Commercial Pile Experiments and Improved Methods of Storage

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A large portion of the American Crystal Research Department for the past several years has been on sugarbeet storage, trying to determine how to better store sugarbeets.

During the late 1940's and early 1950's considerable research work was done on storage pile ventilation. It was found that cooling the commercial beets as soon as practical after they were stored did reduce storage losses, but that dehydration of the beets or freezing the stored beets was so easy if conditions were not closely controlled that the practice was discontinued. Installation and removal of the ventilating tubes and fans was expensive and often delayed harvesting operations. These factors led to the discontinuance of storage pile ventilation.

As larger, more efficient beet harvesting equipment was developed and used generally, larger, more efficient piling equipment was also necessary. To utilize this harvesting and receiving equipment better, beets were harvested and received on a 24-hour per day schedule. The more rapid harvest and delivery of the crop (generally 75% of the crop in our Northern area is received and stored in 15 days), put the beets into storage in a cooler, cleaner condition, in excellent condition for storage, if not for too long a period.

Covering of storage piles with black plastic was tried commercially several years and also evaluated experimentally in 1968-69, but this practice was also discontinued as the work and expense did not appear to be justified by improved storage results.

In 1967 in cooperation with several of the other sugar companies and the Foundation, beets with several growth regulator treatments were placed in a storage pile at East Grand Forks. These treated beets were left in the storage pile for 115 days, and removed, sampled and analyzed. The data was not conclusive, but from this work, we were quite certain we would need to simulate storage conditions in the lab, to get accurate results. The beet samples were scattered through the storage pile. Many were damaged or lost when they were taken out in a sub-zero blizzard with blowing snow. The samples placed into the pile were not paired or chosen closely enough and there were too few replicates saved.

In our 1968 beet storage test to determine the effectiveness of plastic covering, samples were chosen more carefully, and again scattered through the pile in plastic mesh bags. Samples were placed on different levels, and in 9 different areas through the pile. There were three different removal dates. Comparisons were made between covered and uncovered piles. Again, the variability between paired samples was great, and too many (one third) of the samples were damaged or lost. It was again decided that storage temperatures and conditions could better be simulated in the lab where conditions could be controlled.

A survey of storage pile temperatures and conditions was made and it was determined that the "average" temperature inside the Red River Valley storage piles (the unfrozen portion) was 36 F, of the Mason City piles about 50 F and of the Rocky Ford storage piles 51 F.

In our 1969 storage tests after reports of differences between storage characteristics of different varieties, it was decided that varieties with and without herbicides should be compared under simulated "ideal" storage conditions.

Our mother beet and steckling root storage room and one of our photo-thermal rooms was closely regulated for temperature conditions with near 100% humidity. The 36 F room closely resembled the "ideal" Red River Valley storage condition and the 51 F room simulated the Mason City and Rocky Ford conditions.

As the program for storage tests was laid out after the beets were planted, it was impossible to get all of the varieties and treatments from the same field. We felt it necessary to determine the gradual loss of sucrose and the buildup of complex sugars that could not be recovered in the bag. It would be necessary to sample the various varieties or treatments regularly, and we believed the only method of doing this was by determing the "check" or starting quality of the samples by many samples or replicates and to remove a large number of samples regularly to determine trends by means of many near identical samples.

Details of the 1969 year's work will be reported by Dr. Dick Watkins and the lab techniques by John Hobbis. The beets from each treatment were harvested with a conventional beet harvester, placed in burlap bags and trucked to Rocky Ford. At Rocky Ford the beets of each treatment were divided into 96 as near identical samples as possible, and placed in perforated plastic bags. Sixteen samples (reps) were analyzed as "check" for each treatment, and eight samples (reps) were analyzed for each removal date and temperature level, with samples at two weeks, one month, 2, 3, and 4 months after start of storage.

From our 1969 tests, it was concluded that the cooperative variety storage evaluations must be grown under identical conditions. There were too many variables if the beets were taken from different fields and dates of planting.

For the 1970 tests, all of the varieties to be evaluated and their chemical treatments were planted in one field at East Grand Forks, at Mason City and at Rocky Ford. As we had found great differences between hybrid varieties and between diploids and triploids in 1969, it was decided that parent material - both multigerm pollinators and male-sterile parent lines should also be compared. The 1969 testing techniques were followed closely in 1970, 96 samples per treatment, 16 samples for the check and 8 samples or reps per date of removal, but the samples were prepared more identically. Each sample of the treatment contained the same number of beets - this including the same number of large beets, the same number of medium sized beets and the same number of small beets. Weights per sample were not more than 1 pound plus or minus the mean. The sugar determinations and other

determinations followed more closely than the previous year, reflecting the improved selection technique. We were able to much more accurately determine the sucrose recoverable after each storage period.

Our 1971 storage experiments followed about the same techniques as our 1970 tests, but a third storage temperature condition was added to the 36 and 51 F temperature rooms, this being 41 F. Earlier work had shown that raffinose built up gradually at 36, with little increase of invert sugars, and that at 51 the inverts built up sharply with little increase in raffinose. We questioned if the 41 F condition would limit the build up of both. As in 1969 we had found some differences between the effects of various herbicides on different varieties at different storage temperatures, we wanted to investigate this further. From our "observation" of poor storage of late planted commercial beets in other years, we wanted accurate data to determine how late planted beets store.

Our 1972 storage experiments were again modified slightly, as we were not satisfied with our harvesting the beets, placing them all in burlap bags and transporting to Rocky Ford, before the samples were made up, and the "check" values determined. In 1972 we harvested the beets from the Red River Valley fields, and within a few hours broke them down to the individual samples or reps as we had done at Rocky Ford. Sixteen samples were run through the East Grand Fords tare lab, and the brei frozen as a "zero check". The other samples in plastic bags were transported to Rocky Ford in refrigerated trucks and a second series of 16 samples analyzed for the "double zero check", to determine the better system of sampling. In earlier tests, we have carried the beets only through 4 months of storage, but in the 1972 beets, samples will be evaluated for 5 months - again at three storage temperatures.

Nitrogen fertilizer has a great effect on the processing quality of beets - sugar content and impurities, and the 1972 storage test is designed to see how several rates of nitrogen, phosphate and potash affect storage-ability of the beet. Our new high sugar variety is being compared with our "standard" variety, at different fertilizer rates and four growth regulators are also being evaluated to determine if they affect storageability.

This paper has been a brief outline of the direction our experimental storage work has taken over the years, and the improvements we have made in our system. The selection of "duplicate or identical" samples is the key to an evaluation of material. The treatments must be produced under identical conditions with only a single variable. Thousands of lab samples must be run each year for up to twenty constituents. Our new GLC instrument will make the final determination of the sucrose that is left in the beet and we will know where the sucrose has gone. We believe we have a great deal to do in improving our storage systems, but the work we have done under controlled storage conditions and in the lab have given us the tools to evaluate larger projects.