Research Report

Sugarbeet Conference, Fort Collins, Colorado

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Prepared by: Roger E. Wyse, December 24, 1973

A. Location of Project: Western Region
Idaho-Montana-Utah Area
Crops Research Lab.
Logan, Utah

B. Work Reporting Unit Title: Sugar Beet Production Practices

C. Work Reporting Unit: No. 10710

D. SMY's for Past Year at Location: 1 SMY

E. Names of Scientists in Project at Location: Roger E. Wyse

F. Mission of Research:

Determine the physiological and biochemical factors affecting the conservation of sugarbeet quality during storage.

Develop methods of reducing sucrose losses in beet storage piles.

Determine the physiological and biochemical factors affecting root yield and sucrose accumulation in sugarbeets.

G. Objectives of Research:

To determine the biochemical pathways of sucrose degradation and oligosaccharide biosynthesis in storage; to develop methods of reducing or eliminating the major sources of sucrose losses in storage, i.e.: respiration, sucrose conversion, resistance to molds; to develop methods of selecting breeding lines and segregating populations for storage characteristics; to test chemicals and beet handling techniques for reducing storage losses; to determine the biochemical pathway of sucrose accumulation; to develop screening techniques to rapidly test chemicals and breeding lines for their ability to increase sucrose accumulation; to study the relationship of physiological characteristics to seedling vigor and yield of sugarbeets; and to develop techniques for selecting superior breeding lines based on early growth and physiological characteristics.

H. Research Accomplishments:

Research emphasis has been on evaluating the causes of quality deterioration in storage. Techniques were developed for evaluating beet quality, including corrected recoverable sugar per ton, marc, raffinose, respiration and uniform quality sample preparation. Results indicated that the optimum storage temperature was 3-5 C. At this temperature mold growth is slow, respiration is at a minimum, and in most varieties raffinose accumulation is minimal. Desiccation at any temperature decreases storage life, increases respiration and reducing sugar accumulation. When beet roots are stored at the optimum temperature in a humid atmosphere to prevent weight loss, respiration rate and susceptibility to mold are the two major factors contributing to storage losses. Both of these factors can

be controlled genetically. Respiration accounts for 70% of the recoverable sugar loss under ideal storage conditions. Respiration rates are affected by genetics, degree of injury, temperature, inhibitors and oxygen content of the surrounding atmosphere. Breeding for low respiring lines is feasible. The development of less severe handling equipment will reduce injury. Controlled atmosphere storage reduces storage losses, but may not be economically feasible. An extensive program to screen breeding lines and inhibitors is currently in progress. Developed and put into operation this fall was an automated respirometer with the capacity to measure the respiration rate of 100 samples every three days.

Enzymes involved in sucrose degradation and the biosynthesis of raffinose and kestose have been identified. Activities during storage were determined and inhibitors tested as a possible means of control. Neutral invertase was isolated and partially purified for biochemical characterization.

Seedling vigor as measured by imbibed seed respiration indicated that seed respiration is an excellent indicator of seed quality but does differentiate between high and low yielding varieties.

I. Impact of Research Accomplishments on Science and General Public:

Each year 65-70% of the sugarbeet crop is stored for up to 5 months prior to processing. During this extended storage period sucrose losses and decreased factory efficiency amount to between 70 and 90 million dollars. Increasing acerage per factory coupled with increasing yields per acre continue to magnify the storage problem. Storage losses must be reduced if the sugar beet industry is to remain viable. If the U. S. industry does not remain competitive the American consumer will have to rely on an insecure foreign market for his supply of sucrose. Sugarbeet companies are now developing storage techniques to maintain optimum conditions for long term storage. Three companies have established breeding programs designed to develop superior storing varieties.

J. Obstacles in Achieving Objectives:

More funds are needed to expand storage facilities and hire technical help to support the storage program.

K. Future Plans and Needs:

Future emphasis will be on the development of methods to reduce storage respiration rates by genetic selection and chemical treatment.

Preliminary work has been completed on the biochemical pathway of sucrose accumulation. Results of this work will be applied to testing varieties and chemicals for their usefulness in increasing sucrose production per acre.