BRUISE DETECTION AND INCENTIVE PROGRAM - A GROWERS APPLICATION

by
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Reduction of bruise to potatoes during harvest and storage operations is critical when considered in the crop's cash return. Consider the following cash return calculations where bruise-free incentives are included (Table 1). These calculations are for out of field delivery. The same calculations hold true for out of storage delivery except that the maximum and minimum percentages are decreased by 5% and the base price will be a bit higher. These same results are shown graphically in Figure 1. A grower may want to change some of the yield and contract values but the relationship still exists.

It is obvious that measures need to be taken to reduce potato bruising. There are several areas to consider in implementing bruise reduction as shown in Table 2. This paper will discuss the two areas that are underlined.

Careful operation of harvesting, hauling, and piling equipment is probably as important as improvement of that same equipment. However, it may be more difficult to accomplish.

Table 1. Effect of Bruise Free Incentive on Cash Return on a 25 T/Acre Potato Crop.

Out-of-Field Contract Incentive: $50/T gain or loss for each 1% above or below 50% bruise free base to upper and lower limits of 75% and 27% bruise free.

Out-of-Field Contract Price: $54.00/T

50% Bruise free 25T/Acre x $54.00/T = $1350.00/Acre

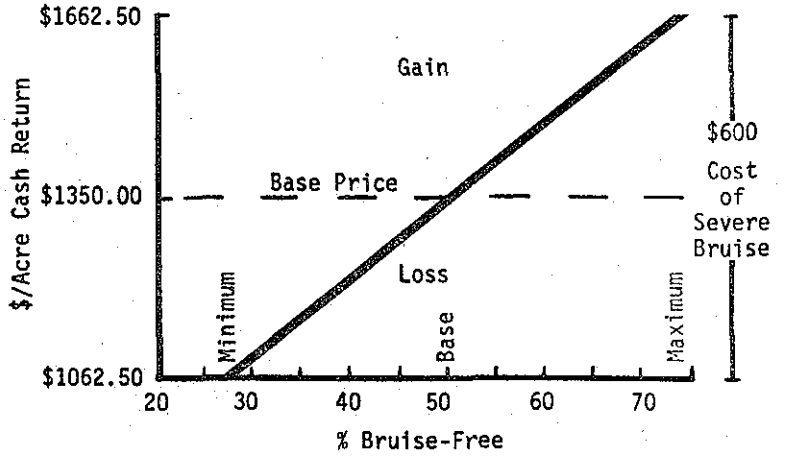
27% Bruise free 25T/Acre x $54.00/T = [(50-27) $.50/T] 25T/Acre
= $1350.00/Acre - $287.50/Acre = $106.50/Acre

75% Bruise free 25T/Acre x $54.00/T + [(75-50) $.50/T] 25T/Acre
= $1350.00/Acre + $312.50/Acre = $1662.50/Acre

Table 2. Areas to Consider in a Bruise-Reduction Program.

1. Better field management from planting to harvest.
2. Improvement of harvesting and handling equipment.
3. More care by operators during digging, hauling, and piling.
4. A system of monitoring bruise from digging to the end of piling operation.
5. Better storage and storage management.

Figure 1. Effect of Bruise-Free Incentive on Cash Return on a 25 T/Acre Potato Crop



Good operators and drivers are essential. However, a positive mental outlook is still very important. Even the best operators can do better if they want to. They need something to motivate them to do better and resist getting careless or sloppy. An incentive program for harvester operators and piler operators seems to be both fair and effective. The methods of setting up an incentive program are pretty much up to the employer or manager. The incentive offered to digger operators shown in Table 3 is an example of an incentive program that has been used. The base of the incentive was set at 60% bruise free. There were no penalties for going below 60% bruise free. The maximum incentive was set at 90% bruise free. While the potato processor incentive maximum is at 75% bruise free, it must be remembered that potatoes are going to pick up bruise between the harvester and the pile. Thus it is important to aim high in harvester operation. Also, with such a program, the harvester operator will be far more concerned about the performance of truck drivers.

Use of an incentive program requires some method of monitoring bruise in the potatoes. This requires both a sampling program and a bruise analysis program.

No matter how good the system of bruise analysis, if the sampling program does not provide a representative sample of the potatoes, the bruise results are worthless and perhaps even seriously misleading and costly.

The most convenient method of sampling is to collect the sample at the back of the truck during the unloading operation. The sample should consist of three portions taken at the beginning, the middle, and the end of the unloading operation.

The sample should be taken carefully but include all potatoes collected. Care should be taken in handling the potatoes so they are not bruised in the sampling process. A canvas tray (12" x 24") seems to work well. Plastic buckets work well for sample containers. Some form of identification such as shown in Figure 2 must be included with each sample. This card stays with the sample until the end of analysis.

The more trucks that are sampled, the better. However, under high load conditions at least every other truck should be sampled. Too many samples will "swamp" the bruise analysis operation.

Samples of freshly dug potatoes stored at 50 to 60^{o}F require about 48 hours for bruise to develop. A lot of potatoes can be dug in 48 hours. Acceleration of bruise development can

be accomplished by elevating tuber temperature to 90°F. Care should be taken not to warm the potatoes to over 100°F or they may go dark. If the tubers are held at 90°F for 12 hours the bruise development will be the same as found when held at 50 to 60°F for 48 hours *. This is very helpful in discovering bruise problems early.

A small heated building with good temperature control will serve for warming the samples. A large fan and holes in the buckets provide for good circulation. When large numbers of samples are taken, it may be that only part can be warmed and the remainder will have to be held 48 hours.

Samples should also be taken from the pile to minitor bruise during unloading and piling. The samples must be hand-picked from the pile and should represent the size distribution of potatoes in the pile. This type of sampling is more difficult but with care it can be accomplished.

Figure 2. Sample Identification Card.

Sample Date _____	Analysis Date _____
Time of Day _____	Time of Day _____
Digger Operator _____	Lbs. of Potatoes Bruised _____
Field _____	Lbs. of Potatoes Bruise Free _____
Truck Driver _____	Total lbs. of Potatoes _____
Storage _____	% Bruise Free _____

Table 3. Bruise-Free Incentive to Harvester Operators.

Incentive: $ 0.11/load gain for each 1% above 60% bruise free to an upper limit of 90% bruise free.

Maximum possible gain: $3.30/load at 90% bruise free.

At 30 loads/day: 30 x $3.30 = $99.00/day

Calculation of incentive/load

$$\text{incentive/load} = \frac{\text{load \% B.F.} - 60\%}{30\%} \times \$3.30$$

Example at 75% bruise free

$$\text{incentive/load} = \frac{75 - 60}{30} \times \$3.30 = \$1.65/\text{load}$$

* Dwelle, R. B. and G. F. Stallknecht. Rates of internal blackspot development in potato tubers under conditions of elevated temperatures and gas pressures. American Potato Journal. Vol. 53:235-245. 1976.

When no formula type of incentive is being given for piler operators, he could receive a bonus or get replaced depending on performance.

Once the samples have been collected and properly identified and acceleration of bruise development has been achieved using a warming treatment, the next part of the program is bruise analysis.

As shown in Figure 3, at the time of bruise analysis the potatoes are washed and then graded to remove cull, undersize, and green ends as done at the processing plants. The potatoes are then placed in wire baskets and immersed in a heated lye bath for 3 minutes. The bath is a solution of 14% sodium hydroxide heated to 200-212°F. CAUTION - THE SOLUTION IS VERY CAUSTIC.

The bath solution can be prepared by using 50% sodium hydroxide solution, technical grade, which is available from various industrial chemical supply businesses.

The tubers are removed from the bath and allowed to drain free of the bath solution. The tubers are then peeled using a high pressure washer made of a rotating drum with nozzels on the inside. High pressure water is supplied from an electrically driven piston pump.

After the tubers have been washed free of the cooked peel, there will be an approximate 10% loss of initial weight. They are then graded into bruised and bruise-free portions. These portions are weighed and the data recorded on the sample identification card. The data is then used to calculate the bruise-free results which are recorded on permanent records. These records then provide for feed back to the operators and also calculation of their incentives.

For an overall review of the bruise detection program, the operation is shown in Figure 4.

In considering the economic feasibility of a bruise detection and incentive program, consider the return due to such a program on a 500 acre potato crop as shown in Table 4. Since these figures are given as an example, they can be changed to meet a growers actual conditions. The cost of the operators' incentive will also be up to the grower. The bruise analysis equipment can be held to the cost shown.

In conclusion, the net return on such a bruise detection and incentive program which increased the bruise free by 20% on 500 acres of potatoes with a useable yield of 25 ton per acre was $119,120. This return is about twenty times the cost of investment. Stated another way, the cost of investment is returned 100% for every 1% increase in bruise-free potatoes.

Figure 3. Bruise Analysis

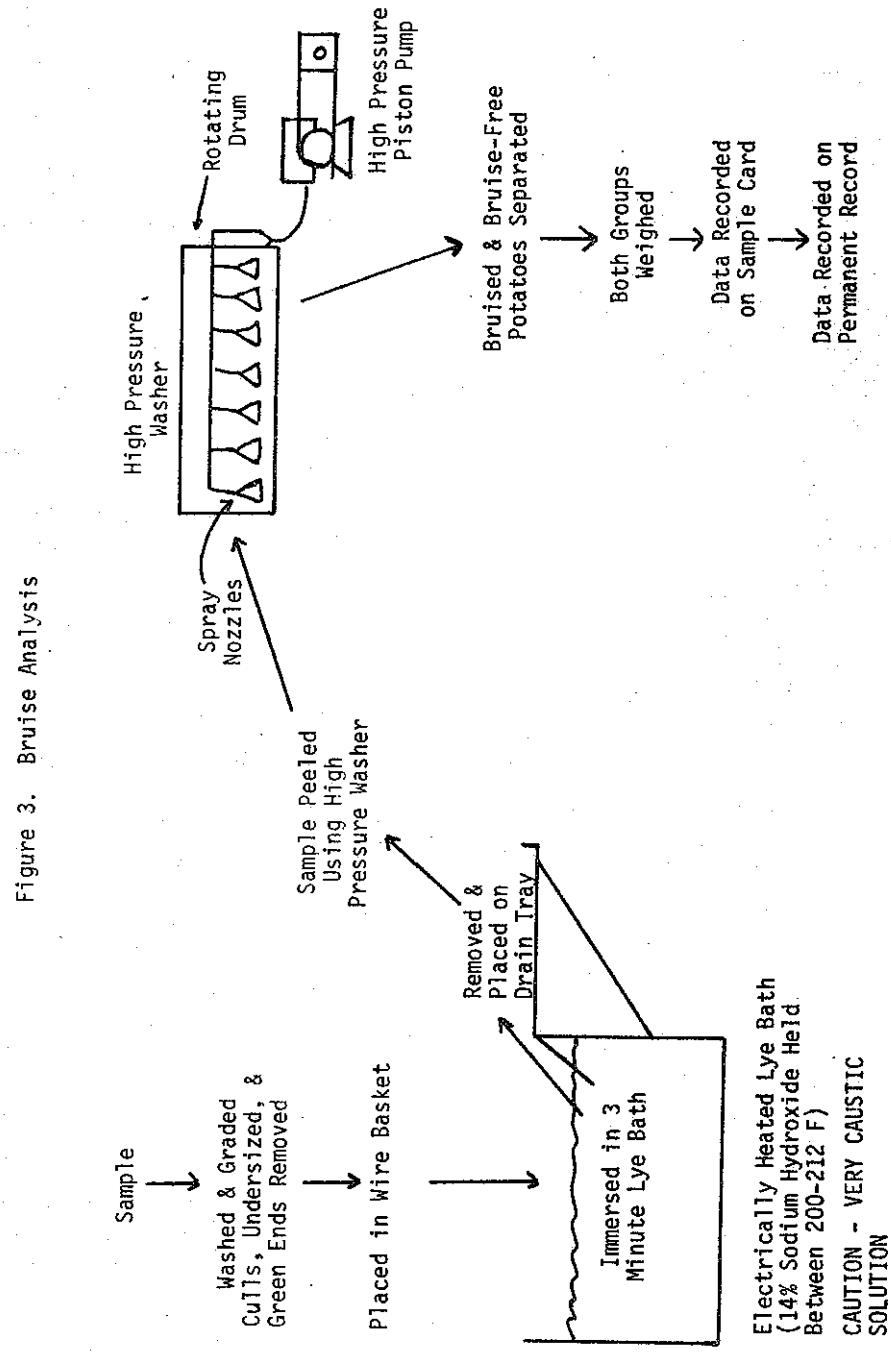


Figure 4. Bruise Detection and Incentive Program

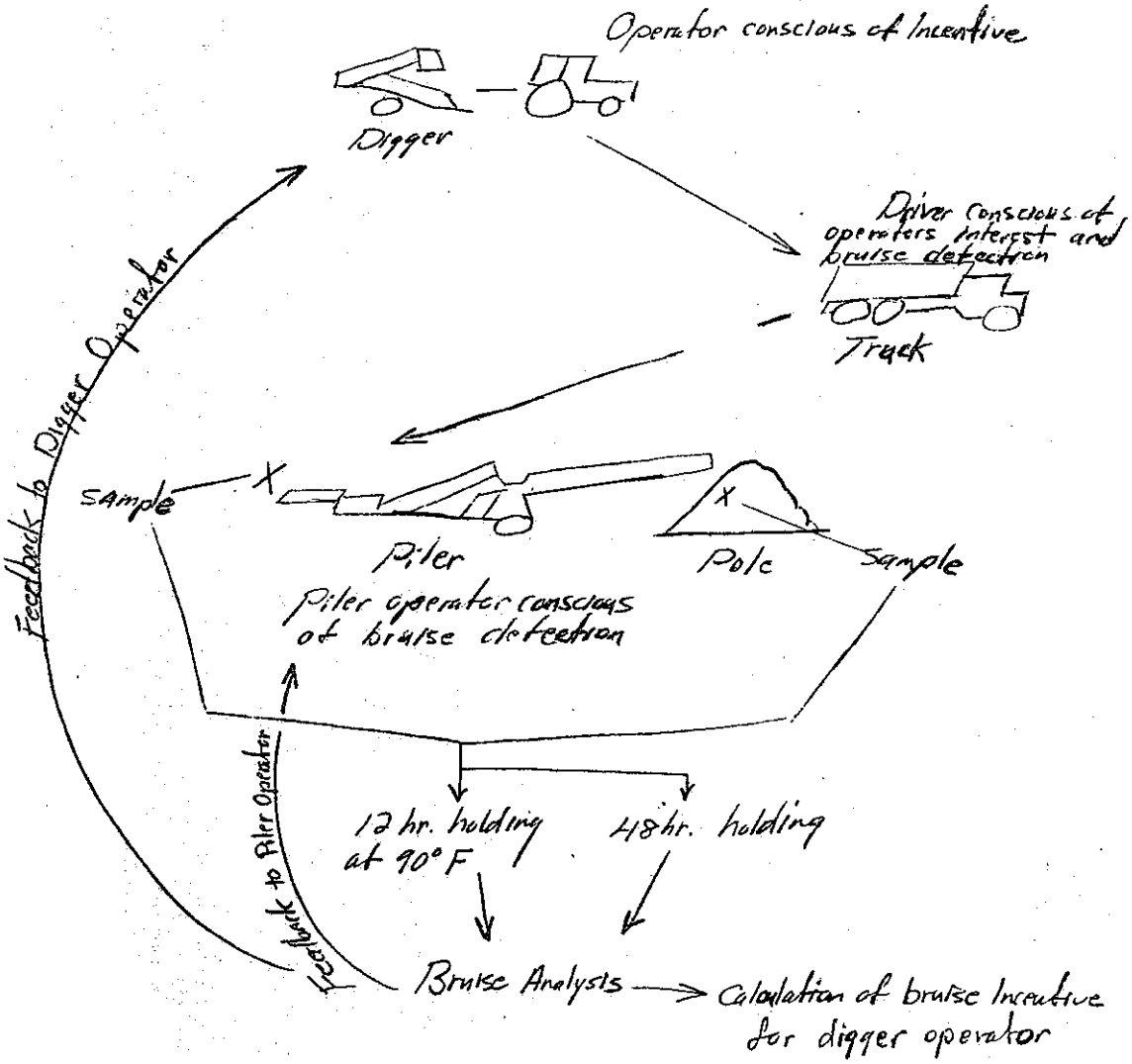


Table 4. Return Due to Bruise Detection and Bruise Incentive Program on 500 Acres of Potatoes at 25T/Acre

Given Information

Base price: $54.00/T at 50% Bruise free
Ave. % Bruise free: 70%
Total Return/A at 70% bruise free: $1600/Acre
Total Return/A at 50% bruise free: $1350/Acre
Gain due to bruise incentive: $250/Acre

Total Gain Due to Bruise Incentive

$250/Acre x 500 Acre = $125,000

Cost of Operator Incentives

$$500 \text{ Acre} \times 25\text{T/Acre} \times \frac{\text{load}}{12.5\text{T}} \times \$1.10/\text{load of 70\% Bruise free} = \$1100$$

Cost of Labor for vruise analysis - $1500

Cost of bruise analysis equipment - 3280

Total bruise detection - incentive cost $5880

Net Gain due to bruise incentive at 20% increase in bruise free potatoes

$125,000 - $5880 = $119,120