Research Report
Sugarbeet Conference, Fort Collins, Colorado
February 5, 6, 1974

Prepared by: Devon L. Doney January 1974

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: Devon L. Doney

F. Mission of Research:

Sugarbeet genetics, cytology, and morphology with special emphasis on problems of development, inheritance and breeding behavior of cytoplasmic male sterility, physiological factors affecting plant growth, root storage, quality; virus diseases of sugarbeet in the intermountain region.

G. Objectives of Research:

Determine genetic, biochemical, and morphological factors conditioning male sterility in the sugarbeet. Map location of genes and determine the biochemical genetics of important morphological, quality and disease resistance factors in sugarbeet. Evaluate biochemical and morphological selection criteria for breeding purposes. Evaluate hybrids and breeding lines for regional adaptation and quality production. Develop parental lines of sugarbeet that are monogerm, excellent in quality, curly top resistant and resistant to storage rots.

H. Research Accomplishments:

Techniques have been developed to study enzyme structure (isozyme technique) from very young individual anthers. Using this technique, we have found differences in the estrase structural pattern in developing anthers of normal plants from that of developing anthers of male sterile plants.

Since mitochondria contain genetic, maternally-inherited material and male sterility is inherited maternally, studies were initiated to ascertain if there was a relationship between male sterility and mitochondrial respiration. Techniques were developed to successfully isolate intact mitochondria from the sugarbeet root. To date no relationship has been found between male sterility and mitochondrial respiration.

The techniques developed in the above study were also useful in evaluating the mitochondrial complementation phenomenon (the increased mitochondrial efficiency observed when mitochondria are mixed from inbreds that give heterotic hybrids) as a breeding tool in sugarbeet. The phenomenon was present in sugarbeet, but was small and not of sufficient magnitude to be of value in a breeding program. Two important facts coming out of these studies were: (1) Hybrids had more efficient mitochondria than the less vigorous inbreds and (2) mitochondrial efficiency was correlated with growth rate during the major part of the growing season.

Research is currently underway to measure the influence and effects of genotypic competition on different selection procedures. The results will be used to determine the most efficient selection procedures.

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

A better understanding of the biochemistry of male sterility is not only a contribution to the scientific knowledge of this most important sugarbeet character, but will enable us to use this character more effectively in sugarbeet hybrid seed production.

These studies involving mitochondrial complementation have given the commercial sugarbeet breeder an understanding of this phenomenon in sugarbeet and an assessment of its merit as a breeding tool. The finding that mitochondrial efficiency is correlated to growth rate is an important contribution to our scientific knowledge.

J. Obstacles to Achieving Objectives:

Very little is known about the biochemistry of male sterility. Therefore, knowing where to start, what to look for and the techniques to use are the major obstacles to the achievement of this objective. Several blind alleys have been pursued with little success; however, we have achieved limited success with our isozymes studies. In addition, the male sterile factor appears to be more complicated than previously thought with interactions involving nuclear genes, cytoplasm, and environment.

In order to measure mitochondrial respiration, intact mitochondria had to be isolated from the root cells. Most methods of plant cell rupture destroyed the integrity of the mitochondria. This was a major obstacle, but was overcome with more refined techniques.

Any study involving selection, breeding, and beet improvement, is a long term study involving several generations. The biennial character of sugarbeet further lengthens these studies. Seed production is also sometimes a major obstacle.

K. Future Plans and Needs:

Continue the studies involving the genetics and biochemistry of male sterility. Pursue and evaluate biochemical and agronomic selection techniques for quality and production. Develop and evaluate new genetic, breeding material.

Much of the routine lab work is being conducted by a biological aid (GS-4). This position should be upgraded to a GS-5 level.