

## The Future: Areas of Emphasis for Future Storage Research

Intermountain and Pacific Northwest  
Keith Ellis  
Utah-Idaho Sugar Co.

One area needing much more work is that of beet handling. I feel that a lot can be accomplished in this area. Some of our predecessors addressed themselves to the deplorable manner and conditions in which we were subjecting this vegetable. Perhaps the reason we weren't listening to these men was the fact that we were operating 80-90 day campaigns during which many of our errors were processed ahead of their turning into a major problem. Now with our longer campaigns the small factors become more important. So I feel the development of improved methods of handling beet roots to reduce injury will be a fertile area of research.

Another area where I feel significant progress can be made is in the development of permanent structures. Most will agree that given enough money we can store beets for a long time. However, the economics become the determining factor. Therefore, the development of an economical permanent structure may be another fruitful area.

In large beet piles a major problem is controlling air flow within the pile to prevent freezing cones and hot chimneys. We need to know what factors such as beet size affect air flow. Also what flow rates are most effective under what conditions?

Lloyd Norman at the conclusion of his talk on juice storage made the plea and I think rightly so that the door is wide open for investigations as to the various ramifications, the chemical interactions, the biological interactions during juice storage, whether it be standard liquor or thick liquor. I feel that the future will see us storing beets better in the piles along with additional juice storage. As we begin storing more juice over longer periods, under more varied conditions I think this alternative to root storage begs our research efforts.

California and Arizona  
Russell Johnson  
Spreckels Sugar Co.

In California only about 5% of the crop is piled so pile losses are not a major problem. More important are the losses which occur in transit between the field and the factory. Time and temperature are the major factors controlling losses during this period, but dirty diseased beets intensify these losses. So one thing we must concentrate on is growing a good crop and harvesting clean, weed free roots.

I would agree that we need to improve our methods of harvesting and handling beets. Not only does injury increase losses in long term storage but also in our high temperature short term transit losses.

Another area needing consideration is reducing transit time. This includes communication between the factory, the farm and the transit company. This is particularly important in our system where everything is tied so closely together and we make such an effort to minimize the time between harvest and getting the beets into the factory. It is extremely important that any planned shut down or any planned delay in the factory be communicated to the agricultural people who are delivering those beets. Otherwise, the result is a build up in inventory. But this is nothing for a research problem, it's a problem that affects the individual companies.

Along the line of variety development, here again I'm skeptical. It would be great to say we have a good variety and it has less sugar loss. But Ed Swift hit the nail on the head in a statement he made, where they had selected a variety and it showed better sugar storage under these long term conditions, but it had lost its value because the direction of the breeding program had gone along the line of sugar content and yield. So I find myself reluctant to start a big variety development program to minimize sugar loss. I think in California we gain more by putting the same effort in attempting to increase the sugar on all the beets we grow.

Another thing that would help us tremendously is weather prediction and weather control. When we try to keep a minimum number of beets out of the ground at any one time, weather is our number one cause of disruption in factory operation. So better weather prediction would be a tremendous advantage to us.

Our best methods at this time of reducing postharvest losses are to grow good beets, and this engages research in all facets of agricultural research. We must make every effort to minimize the time between harvest and processing and do what we can to minimize injury. I've often said and I've heard it again here, that if we handled beets like we handle cantaloupes or melons or tomatoes or peaches instead of treating them like rock, sand, and gravel, we'd do a lot better job in the way we handle and manage beets, whether it's short time transit or long time storage in piles.

Michigan, Ohio and the Red River Valley  
Maury Frakes  
Michigan Sugar Co.

In our area I think there are several possible approaches to reducing postharvest losses of sucrose (1) We could reduce the campaign to 90 days with a 45-day delivery and not more than 45 days of storage and possibly use thick juice tanks. This sounds simple but you all know it is economically unfeasible. One of the objectives of improved storage is to profitably increase the length of campaign using existing factories and facilities (2) Another possible solution is to improve long term storage methods by building complete enclosures or canopies to better control pile conditions over extended periods. I congratulate Utah-Idaho Sugar Co. for their foresight and the completeness with which they have progressed in this area. However, in going to a complete enclosure there is less leeway for error. A hot spot in the interior of an enclosed structure could be disastrous. So I think we need to study methods of controlling beets in enclosed structures to minimize this possibility. A good share of these problems we've been talking about are company problems that they will have to solve for themselves.

Each individual company needs to assess their individual problems based on weather conditions, methods of storage whether it be at one large piling area or at many small areas, grower contracts, etc. All these enter into developing a storage problem.

For example, of very serious importance is the contract with the growers. If you are buying beets on sugar test and guaranteeing extraction, which is what some are doing, the company can put in money to reduce storage losses and if sugar is saved, profits are improved. But if you are on a participating contract where the grower gets 60% of the profits and you put a dollar in storage to save \$2 worth of sugar and give the grower \$1.25, the company is losing money.

There are areas of general importance, however, that merit support by all companies. One is the area of postharvest physiology. We need to know more about how these beets react under various storage conditions. What enzymes are involved in sucrose degradation and how can they be controlled by the use of inhibitors? If respiration and enzymatic conversions could be reduced, you are talking in the neighborhood of 20-30 lbs of sugar per ton.

Another area is variety development. I think the time will come when we will have one variety for long term storage and one to be sliced directly at harvest or after only short term storage. However, one should keep in mind that these improvements will be useful only after we have controlled pile conditions. A plant breeder can work 20 years to get 1 1/2 points higher in sugar and 2 points higher in purity and it can all be lost in 2 weeks of storage. Also we need to develop improved methods of handling these beets to reduce injury.

I think these are some areas the BSDF can support without considering problems indigenous to one company area.

Rocky Mountain Area  
Sherman Fox  
Great Western Sugar Co.

In the area east of the Rocky Mountains and north of Texas there is not general agreement on how you should handle storage procedures. It varies from those who like to run long campaigns and believe in protecting piles to those that think the only way to protect beets is to process them quickly and have thick juice storage. Even people who are putting in thick juice storage systems, and we have one of our own, are not really shortening the campaign, we're usually putting it in so that we can process more beets through the same factory and we still have a campaign which is over 100 days long. This situation requires a lot of beets to be stored and it is well justified to protect these beets.

We in Great Western's area have found that by putting about 10 cents per ton worth of straw on a pile, we can get our money back 5 or 6 times. The factory managers don't always like it, but factories can be modified to digest some straw and thus make this an economical practice.

The general agreement is that we don't help ourselves to store beets by rough handling when they're harvested and put in the piles. Actually we're going through a difficult period, where about 1/3 to 1/2 of our growers have good grab roll screens and good cleaning equipment to take the dirt off beets in the field. What we have to do now is accept beets from farmers that are actually clean enough and with little damage and then put them over an aggressive piler that's designed for the farmer that brings in dirty beets. So I think real emphasis has to be put on getting the beets clean in the most gentle fashion. At the moment it looks to me like that's in the field on a harvesting machine.

No matter how good these beets are stored after they're put in a pile or how nice they are handled before they are put in a pile, if you put them in at the wrong time you can have losses that could readily be avoided by piling them at the optimum time. This calls for greater amounts of receiving equipment and greater amounts of harvesting equipment on the part of the farmer. But I think it is very common to have beets piled a week earlier than necessary and when you're putting 60 or 70% of your beets in storage a week too early, you generate tremendous losses that aren't apparent at the time you put them in.

Quite often I've heard reference to the frozen rims on piles that are not losing sugar. However, I'm convinced that they are losing sugar. Our rim tests have shown that when we've put samples in those rims, they show a tremendous sugar loss, even though they have never thawed. So losses do go on even in those frozen piles. I think some research should be done in the area of finding just what it takes to stop sugar loss. Because it is obvious that it doesn't stop just because that rim is 28 degrees or 20 degrees

Last, I think what's needed is an exchange of information. Today is the first day of my life that I've felt that I knew fairly well what was

going on in the other sugar companies. I think we've all got to get our heads together and talk to each other a bit more about what each one is doing so that we don't go out reinventing the wheel that somebody's already invented.



Stanley Bichsel  
Holly Sugar Company

The BSDF Storage Action Committee consists of a representative from each company and includes the four previous speakers. The function of this committee will be to discuss the storage problem and develop a list of priorities for storage research for presentation to the BSDF and other funding agencies. These areas of research will be national in scope, and the results of which will be of potential use by all companies in the industry. From the discussions in this conference I think some possible areas for research emphasis are the following:

1. Variety selection is an important facet of controlling storage losses. Much work has been done but obviously much more is needed to select the proper varieties in the colder climates. However, this may be an individual company problem.
2. Beet handling. We've heard over and over again that we must develop better ways of handling beets to get the dirt off without excessive physical injury which induces higher respiration rates and facilitates mold invasion.
3. Determine the optimum environment and procedures for storing beets. We have seen many different ways of doing this and I'm sure there is not one single answer for each geographical area. In one area straw may be the answer in another a permanent enclosure. The actual method used will be a matter of economics.
4. Chemical treatments pre and postharvest are a possibility.
5. Cultural practices such as topping and fertilizer treatments.
6. Determining more about the postharvest physiology of the beet root. Particularly the enzymes involved in sucrose degradation and non-sugar accumulation. Results of this work can be used to develop proper storage conditions and facilitate the screening of chemicals capable of reducing storage losses.

As chairman of the Storage Action Committee, I will be meeting regularly with the other members of the committee. We will be drawing on the BSDF and government agencies for financial support and research help from sugar companies, allied industry, universities and USDA-ARS. Working together through the BSDF I think we can make more rapid progress towards solving the storage problem than we could ever hope to individually.