Research Report

Sugarbeet Workshop, Fort Collins, Colorado

February 5, 6, 1974

Prepared by L. L. Hoefert, January 7, 1974

A. Location of Project: Western Region
Northern California-Nevada Area
U. S. Agricultural Research Station
Salinas, California

B. Work Reporting Unit Title: Improved Sugarbeet Varieties and Production Practices.

C. Work Reporting Unit: 10710

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

E. Names of Scientists in Project at Location: Lynn L. Hoefert

F. Mission of Research:

To develop knowledge of ultrastructure, cytology and anatomy of sugarbeet--both diseased and healthy--as they relate to sugarbeet genetics, pathology and physiology.

G. Objectives of Research:

To investigate pollen development in sugarbeet with the electron microscope; to compare normal pollen development with development of cytoplasmic male-sterile pollen; to study the effects of virus diseases on sugarbeet cells and to identify the different viruses by ultrastructure; to investigate aspects of virus movement in the plant and vector relationships at the fine-structure level; to study mechanisms of virus resistance and susceptibility using electron microscopy and cyto- and histochemistry; to observe normal sugarbeet cytology as it applies to genetic, pathological, and physiological studies of other investigators; and to compare the effects of similar viruses on different hosts, including such weed hosts as may be reservoirs of sugarbeet viruses.

H. Research Accomplishments:

Research emphasis has been in two different areas--pollen development and virus effects. Pollen development in Beta has been studied from meiosis to mature pollen stages with the electron microscope. A thorough study was made of tapetal cells that surround the developing microspores because drastic changes were found to occur in tapetal cells of cytoplasmic male-sterile anthers. The effects of various

sugarbeet yellowing viruses have been studied in sugarbeet and closely related species, as well as in weed hosts that serve as natural virus reservoirs. Beet Yellows Virus has been studied in sugarbeet and New Zealand Spinach. Beet Yellow Stunt Virus was studied in Beta and Sowthistle. Beet Western Yellows Virus was studied in Beta and is being studied in pennycress. Curly Top Virus has been investigated in Beta and currently is being sought in spinach.

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

It has always been important (whether by sound reasoning or not) to be "first" in descriptions of scientific results. If that is an adequate criterion of "impact", we have first (1) described flexuous particles in food conduit of plants and between cells, (2) described the structure of higher plant sperm cells as seen with electron microscopy, (3) described virus particles in transfer cells, (4) showed alteration or destruction of a plant virus in older leaves of infected plants, (5) showed complete process of tapetal cell degeneration in normal anthers, (6) showed small spherical virus particles inside food conduit of plant and described its development during infection (BWYV), and (7) showed morphological evidence for the presence of curly top virus in host cells. Basic understanding of biological processes like virus infection and virus movement will ultimately enable us to control such diseases. Furthermore, owing to the many morphological types of sugarbeet yellowing viruses, we are able to distinguish these diseases by electron microscopy. Such information is useful as a diagnostic tool. Knowledge of normal plant processes, such as pollen development, will enable us to understand aberrant processes associated with different types of sterility. Taken together, ultrastructural and anatomical investigations lead to a better understanding of the plant; more knowledge serves as fuel for more and better plants through breeding programs and quality improvement.

J. Obstacles to Achieving Objectives:

Temporary, part-time assistants who are trained and cannot be re-hired.

K. Future Plans and Needs:

Future plans for research are to extend and expand ongoing programs. Extension of these programs would fall into the mission and objectives categories previously discussed. Expansion of ongoing programs would include histochemical and cytochemical investigations relating to virus effects and pollen development. Other possibilities include tissue culture of virus host and vector cells, pollen culture, and scanning electron microscopy of pollen, plant pathogens, fungi, and the like. Development of these programs would require outlay of funds for equipment for culturing and scanning electron microscopy and therefore would depend upon the availability of funds.