Storage Studies Conducted by American Crystal Sugar Company

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Since one of the major problems of the sugarbeet industry is the tremendous losses of sugar which occur in the storage piles, we at American Crystal have been evaluating some type of storage experiment every year since 1967. The first study was conducted at East Grand Forks, Minnesota on sugarbeets in conjunction with an experiment involving Maleic Hydrazide, Pyrocatechol and a spreader sticker along with a check or no treatment. The beets were sprayed with these compounds about 30 days before harvest to determine if sugar percentage could be increased by a simple spraying technique. The beets were harvested at the usual harvest time by commercial methods and sorted so all beets were about the same size. Beets from each treatment were than divided into 10-beet samples and placed in onion bags. Six reps of each treatment were rasped for brei samples at the start of the storage experiment. The remaining 6 reps were placed in a large storage pile where they remained for 115 days before they were removed, rasped and analyzed.

The data from this study indicated that the treatments had no effect on the beets at harvest time in that no increase in sugar content or extractable sugar per ton was noted due to the spraying procedure. However, after the 115 day storage period it was noted that possibly the Pyrocatechol could be of value on stored sugarbeets since this treatment lost less sugar during the storage period. Pyrocatechol is now being studied further under controlled storage conditions at Rocky Ford this year.

The 1968 storage study was much larger than the 1967 experiment and involved how beets store in covered and uncovered piles at East Grand Forks, Minnesota. This study consisted in placing captive samples which were enclosed in nylon netting in both covered and uncovered piles at 8 different time intervals. Each captive 10-beet sample had a duplicate mate or check which was rasped at the time the captive sample went into the storage piles to be used as a check. The pile covering used in this experiment was a black plastic type and covered the sides and over the shoulder of the pile. The first samples were removed after only 13 days in storage and the last samples after 108 days.

Several problems developed during the course of this study which gave rather erratic results. One problem was that many of the samples were lost during the removal process. Also the variability between paired samples was higher than expected so much of the data had to be averaged together to have meaningful results. It appeared that environmental conditions around the groups of samples were not as uniform as one would expect.

The results of this study indicated that the use of pile covering did not change the sugar loss during the storage period. The samples were all placed to a sufficient depth in the pile so that the outer portion was not considered. It was also noted that the losses were exceptionally high after only 13 days in storage. This high loss was caused by the huge increases in non-sucrose sugars during this time. Evidently something

happens during storage that we do not understand and could be related to changes during the "sweating" period which occurs soon after piling.

Due to the problems encountered in the 1968 experiment it was decided to change the procedures in 1969. This experiment was designed to determine the storageability under controlled storage conditions at the Rocky Ford Research Lab. This study involved 4 varieties and 4 herbicide treatments from 3 different beet growing areas. These areas included Grand Forks, North Dakota, Bird Island, Minnesota and Rocky Ford, Colorado. The beets harvested from the northern areas were trucked to Rocky Ford in an insulated van where the beets were sorted and placed in perforated plastic bags. Sixteen reps of these samples were processed through the tare lab for checks at the time the remaining samples were introduced into storage temperatures of 36 and 50 F. Eight reps of each treatment were removed from each temperature after 3 weeks, 1, 2, 3, and 4 months of storage.

The results of this study indicated that at both temperatures there were differences in storageability among varieties and herbicide treatments. At 36 F the Betanal and Avadex treated beets lost more extractable sucrose than the non-treated checks. However, at 50 F this trend was reversed. This indicates there could be a herbicide-temperature interaction related to storageability. One of the problems encountered in this study was that the beets from an area were not grown in the same field and this could account for some of the differences among treatments.

In 1970 all of the beets from an area were grown in strips in the same field to eliminate field differences. For this study several varieties and breeding lines from 3 growing areas were compared. This experiment was handled very similar to the 1969 study.

The results of this study indicate that in general triploid varieties seem to lose less extractable sugar per ton during the storage period than diploid varieties at both temperatures. There also appears to be a definite difference among varieties. It is also interesting to note that a variety which stores well at 36 may not store well at 50 F.

Since there appears to be differences in storageability among varieties we felt it would be interesting to see how the individual component lines of some of the varieties stored. The data indicates that there are tremendous differences among these lines. In general the multigerm pollinators seem to store much better than the monogerm male sterile and "O" type lines, especially at the cooler storage temperature. It is also interesting to note that lines which are reselected within a parent line for sucrose seem to store better than the original line.

Since there are differences in storageability of lines we have now made selections within some of our breeding lines for storageability. We feel a good method for doing this is by using mother beets which have been stored for about 130 to 140 days at 36 F. If these beets would be analyzed at the time of harvest we would find very small differences in sugar and purity in the groups; however, after the storage period these differences become very apparent. As an example, in one pollinator line the purities after storage ranged from 92.5 down to 40.0. Only those beets above 85.0

were replanted and used in growing the seed crop. We feel that some improvement can be made in storageability by mass selection for this ability to store.

The 1971 study was designed to determine if the use of herbicides with normal and late planting dates on several varieties of sugarbeets from the Red River Valley and Rocky Ford, Colorado could affect the storageability under controlled conditions. Most of the treatments from the Red River Valley were stored at 36 and 41 F except 4 treatments which were also stored at 50 F.

The data indicates that when sugarbeets grown in the Red River Valley are stored at 36 or 41 F there is no difference between normal and late planting dates in the pounds of sugar lost as calculated from the corrected direct pol. readings. The beets from Drayton appeared to lose more sugar than those from Gilby or East Grand Forks when stored at 36 F, but no difference is noted between the Drayton or Gilby beets when they were stored at 41 F. However, beets from both of these areas appeared to lose more sugar than those from East Grand Forks when stored at this temperature. The data also indicates that in general the checks lost more sugar than those treated with T.C.A. or Betanal and there appeared to be no differences between the herbicides when stored at 36 F. At 41 F the T.C.A. treated beets seemed to lose more sugar than those treated with Betanal. There appeared to be definite differences in sugar losses among the varieties used. There seemed to be little difference between the storage temperatures of 36 and 41 F. When the 4 treatments stored at 50 F are considered the data indicates the late plantings lost more sugar than those planted at the normal time. This trend was reversed when the beets were treated with T.C.A. indicating a planting date-herbicide interaction when beets are stored at 50 F.

The same trend is noted in all cases when the purity is considered. The data shows that there is a decrease in purity with time in storage at all temperatures. There appears to be little difference due to planting date, herbicide or variety. Little difference is noted between the 36 or 41 F storage temperatures; however, the purity decreased much more rapidly at 50 F. When the non-sucrose sugars are considered it is noted that the raffinose did not increase at the 36 F storage temperature as expected. There was a slight increase up to the first month in storage and then a general decrease to a level lower than the checks going into storage. The kestose, glucose and fructose all increased during the storage period, especially at the 50 F storage temperature. There appeared to be little difference between the 36 and 41 F storage temperatures. There also appeared to be little difference among the treatments when the non-sucrose sugars are considered.

There appeared to be little change in sodium or potassium during the storage period as would be expected. The late planting date seemed to be higher in sodium than the normal planting date and one variety seemed to contain slightly more sodium than the others. Also one variety appeared to contain more potassium than the other varieties tested. There was little difference noted among the treatments in amino nitrogen at 36 or 41 F but there seemed to be a general decrease in this constituent at 50 F.

The pounds of shrink changed considerably more than one would expect in this study. At 36 and 41 F the checks had a much higher shrink than the beets which were treated with a herbicide and planted at the normal time. This trend was reversed when the late planting date is considered. There appeared to be no difference between the two herbicides used at East Grand Forks; however, the Eptam treated beets from Drayton had a higher shrink than the checks when stored at 41 F. There appeared to be no differences among the varieties. At the 50 F storage temperatures the T.C.A treated beets lost more weight when planted at the normal time and this trend was reversed when the late planting date is considered. There appears to be a planting date-herbicide interaction at this temperature. The question is now asked why this occurred? This could account for some of the changes in processability of beets which have been noted over the past few years. More study will be needed in this area to determine the long range effects.

The data indicates that American #3 hybrid "T" appeared to store best at 36 F; however, at 41 F there was no difference among varieties. There seemed to be little difference due to storage temperatures of 36 or 41 F, but the 50 F storage temperature stored much more poorly. In most cases herbicide treated beets stored as good or better than those not treated with a herbicide. There also appeared to be little difference between the two planting dates used in this study.

The beets grown at Rocky Ford, Colorado were stored at 41 and 50 F. There appeared to be little difference among these treatments at either temperature when sugar loss is considered. However, beets stored at 50 F lost more sugar than those stored at 41 F as would be expected. There was little difference in the purity among treatments except the late planted beets with Ro-Neet appeared to maintain a higher purity during the storage period.

There seemed to be no difference among treatments when raffinose and kestose are considered. The kestose increased during storage, especially at the 50 F storage temperature. This same trend is noted for glucose and fructose. It was also noted that 67-4T32 appeared to increase in glucose and fructose faster than the remaining treatments.

There was no change in sodium and potassium during the storage period; however, the amino nitrogen decreased in all treatments as was noted in the beets from the Red River Valley. When the pounds of shrink are considered at the 41 F storage temperature it appears that the American #2 Hybrid "B" with Ro-Neet had the greatest shrink. At 50 F this treatment and 67-4T32 had the greatest shrink.

During the storage period the American #2 Hybrid "B" with no herbicide applied appeared to have lost the most sucrose at the end of the storage period, but stored the best up to the third month. This variety also contained the most sugar at the beginning of storage. The treatment which appeared to be the best was the American #2 Hybrid "B" + Ro-Neet.

The 1972 storage experiment is designed to determine the effect of fertilizer rates on the storageability of our commercial varieties. Also

included are 4 growth regulators which may be of value in decreasing sugar losses during the storage period. These treatments are now stored at 36, 41 and 50 F temperatures and the last samples will be removed from storage March 20. The data from this study is not complete at this time.