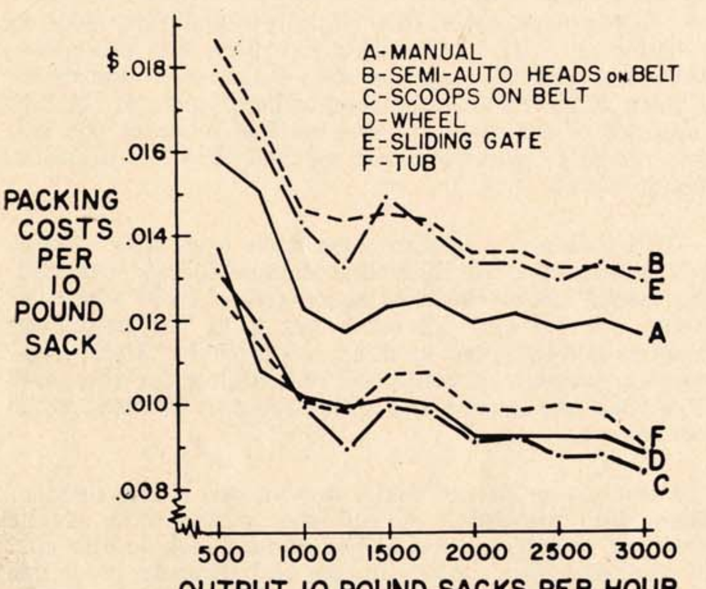

Figure 18—Comparison of costs of packing potatoes in 10-pound sacks, using six methods. This chart shows that the scoop, wheel, and tub are all low-cost methods. In deriving the cost curves, it is assumed that each plant will be working 6 months per year.

Labor Requirements

IN addition to equipment costs for the various operations, another apparent difference between the various operations is labor requirement. These labor requirements are shown in Table 2 (Appendix). They are not averages. Rather, they are expected outputs per worker in the various jobs. The "manual machine" uses five workers to fill 1000 sacks per hour. Eleven workers are needed to fill, weigh, bale and car load these sacks. To perform the same operations at the same rate, the "heads on a belt" method uses 13 workers. All of the six methods have different labor requirements, as shown in Table 2.

In comparing total labor requirements of the six methods, the "scoop" machine uses the least amount of labor. Here 8, 15, and 21 workers are needed for the 1000, 2000, and 3000 10-pound sack capacity operations. The "tub" is also an efficient user of labor with 8, 16, and 22 workers for the three capacity operations.

Costs of The Six Packing Methods

LABOR, equipment, and power costs are combined in Figure 18 to compare the six methods of packing 10-pound sacks. These packing costs include baling and car loading.

The "scoop," "wheel," and "tub" machine methods (as pictured in Figures 3, 4, and 6) have relatively low costs. Probably there is not enough difference among these three methods to warrant a statement that one of the three has "lowest costs." At an output of 1000 10-pound sacks per hour, each of the three has costs of about $.01 per 10-pound sack. The "manual" machine method has costs about 20 percent higher than these three. The "heads on a belt" and "sliding gate" methods show costs 60 to 70 percent higher than the three low-cost methods.

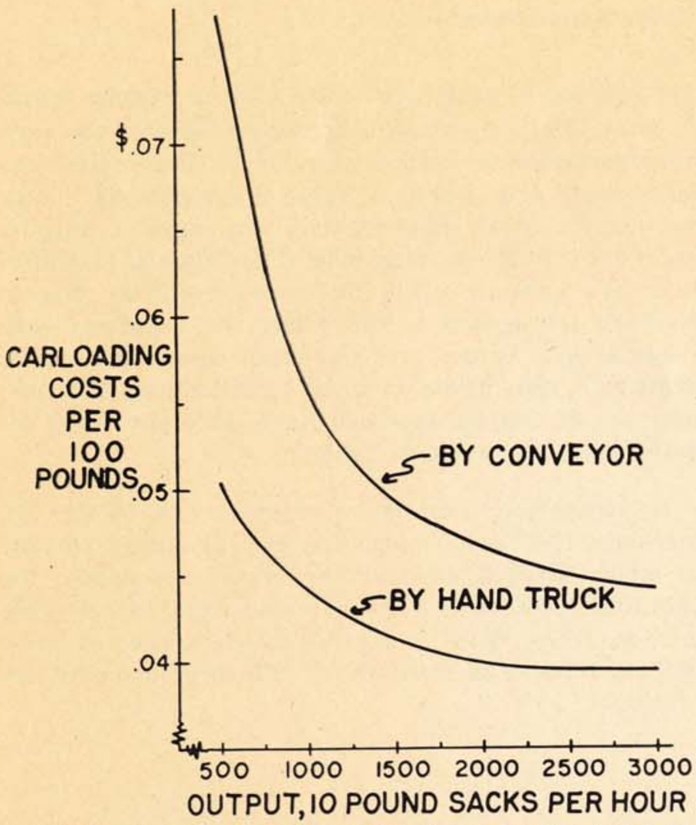

Figure 19—Comparison of costs of car loading baled 10-pound sacks, conveyors vs. hand truck methods. In most operations hand trucking is a lower cost method. In deriving these curves it is assumed that each operation will be in use 6 months per year.

Conveyor Car Loading

SOME packing sheds use conveyors for car loading, while others—the majority—use hand trucks. Figure 19 shows that for most operations hand trucking methods have lower costs. At an output of 2000 sacks per hour, hand trucking costs average $.04 per cwt. Comparable conveyor car loading costs are $.046 per cwt. The difference of $.006 per cwt. amounts to $2.16 per car of potatoes.

Conveyors do have advantages in certain type operations:

- They are virtually a necessity where the packing is below the level of the loading ramp.
- Conveyors work well in high output plants where there is a steady flow of potatoes.
- They work best in operations where each car is loaded with one type sack, one grade and one size.

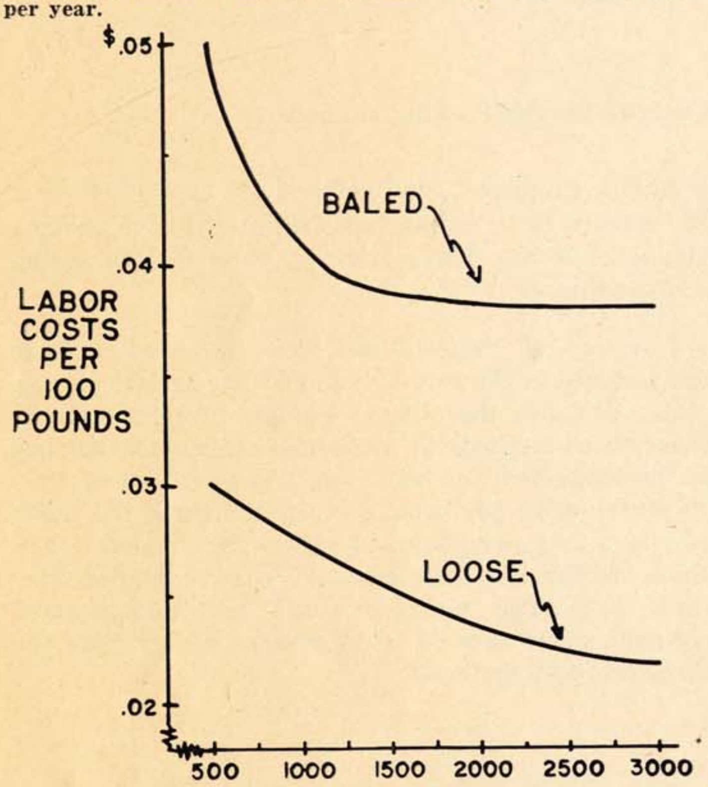

Figure 20—Comparison of labor costs in car loading 10-pound sacks, baled vs. loose. Baling labor costs are about 1 cent per cwt. higher than "loose" labor costs. In both methods hand trucks were used to move the potatoes to the car.

Car Loading of Bales and Loose Sacks

THE baling operation is an important user of labor in the packing of 10's. Baling is generally done in conjunction with car loading and these two sub-operations are analyzed together as a single work-operation. Figure 20 shows a comparison of labor costs of the two methods of car loading. One method includes the baling operation and the other method shows loose sacks being loaded.

The baling-car loading operation used about 60-70 per cent more labor than the comparable loose-car loading pack. Labor costs, at an output of 3000 sacks per hour, are 3.8 and 2.2 cents per cwt., for baling-car loading and loose-car loading, respectively. Thus, labor costs are about 1.6 cents per cwt. higher for the baled 10's than the loose ones. This amounts to about $6.00 per car.

Labor costs do not make a complete comparison of these two methods. A full cost comparison of the costs of baling vs. non-baling should include the cost of the bale used. Also, buyers and shippers recognize that potatoes in bales are better protected from bruising and light damage enroute to the retail store.

Greater Efficiencies Through Increased Volume

IN planning for the future, packing plant managers face problems of determining which of the possible methods of packing and loading 10's is the most efficient and suitable to their needs. This has been discussed in the previous sections. An equally important problem is the one of how many days to work during the season. For example, does it pay a packer to operate continuously throughout the season If so, what is the difference in costs of operating a plant 6 weeks and 6 months?

Other problems of a similar nature deal with economies possible through full employment of machinery and equipment. Thus we find in the following pages that one common inefficiency is that of not operating equipment to its full capacity. Being aware of this problem is the first step in its solution. A more serious and costly problem in packing potatoes occurs when laborers are not fully used. The solution to this problem is not easily attained but the following pages give some ways to more fully utilize the time of the workers.

Length of Season and Costs

MANY packing plant managers have some choice as to how many days per year their plant will run. This choice, of course, may be limited by the availability of potato supplies and the condition of the market. The planning cost curves shown in Figure 21 apply to the manual machine, but the general principle remains the same for any packing method. At any given capacity output rate, large reductions in average costs are possible as the length of season increases from 300 to 1200 hours.

To illustrate, if a packing shed has a capacity of 1000 10-pound sacks per hour and is run 1200 hours per year, packing costs are $.013 per sack. This same plant operated 600 hours has costs of $.015 per 10-pound sack. A 300 hour per year operation results in costs of $.016 per sack. Thus it is possible for a plant manager to decrese packing costs $13 per carload of 10's by extending the packing from 300 to 1200 hours.

What is involved here is that each packing plant has certain fixed costs. The total amount of these costs remains about the same regardless of output. The secret then is to increase output to spread these fixed costs over more units. One way to accomplish this is to operate the 10-pound crew and machines for a long season.

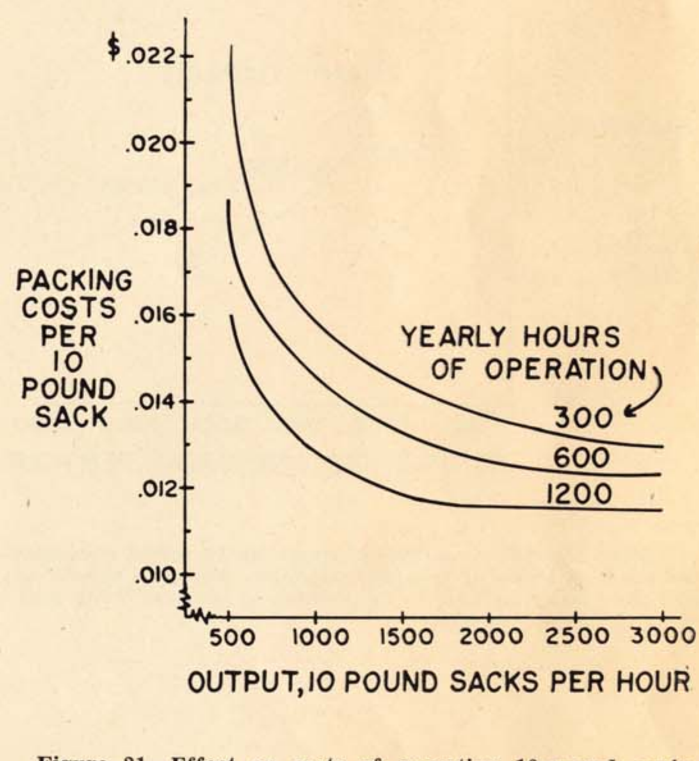

Figure 21—Effect on costs of operating 10-pound equipment at three levels of hours per year. Spreading fixed costs over more hours per year is one way of cutting per unit costs.

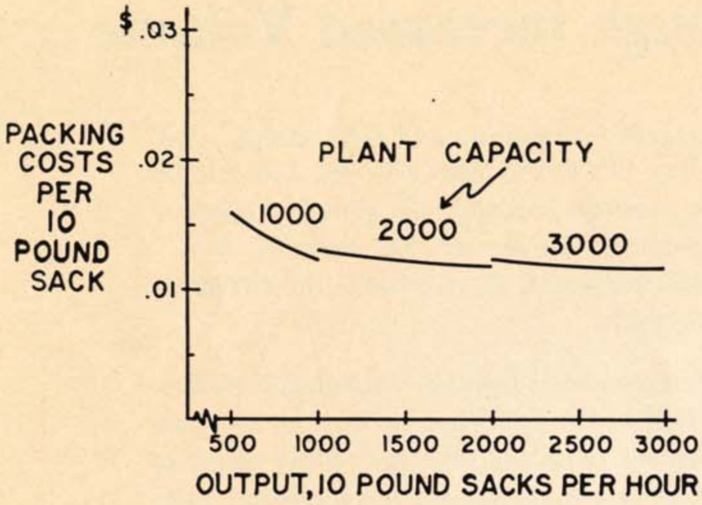

Figure 22—Effect on costs of operating 10-pound equipment at levels of less than capacity. This shows the cost advantage of operating machines at capacity levels.

Effect of Inefficient Use of Equipment on Costs

ONE inefficiency common in many Idaho packing plants is underemployment of equipment. This is true in the 10-pound operation, as with other packing jobs. Figure 22 shows costs of three sizes of 10-pound operations. The line at the left of the chart shows costs of packing 10's with equipment designed for packing 1000 sacks per hour. At outputs less than 1000 the crew size and power costs decrease, but not at a rate proportional to the decreased production. Total equipment costs remain the same and the result is that at outputs of less than 1000 the equipment is used less efficiently and the costs per unit are higher. In this example there is a combination of labor and equipment which works at optimum efficiency at an output of 1000 sacks per hour. At outputs of less than 1000, not only do equipment costs (these are fixed) per unit increase, but labor costs (variable) per unit increase because labor is now being used less efficiently. Per unit labor costs increase because there is now too much equipment relative to the labor force.

At 1000 output (in the plant with a capacity of 1000) costs are $.012 per sack. In this same plant, costs are $.016 when output is only 500 sacks per hour. The difference of 4/10 cents per sack amounts to $14 per carload of 10's.

The point brought out here is that lowest costs are possible when equipment is operated at capacity.

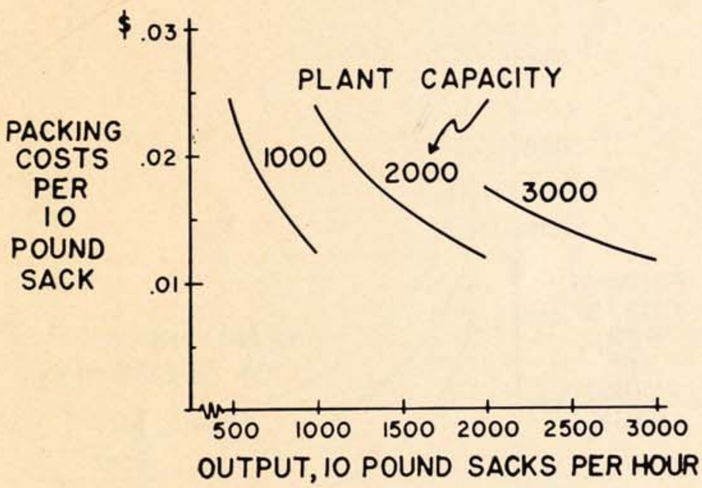

Figure 23—Effect on costs of operating 10-pound equipment and crew at levels of less than capacity. Foreman should adjust crew size according to the volume of potatoes being packed by the 10-pound crew.

Effect of Inefficient Use of Equipment and Labor on Cost

AN even more costly inefficiency than the one illustrated above occurs whenever plant managers do not adjust labor as output changes. Figure 23 is similar to Figure 22, except here neither equipment nor labor vary with output.

Picture a 10-pound packing crew and equipment. They have an ideal set-up for packing 1000 sacks per hour. Both laborers and equipment are being worked at capacity. The costs at an output of 1000 sacks per hour are $.012 per sack (left line of chart).

Now introduce a decrease in volume of potatoes to the 10-pound crew. For example, the lot may change and the poorer quality takes longer to be graded. The new output of the 10-pound crew is 500 sacks per hour. The foreman, not aware of his responsibility at this time, keeps the same number of workers on the 10-pound crew. Obviously this crew is now under-employed, as is the equipment. With this drop in output, costs have doubled from $.012 to $.024 per sack.

The cost difference of $$.012 per 10-pound sack looks small, but amounts to $44 per car.

Pertinent conclusions derived from Figure 23:

- When output varies, adjust crew size. This may be done by moving workers back and forth from the grading table to the 10-pound operation. This has the desirable effect of helping both groups adjust to the quality of potatoes.
- Keep output at as steady a rate as possible. One way to accomplish this is to have an even-flow hopper between the grading crew and the 10-pound crew. A hopper provides a reservoir of potatoes and keeps the 10-pound crew somewhat independent of the changes in graders' output.
- Lowest costs are more often attained at capacity levels than at any other point.

Appendix

THIRTEEN potato packing plants were studied in the winter of 1955-56. These sheds were of above-average efficiency in their 10-pound operations and were selected on this basis. They were of various sizes, with capacities of 500 to 2400 10-pound sacks per hour. In addition, these plants used the various types of 10-pound machines common in the industry.

Methods of Analysis

ONE full day's operation was studied at each sample plant. Each plant provided detailed information on labor requirements for each job in its 10-pound operation. For purposes of this study the 10-pound operation includes all packing plant work done to the potatoes after they are weighed and channeled to the 10-pound crew. Sacking, weighing, tying, baling and car loading are the main jobs. Foremen's, manager's and clerical labor are not included as costs. Thus the labor figure is for actual labor performed and not indirect services.

A time record was kept for each lot of potatoes in each plant, and throughout the analysis individual lots were kept separated. Also collected from the plants were costs of machinery and equipment. In the analysis, costs were based on 1955 replacement costs of machinery. This equipment was depreciated at 20 percent for sacking equipment and 10 percent for all other equipment. A breakdown of other fixed equipment costs is in the footnote following Table 1. Power consumption costs were estimated, using horsepower of motors as a basis. The formula used for this calculation is given in the assumptions in this Appendix.

In addition to the actual amount of labor involved in a job, an estimate was made of how busy each laborer was on his particular job. This estimation process is called "work sampling" and was used to construct "production standards" for each job. Work sampling is a method of determining what a worker is doing or how busy he is on his particular job. It is similar to time and motion techniques except that numerous check observations take the place of a continuous observation. In this study, work sampling was used to provide information to build up production standards.

Derived production standards and estimations of equipment and power costs were combined to construct "models" of 10-pound operations. These models were of several sizes, ranging from 500 to 3000 10-pound sacks per hour capacity. Production standards used to make these models are based on actual performances of workers as derived by work sampling. Production standards are not top performances; neither are they averages. Rather, they are outputs which average workers can maintain throughout the day if kept reasonably busy. For example, a car loader can handle 1700 10-pound sacks per hour all day long if provided with the work. This 1700 figure, then, is a production standard for a car loader. If a model 10-pound operation of 1000 sacks per hour capacity were being designed, one car loader would be included. A model of 2000 sacks per hour capacity would need two loaders. A 3000 capacity model would still use only two car loaders, for the two car loaders would be able to handle up to 3400 sacks in an hour.

Assumptions

IN constructing models involving over-all costs of 10-pound operations, least costs combinations were used. For example, it was found that in most plants the hand trucking operation was cheaper than conveyor car loading. Thus, in the models, hand trucking was used as the method of car loading.

A major assumption underlying this whole analytical treatment is that the 10-pound bagging operation can be analyzed as a separate operation even though it is integrated as a part of a complete potato packing operation. It is recognized here that this is a problem. However, in the analysis, and also in the collection of the data, the work was simplified by the assumption that an analysis could be made of a part of a whole. In the collection of data, for example, whenever a worker of a machine was used jointly by another operation within the plant, the worker's or machine labor was divided and only part of it was assigned to the 10-pound operation.

The assumptions and simplifications are as follows:

1. This is an analysis of the 10-pound operation only. The plants have 100-pound crews, grading crews, and so on, but they are not included in this analysis.
2. The working day of the plants is 8 hours, minus two 15 minute rest-periods per day, or a total working time of 7½ hours per day.
3. Unless otherwise stated, the plants were set up to work 25 weeks or 1200 hours per year.
4. All packed 10-pound sacks are assumed to be loaded on railway cars.
5. Jobs were distributed between men and women as follows: All jobs of handling 10-pound sacks are done by women. All jobs of handling units larger than 10 pounds in weight are done by men. Thus, sack-filling, weighing and sack-closing are women's jobs. Baling, car loading and hand trucking are men's jobs.
6. Wage rates are $1.00 per hour for women and $1.25 per hour for men. These rates conform closely with those actually paid in the industry.
7. In the construction of production standards it was assumed that each worker should be fully occupied during his working hours. Fully occupied does not mean that the worker should be busy 100 per cent of the time—rather that he should be busy about 80 percent of his time on the job. The 20 percent of the time not occupied with work includes personal time off, waiting for work, and breaks of various types.
8. In construction of models, crews were organized to do the various jobs for each capacity plant. As an example, if a plant model were being con-

structed with a capacity of 3000 10-pound sacks per hour, a crew of the minimum size which could do the job was used in that plant. In addition, this plant had costs representing enough equipment to do the packing job at this capacity.

9. Where rates of plant operation are specified, it was assumed that an essentially uniform rate of output per plant-hour would be maintained throughout the season.
10. Fixed equipment costs were calculated based on the replacement cost of the machines at 1955 prices. The 10-pound sacking equipment was written off in a five-year period. All other equipment had a depreciation cost of 10 percent per year. Interest on investment was calculated at 5 percent of original investment.
11. Costs do not include the cost of potatoes nor the cost of 10-pound sacks or bales.
12. No overhead costs are included in this analysis. The only costs involved are labor on the 10-pound operation, machines used for packing 10-pound sacks, and power costs on the 10-pound operation. Foremen's, manager's, clerk's, buyer's and salesmen's salaries are not included as costs. Building costs are not considered.
13. Power consumption costs for 10-pound operations were calculated from the rated horsepower of motors in use. The horsepower of all motors in the 10-pound operation was multiplied by $.014 to get power costs per hour of operation.

Power costs were derived using:
$.01 per kwh. for 90 percent or better, power factor
70 percent motor efficiency
5 percent line loss
75 percent diversity factor

Therefore, each horsepower required:

$$\frac{1 \text{ hp}}{.70 \times .95} \times .75 \times \frac{1746 \text{ kw}}{\text{hp}} = .8414 \text{ kw}$$

.8414 X $.015 = $.0126 per hp per hour

Add 10 percent to this for lights for a total of $.014 per hp per hour.

Table 1: Yearly Equipment Costs For Six Months of Packing Tens*

Machine-method	Capacity, 10-pound sacks per hour 1000	2000	3000
Manual	$ 573.20	$1464.20	$1845.20
Automatic heads on belt	985.40	1958.60	2511.80
Scoop	1345.40	2078.60	2301.80
Wheel	403.10	1054.10	1192.40
Sliding gate	576.20	1350.20	1560.20
Tub	1495.40	2708.60	3411.80

* Includes costs of equipment necessary to pack 10-pound sacks at these capacities. Costs are calculated by using 1955 replacement prices depreciated at 20 percent for sacking equipment and 10 percent depreciation for scales, belts, heatsealer, monorail, and handtrucks. Interest cost is 3 percent (interest at 3 percent equals approximately 5 percent of undepreciated balance). Insurance and taxes are each 1 percent. Fixed repair costs are 5 percent.

Table 2. Labor Requirements in Packing 10's, Using Six Packing Methods as Shown in Figure 1.

Machine-method	Capacity, 10-pound sacks per hour 1000	2000	3000
		(workers)	
Manual	11	21	31
Automatic heads on belt	13	24	35
Scoop	8	15	21
Wheel	9	16	23
Sliding gate	13	24	35
Tub	8	16	22

Table 3: Cost Comparison of Six Methods of Packing 10's.

Machine-method	Costs per 10-pound sack at an output of 1000 10-pound sacks per hour
Manual	$.0123
Automatic heads on belt	.0146
Scoop	.0099
Wheel	.0101
Sliding gate	.0143
Tub	.0101

Table 4: Cost Comparisons of Car Loading 10-pound Sacks.

	Costs per cwt. at an output of 1000 10-pound sacks per hour
Method	
By conveyor (baled)	$.512
By hand truck (baled)	.377
Labor costs	
Loose (by hand truck)	.250
Baled (by hand truck)	.375

Potato Publications

YOUR University of Idaho conducts research in many phases of potato production and marketing. Following are some titles which may be obtained by writing your county agent or the University of Idaho at Moscow or Boise.

Packing Idaho Potatoes, A Study of Plant Design, Equipment Layout, and Costs. Experiment Station Bulletin 247

Injury to Russet Burbank Potatoes. Experiment Station Bulletin 218

Irrigation of Russet Burbank Potatoes. Experiment Station Bulletin 246

An Analysis of Potato Packing Costs in Idaho, 1950-51 Season. Experiment Station Bulletin 208

Storing the Idaho Potato. Experiment Station Bulletin 296.

A Study of Simulated Hail Injury to Potatoes. Experiment Research Bulletin 22

Bottle Neck Tubers and Jelly-end Rot in Russet Burbank Potatoes. Experiment Station Research Bulletin 23.

Producing the Idaho Potato. Experiment Station Mimeo 121

Fusarium Seedpiece Decay of Potatoes in Idaho and its Relation to Blackleg. Experiment Station Research Bulletin 15

THIS BULLETIN IS FOR . . .

- foremen
- managers
- owners

Which packing method should I use in packing 10's?	How many 10's should I pack an hour with the equipment I have?	How many workers do I need in packing 10's?
What does it cost to bale 10's?	Which provides lower costs, hand truck or conveyor car loading?	How important are fixed costs in a 10-pound operation?
When the grade of potatoes changes, what should a foreman do about labor on the 10-pound crew?	When should conveyors be used for car loading?	Does it pay to pack 10's steadily throughout the season?

Answers to these and other questions on the efficient packing of Idaho potatoes in 10-pound sacks are given in this bulletin.