Postharvest Sugar Losses From Sugarbeets in California

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In northern California the harvest begins about the first of July and proceeds until the fall rains come and the ground becomes wet and inaccessible to trucks and harvesting equipment. This is usually some time in November or early December. At this time harvest is discontinued until the rains cease in the spring. Usually this is early March.

When the ground is sufficiently dry, the harvest again commences and proceeds until all beets of that crop are harvested and processed. The termination of this spring harvest is usually some time in May.

In an attempt to maintain beet-free areas as a means of avoiding virus yellows and for economic reasons, most of the beets harvested in northern California in July and August are harvested at distances ranging from 75 to 250 miles from a factory. During this period in the San Joaquin Valley of California, from which most beets are being harvested, temperatures often exceed 100 F. The Imperial Valley harvest from southern California also takes place largely in May, June and July. Many of these beets are also shipped long distances to a processing facility at times when temperatures often reach 100 F. These beets during transit are out of the ground, unable to carry on any photosynthesis, yet still metabolize so they are actually incurring sugar loss under these conditions.

Actual piling of beets in California is done only on a very small scale. In the fall, commencing about November 1, it is common practice to build a relatively small inventory of beets, usually amounting to a 3 to 5-day supply. Sometimes it could be as much as a 10-day supply. The purpose of this pile is simply to help provide inventory beets to hopefully prolong the harvest when the first rains come. The same type of piling is sometimes done in the spring as harvest begins again. Small inventories of so-called rain piles will sometimes be built in March, but consumed before April as a hedge against intermittent operations resulting from rain.

In total, only about 5% or less of California beets are ever piled, and at any one time the amount would probably not exceed 2%. This is compared with some of the figures expressed as high as 60 to 70% of the beet crop being piled in some other areas of the United States.

For the purposes of discussing postharvest sugar losses, I should like to consider both piling and transit losses, because beets in either status are subject to sugar loss without an ability to replace it.

Extensive studies have been conducted under California conditions on both piled beets and also beets in transit. Spreckels factory piling studies have been limited to periods of only 5 to 20 days duration. This

is a reasonable range of the length of time beets are normally piled in California.

Our methods of determining losses in these piles have been both to measure losses in captive samples and also measure losses by total weights in and out of piles established and sampling to determine sugar and other desired analytical contents.

Results from extensive studies have shown a range of sugar loss from as little as .4 pound to as much as 4 pounds per ton of beets per day. In reviewing the individual studies there seems to be nothing in the experimental design or chemical analyses that could be responsible for such a wide variation. The variation among these studies appears to be due almost exclusively to the environmental conditions that existed at the time of piling and during the time the beets are in the pile plus the condition of the beets going into the piles. In some of these tests, the minimum temperatures ranged from 30 to 40 F, with maximum daily temperatures being under 50 F. In other tests minimum temperatures were from 50 to 60 F, while maximums were sometimes as high as 60-80 F. In these studies, no attempt has been made to divide the fractions of the sugar loss between metabolic losses and losses due to organic decomposition.

The conclusions of these piling studies have been that sugar losses were due primarily to three things: 1) The temperature conditions that occur at the time of piling, 2) The quality of beets going into the pile 3) The physical losses that occur simply as a result of handling the beets.

Under the conditions of operation in California, it would appear that more sugar is lost during transportation of beets under high temperature conditions than as a result of the conventional piling of sugar beets.

Transit losses tend to be compounded during the summer months of June, July and August when beets are shipped at greater distances than at almost any other time of year. This is also the time of year when maximum temperatures occur in California.

To determine the magnitude of sugar losses during high temperature transport, captive samples were placed in railroad cars and followed at 2-day intervals for a period of 6 days. Ordinarily, beets are not in rail cards for a period of 6 days under these conditions, but they were held that long simply to study the effect on sugar content.

One observable aspect of beets held in cars for a period of 4 to 6 days was the development of various types of mold growth throughout the rail cars of beets.

Figure 1 shows the development of this mold on individual roots throughout this 6-day transit period.

At the beginning of this study it can be seen that only about 3% of the beets in the captive samples had any visible signs of mold or rot growing on them. By the end of the 6-day period, essentially 100%

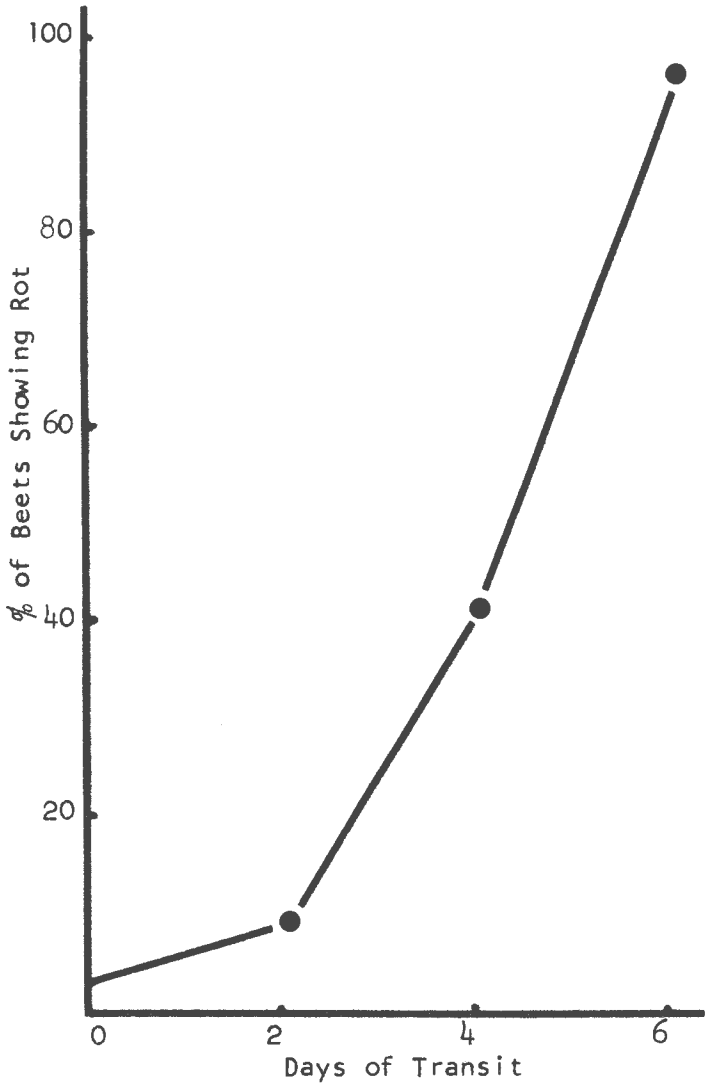

Fig. 1 Percentage of beets showing rot as affected by transit time.

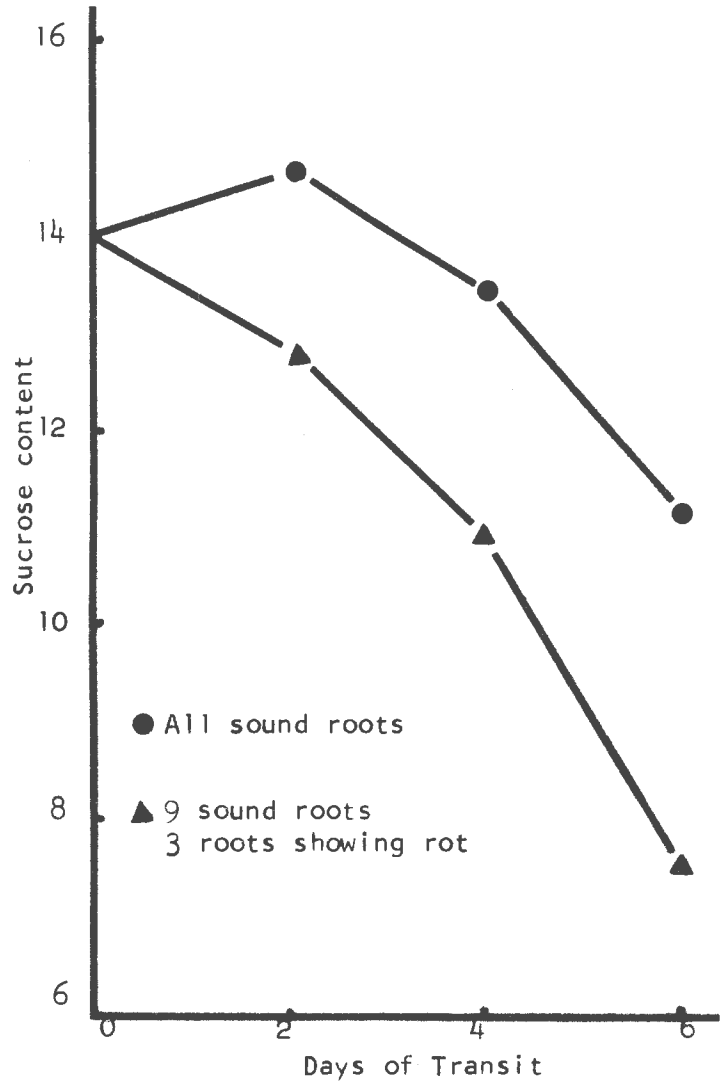

Fig. 2 Sugar content of sound beets compared with beets showing some rot over a 6-day transit period in August in Central California.

of the beets had some degree of mold or rot that could be identified. It should be pointed out that beets with rot were not necessarily all decomposed. Samples containing any beet on which an observable spot of rot could be found was indicated as having rot. Beets showing no rot at all could have composed the remainder of the sample. Thus, at 6 days, while all samples showed rot, all beets were not completely rotted.

To determine the effect of the initial condition of the sugarbeet on the sugar loss that developed during transit, another test was designed in which captive samples were used. In the one set of samples, only sound beets were selected. In the other set of samples, nine sound beets and three beets showing some degree of rot comprised the sample. The results of this test are shown in Figure 2. The difference between these two types of beets can readily be seen. For the first two day period in sound, healthy beets, dehydration appears to over-compensate the sugar loss by both metabolism and organic decomposition, because a slight increase in sugar content is observable. However, after that time a sharp reduction in sugar content does occur.

In the samples showing rot, it can be seen that the sugar loss is so great and so immediate that no benefit can be measured from dehydration.

As a result of these tests, two things have been accomplished to the best of the ability of those individuals involved in the harvest and shipping of sugarbeets. During these periods of high temperature, close cooperation with the railroad is maintained to keep transit times as short as possible. Rarely does this transit period extend more than two days at this time. Also, in so far as possible, agronomic practices are recommended that will produce beets in as healthy a condition as is achievable.

At this time a concern exists in California over the occurrence of what appears to be an increasing incidence of a bacterial rot caused by Erwinia.

This rot seems to be most prevalent in those areas where beets are shipped the longest distances and during periods of the highest temperature and, therefore, subject to the most loss when rot is apparent.

Several other studies of transit losses have been made, but as yet none of these seems to offer any great promise of reducing sugar losses in transit. Attempts have been made to ventilate cars in transit. In the comparisons that were made, the ventilated car actually lost more sugar than the unventilated car.

Attempts have been made to whitewash the exposed surfaces of loaded cars at receiving stations, hoping this would reflect some of the heat being absorbed by the sugarbeets. This does not appear to be of sufficient value to continue.

An attempt is currently being made to evaluate sugar losses in wooden rail cars compared with metal rail cars. At this time data appear to show no distinct preference one way or another between these two types of cars.

In general terms, this has been an attempt to define the postharvest sugar losses in California-grown beets.