

## Economic Significance of Quality Losses in Commercial Piles

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Sugarbeet processing companies which operate in the northern half of the United States generally follow a similar campaign plan. They start processing direct delivery beets on or about October 1 each year, start piling beets for storage on about October 10th to 20th and store enough beets to run the factories until the last week in January or later.

(Figure 1 - Campaign Plan) This figure shows a theoretical campaign in which: Harvest and processing start on October 1; the factory runs on direct delivery beets until the 30th day; piling and storage starts on day 10; 100% of beets are harvested by day 30; on the 30th day approximately 72% of the total crop of beets is in storage; on day 31 factories start processing stored beets and depleting the amount of beets in storage; processing continues until day 114, which is in the last week of January, when the stored supply of beets is exhausted.

Due to weather variations during the growing season and the harvest period the actual campaign will always vary somewhat. A small or large crop due to varied growing conditions will commonly vary the campaign length in any specific district by 10%.

Rainy weather during the first planned days of piling can delay harvest and significantly reduce the number of days that beets are stored as well as reducing the % of the crop that goes into storage at all.

Any beets that are in storage are losing sugar and at varying rates depending on time in storage and storage environment.

(Figure 2 - Recoverable sugar loss)

Great Western Sugar Co. has conducted many storage tests on commercial sized piles over the past 5 years in which piles were: (1) left unprotected (2) sides and tops covered with varied depths of straw, or varied types of plastic (3) beets were stored in earthen trenches and power ventilated.

The loss of recoverable sugar during storage on above ground piles follows the same trend regardless of protective treatment. The greatest normal loss per day occurs on the first day of storage when the beets commonly lose over a lb of sugar per ton of beets from respiration alone. This high initial respiration diminishes rapidly in a healthy pile in 10 days. A reduced and relatively uniform rate of loss occurs during the next 60 to 70 days of storage. After about the 80th day of storage (third week of December) in our Rocky Mountain districts storage losses usually accelerate due to thawing of frozen pile rims and cones in the interior of piles.

Rim protection reduces and delays these losses but does not stop them. Complete protection in enclosed pits or structures can drastically

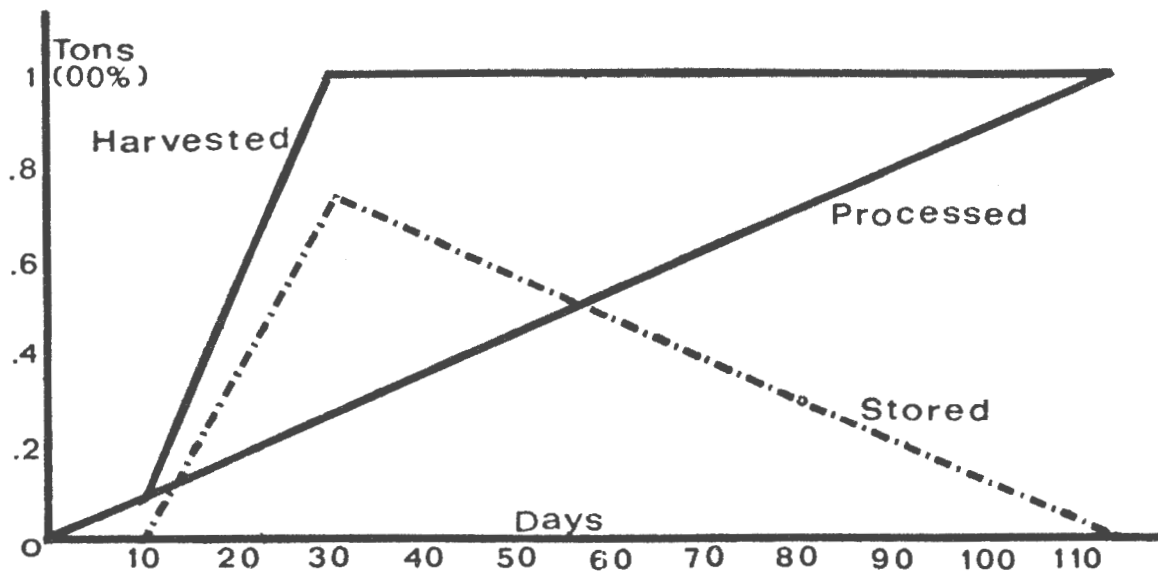


Figure 1.

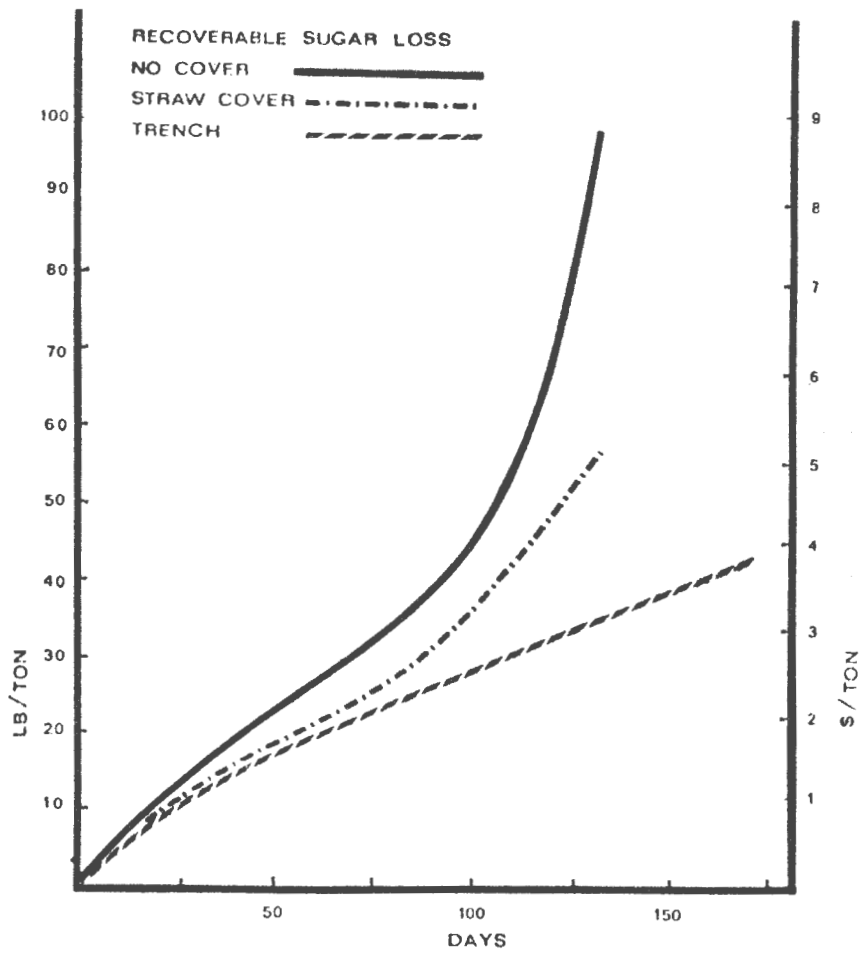


Figure 2.

change the losses. There will be a paper on this subject in tomorrow's sessions.

Typical sugar loss rates in above ground storage piles are shown in Table 1.

Table 1. Sugar losses.

Day of Storage	Minimum Loss		High Loss	
	Lb/T/D	Lb/T	Lb/T/D	Lb/T
0-10	.65	6.5	.78	7.8
10-80	.30	21.0	.36	25.2
80-100	.50	<u>10.0</u>	.60	<u>12.0</u>
Total	-	37.5	-	45.0
Average	.375	-	.450	-

Beets that are harvested in reasonably clean conditions, stored during reasonably cool weather and don't go through extreme freeze and thaw cycles near the end of storage commonly go through a 100 day storage period with an average loss of .375 lb/ton/day.

Warm weather during piling, muddy beets that don't ventilate freely and strong, warm "chinook" winds after pile rims have been severely frozen commonly increases the average sugar loss to .450 lb/ton/day.

Our test show that these losses can be reduced by about 20% by proper pile rim protection during either a good or bad storage season.

Losses based on the minimum loss column of this table were used in computing the sugar losses shown on the last slide.

(Figure 3 - Sugar Loss)

The solid black line on this graph is the same line shown on the first slide and represents the part of a typical ton of stored beets in a 114 day campaign. A factory that processes 1/2 million tons of beets during a 112 day campaign would experience the sugar loss shown on every ton processed.

The incremental sugar loss is represented by solid bar graphs that begin at the 20th day and is expressed in pounds per ton of beets processed. The incremental loss is the greatest between the 25th and 35th day when the greatest tonnage of beets is in store and 1/2 of those beets in storage are going through the high early respiration loss "sweat" period. Incremental losses diminish toward the end of campaign even though losses per ton per day have increased. There are very few beets in storage to incur losses.

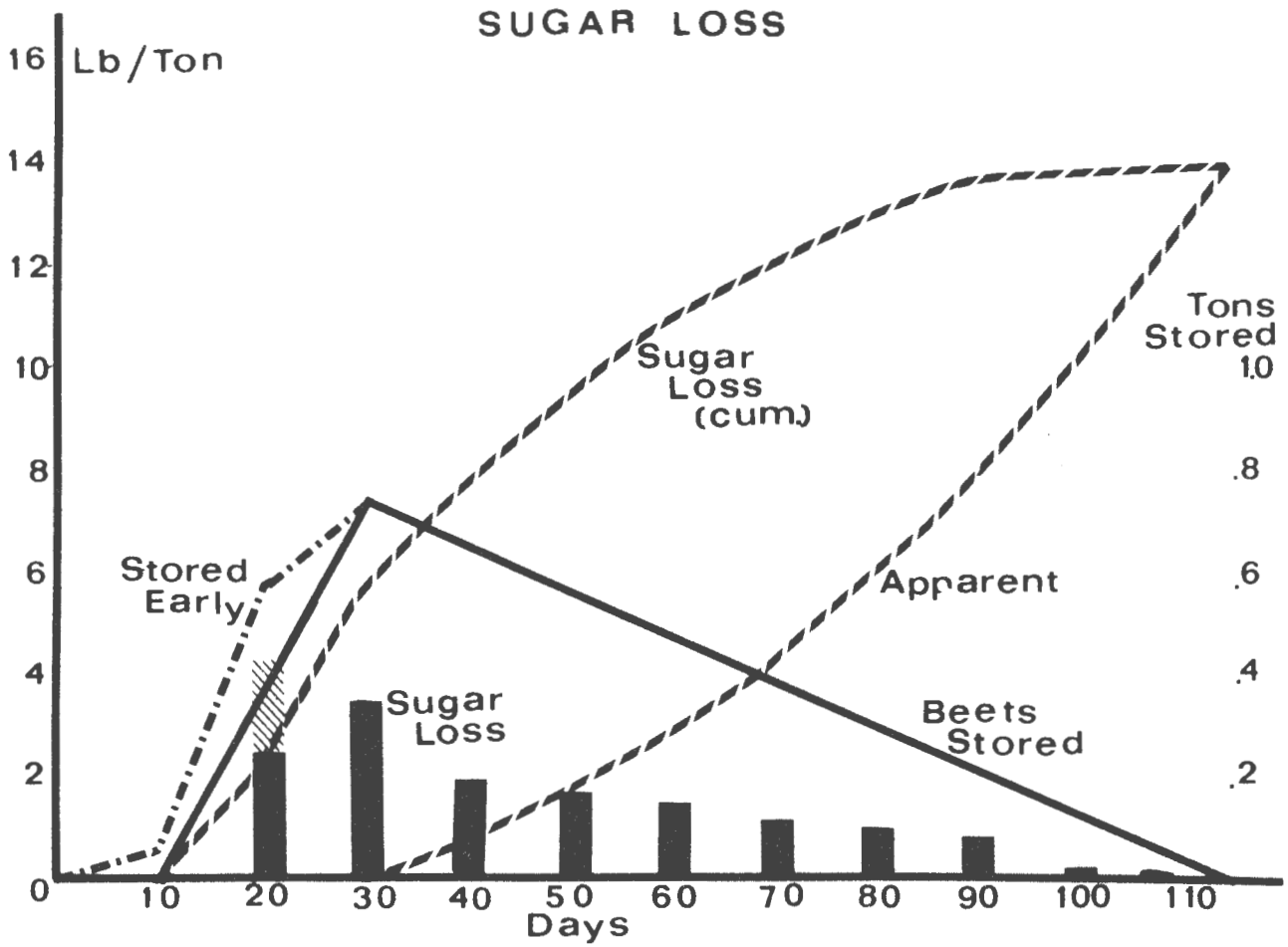


Figure 3.

The cumulative sugar loss shown on the top dashed line begins on the first day that beets go into storage and builds up rapidly while many tons are in storage and the beets are going through their "sweat". 1/2 of the total loss has occurred by the 35th day of campaign (which is only 15 days after the "average" beet went into storage). The total loss reaches 14 pounds per ton by the 112th day of campaign. Keep in mind that this is not the loss on any individual ton of beets in storage but is the average loss sustained by every ton of beets involved in the entire campaign. The beets processed for the first 30 days of campaign were assumed to be direct field to factory delivery with no loss at all. The first beets will go into storage on the 10th day and will be in storage 100 days with a sugar loss of 37.5 pounds per ton of beets stored.

The bottom curve, labeled as "apparent" indicates the pattern of sugar loss as a factory manager or district manager sees it. During the 30 days of processing direct delivery beets no loss is recognizable. The beets processed between the 30th and 40th day look good and process well since they are not frozen and have been stored only an average of 15 days. Toward the end of campaign beets are sliced that are in poor shape after 80 to 100 days of storage and it appears that our big losses are occurring then. Actually much greater losses occurred back in October. 14 pounds of sugar is still lost no matter how or when we recognize it.

The dashed line at the left of the graph is labeled "stored early". It indicated the effect on the amount of beets stored by the 20th day if growers deliver 75% of their beets to storage during the first 10 days of piling instead of 50%, as the plan calls for. Nervous growers will tend to do this following a year like 1969 when part of the crop didn't get harvested due to adverse weather. This increase in harvest rate puts 60% of the total years crop in storage 6 days too early, and this is usually during marginal warm weather. Losses of .5 lb/ton/day are common and the equivalent of 1.8 extra pounds of sugar per ton of beets is lost on the entire crop. See the diagonal hatched extension on the bar graph at day 20.

Other practices not shown on the graph that can cause serious sugar losses include the following:

Warm beets held in railroad cars for 4 days when they should be direct field to factory delivery during the first 30 days of campaign probably lose 1 lb/T/day or  $\left(\frac{1 \text{ lb}}{\text{T day}} \times \frac{30}{112} \times 4 \text{ days in a car} = 1.1 \text{ average pounds sugar lost on every ton of beets in the campaign}\right)$ .

Piling beets during weather that is too warm for adequate natural ventilation and cooling can double the normal early respiration losses.

To summarize, during a 144 day campaign you would expect to lose 14 pounds of sugar for every ton of beets processed if the weather is good and all phases of storage go as per plan.

With poor harvest and storage weather and a few variations from plan the loss could change as follows:

Minimum Loss  
Poor storage conditions ( + 20%)  
Fast (early) harvest  
Railcar loss (4 days)  
Total loss

14.0 lb per ton  
2.8 " " "  
1.8 " " "  
1.1 " " "

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19.7 lb per ton on every ton  
of beets processed  
during an entire  
campaign.