ECONOMIC VALUE OF LOSSES OF POTATOES IN STORAGE

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The objective of the economic phase of the potato storage research [1/] is to evaluate the economic loss to the Washington potato industry as a result of changes in potato quality in storage. The types of loss or cost from deterioration in storage are as follows:

1) Loss in weight, or shrink.
2) The enlargement of bruises, cuts and the development of rot, resulting in greater loss of weight from trimming.
3) The cost of increased numbers of trimmer inspectors on the processing line as the proportion of potatoes with cuts, bruises, rot, and other defects increases.
4) The cost of reconditioning potatoes, or the loss in quality and quantity of the finished product, resulting from the build-up of sugar in the tuber when subjected to low temperatures in storage.

These losses and costs can be reduced by improvements in storage facilities, primarily improvements in control over the temperature and the humidity of the potatoes in storage. In the 1973 survey of potato storage facilities, about 4 percent of the capacity had both refrigerated air and excellent humidity control (Table 1).

Table 1. Proportion of Potato Storage Capacity with Various Ratings of Temperature and Humidity Control, Washington, 1973.

Rating of Air	Rating of Humidity					
	Excellent	Good	Average	Poor	None	TOTAL
	(Percent of capacity)					
Refrigerated Air	4	7	--	--	1	12
10-20 C.F.M.	14	38	6	1	--	59
5-10 C.F.M.	--	1	8	1	2	12
Good Outside Air	1	1	6	4	--	12
Poor Outside Air	--	--	--	2	3	5
TOTAL	19	47	20	8	6	100

1/ Storage of Early Harvested Washington Potatoes, Project 0186.

A wide range of air and humidity conditions existed in the storages, with the bulk of them rating quite good. The question to be answered is whether further improvements to include refrigerated air and excellent humidity controls can be justified by the reduction in losses?

Procedure

The procedure followed in this study was to obtain estimates and data wherever available with which to derive rough estimates of the sizes of such losses. Processors provided data and estimates of losses and costs, and their cooperation is sincerely appreciated.

Loss estimates were converted to tonnage figures using a 6000 ton storage facility as a base. In other words, a 1 percent loss in storage would amount to 60 tons of the total capacity of such a facility.

Estimates in terms of tons of potatoes can be converted to dollar value based upon any level of potato price. Such values over the life of the storage facility can be compared with the increased costs of storage that could reduce such losses. Estimates are presented in this report, but each storage firm should use data from its own facilities to make more precise investment decisions.

Although precise measurement of losses could not be determined in this study, reasonable estimates can give guidance to how much more investment and operating costs can be justified by reduction in storage losses.

Shrink

Weight loss in fairly good storage facilities seems to be about 7 percent during the storage season. Potatoes in poorer storages are generally removed early to avoid greater shrink. Research results of Dr. Iritani at Washington State University and of Drs. Sparks and Summers (2) at the University of Idaho indicate that weight loss can be held as low as 4.5 percent. Thus, improved temperature and humidity controls make a reduction of 2.5 percentage points, -- from 7 to 4.5%, seem quite feasible. Even greater savings likely can be made by improving the poorer facilities. In a 6000 ton storage, this savings of 2.5 percent of the potato weight amounts to 150 tons of potatoes, the production from 5 or 6 acres. At $50 a ton, a savings of 150 tons of weight amounts to $7500. This is a conservative estimate; Sparks and Summers calculated the losses from shrink in their best and poorest storage experimental conditions. They used $35.60 a ton for field-run potatoes. If we increase the value to $50 a ton, weight loss with 95% relative humidity, intermittent fan conditions amounted to $2.17 a ton and with conditions of 85% relative humidity and continuous fan, to $4.29 a ton. The difference is $2.12 a ton or $12,720 for a 6000 ton storage. Since all of their experimental lots were held at 45°T, this difference is attributable to the level of humidity and the type of air flow through the storage bins.

Trim Loss

Each potato with a defect must be trimmed. Cuts and bruises received in harvesting and moving into and out of storage can suberize, or heal, in desirable storage conditions, or they can develop rot and spread. Poorly handled potatoes have many defects which simply spread and multiply if stored with poor temperature and humidity conditions. Thus, the problem of estimating how much loss can be prevented by improved storage is a difficult one. Processors blend lots of differing amounts of defects in order to keep a uniform flow over the line and process poorly handled potatoes as well as potatoes from poorer storage facilities early in the season in order to reduce the loss. Under such management the weight loss from peel and trim increases through the season. About 3.0 to 3.5 percent of stored potatoes is lost from trim if those potatoes have been handled well in harvest and movement into storage. If they have been poorly handled, the trim losses can amount to 15 or 20 percent. Assuming good handling of the potatoes, improved storage facilities and controls can feasibly reduce the trim loss to 1.5 or 2 percent, a saving of 1.5 percent of the potatoes or 90 tons in a 6000 ton storage.

Again, this is a very conservative estimate. If we adjust the Sparks-Summers cost estimates to a potato value of $50 a ton, they calculated increased losses from flattening of $2.50 a ton, from shriveling, of $0.74 a ton, from sprouting, of $0.47 a ton, in storages with 85% relative humidity and continuous fan over those in storages with 95% relative humidity and intermittent fan (2).

Rotting was slightly less in the lower humidity with losses $0.17 a ton lower.

The total difference in losses between the two types of conditions amounted to $3.54 a ton or $21,240 for a 6000 ton facility. In comparison, my estimate of a 90 ton loss or $4500 looks very low, but is based not on controlled experimental lots but on results when potatoes are managed from storages into processing to keep those losses at a minimum.

Cost of Trimming

In the estimates of shrink and trim loss, the focus has been on the weight lost. However, the consideration of the cost of inspecting and trimming involves, not the weight, but the number of potatoes having defects. Every potato with a defect must be picked up and trimmed, whether the defect is small or large or whether it has enlarged during storage.

The number of trimmer-inspectors on the line, therefore, is a function of the proportion of the potatoes that have defects. The number of trimmers increase rapidly with an increasing proportion of potatoes with defects (Figure 1). McKinney and Thiessen (1) sorted 39 lots of potatoes into three classes:

#1, those requiring no trimming 51.5%

#2, those requiring trimming 44.1%

#3, those to be discarded because the trimming cost would exceed the value of the remaining products 4.3%

However, the range from high to low was astounding:

#1, 70.8% to 16.5%

#2, 77.0% to 25.1%

#3, 13.3% to 0.5%

Consider the difference in labor cost on the processing line between a lot with 71% of the potatoes requiring no trimming and a lot with 77% of them requiring trimming.

Processors attempt to keep an even number of trimmers on the line by blending various lots of potatoes so that the proportion of tubers with defects remains about the same throughout the storage season. An example of the number of trimmers in such a plant is shown by line A in Figure 2. Presumably if the management did not mix the lots of potatoes, there would be a considerable variation in number of trimmers needed, but also there would be an increasing number needed throughout the season, as shown by line B.

But my task is to estimate how many more potatoes acquire defects in storage. This is related to whether the cuts and bruises suberize or spread and develop rot. If the defect in one potato spreads and rots, I have assumed that the rot would likely spread to one additional potato. Improved storage could well reduce the number of potatoes with defects comparable to the estimate of reduction of trim loss. I used 1-1/2 percent fewer potatoes with defects as a basis of estimating savings in costs, and the relation between the numbers of trimmers on the line and the proportion of potatoes with defects. I assumed $3.25 per hour for wage and fringe benefits of the trimmer. Very roughly, a reduction of 1-1/2 percent in the proportion of potatoes with defects would mean about $1

an hour saving in labor cost. If 6000 tons can be processed in 1000 hours, the saving is $1000.

Note that harvesting and handling practices can have much greater impact on the labor costs of trimming. If the proportion with no defects can be increased 15 percentage points, you can reduce the costs of trim labor by $10 an hour.

Risk of Sugar Buildup

If tubers become too cold, sugar content in them rises and extra cost is required if they are reconditioned. Reconditioning can cost 8 or more cents a ton and results in more shrinkage in weight. If instead of reconditioning, they are given extra blanching when processed, both the weight and the quality of the finished product are reduced; often the product must be sold as Grade B rather than Grade A.

These extra costs or losses occur when temperatures get too low in storage. No specific amount of loss can be estimated. No loss occurs if the temperature remains above a satisfactory level. However, if the storage is not adequately insulated, if supplemental heating is not available and if outside temperatures drop too low, then a loss can occur.

The situation is similar to that of risk from fire. Precautions can be taken to minimize the risk and insurance premiums can be paid to insure against loss if a fire should occur. Just so, some cost must be estimated for the risk of sugar buildup from low temperatures.

Since I found no data for estimating such an insurance premium, I simply used 1%. This means that I assumed that storages with less than adequate insulation and heating might experience cold temperatures once every 10 years that would result in sugar buildup in 10% of the potatoes that were least protected (or 1 in 5 years resulting in 5% of potatoes affected etc.).

Summary

The rough estimates made above may be summarized as follows for a 6000 ton facility.

Savings in weight loss	-	150 tons
in trim loss	-	90 tons
in labor cost	-	20 tons
in premium for risk	-	60 tons
TOTAL		320 tons

At $50 a ton, 320 tons amounts to an annual savings of $16,000. This conservative estimate of savings can be balanced with the increase in annual cost of investment and operation of facility with controls or humidity and temperature to make those savings possible.

REFERENCES

(1) McKinney, A. Mark and Wayne L. Theissen, Measuring Some Elusive Costs of Storing Potatoes for Processing Into Frozen Products. American Society of Agricultural Engineers Paper No. 74-6506.

(2) Sparks, Walter C. and Larry V. Summers, Potato Weight Losses, Quality Changes and Cost Relationships During Storage. Idaho Agricultural Experiment Station Bulletin 535, January 1974.

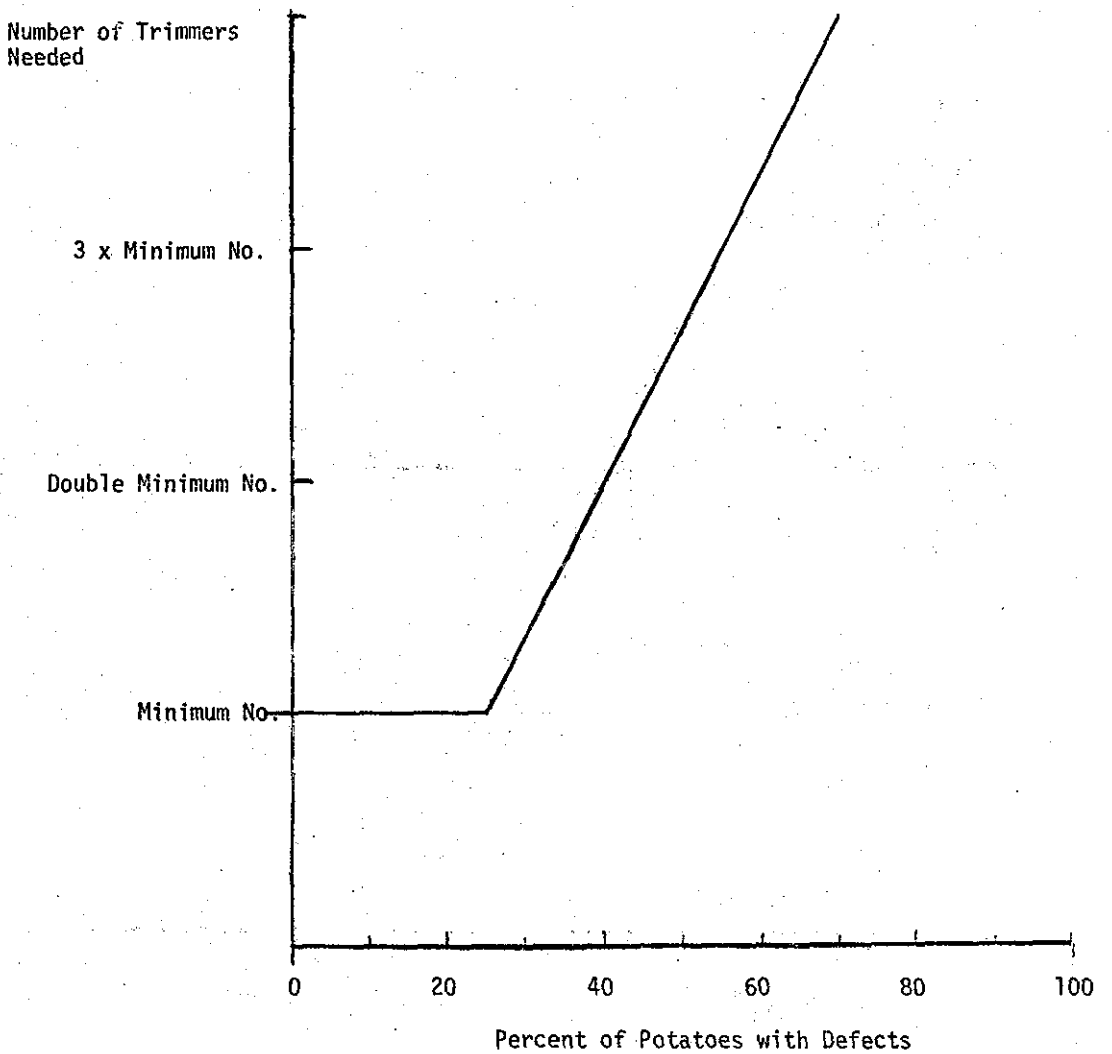

Figure 1. Relation of Number of Trimmer-Inspectors Needed on Processing Line to the Proportion of Potatoes with Defects

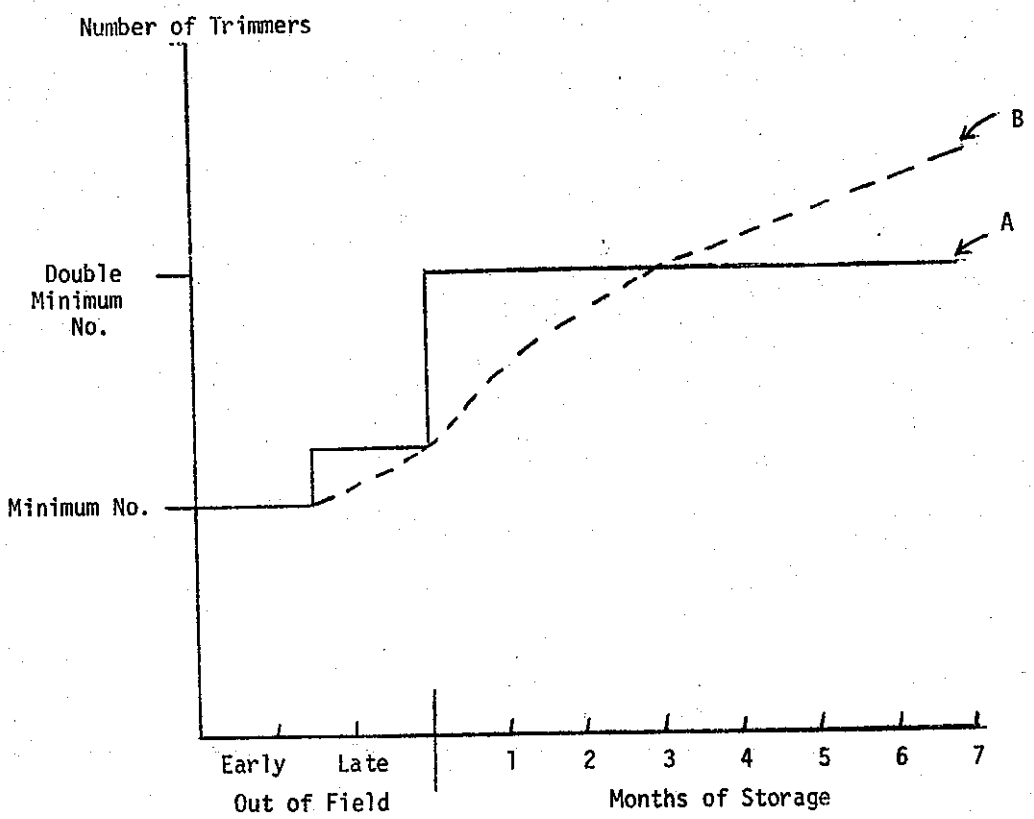

Figure 2. Relation of Number of Trimmer-Inspectors on Processing Line to Out-of-Field and Storage Potatoes.