Research Report

Sugarbeet Conference, Fort Collins, Colorado

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Prepared by Richard J. Hecker, January 7, 1974

A. Location of Project: Western Region
Colorado-Wyoming Area
Crops Research Laboratory, CSU
Fort Collins, Colorado

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

C. Work Reporting Unit: No. 401-5602-10710

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

E. Names of Scientists in Project at Location: R. J. Hecker, also cooperating with G. A. Smith, G. W. Maag, and E. G. Ruppel

F. Mission of Research:

To develop new information about methods of breeding sugarbeets by which breeders can make genetic improvement more rapidly and efficiently for yield, sucrose content, and quality at harvest; to discover the relationship of genotype and environment (particularly nitrogen fertilization) and the relative importance and effect of each on improved sugar production; to develop germplasm with resistance to Rhizoctonia root rot as a biological control for this wide spread sugarbeet disease.

G. Objectives of Research:

To develop and provide new information to sugarbeet breeders and others on how to make variety improvements by breeding, through the use of adapted or unique methods; to gain new information about the genetic control and potential of quality improvement, and about methods of improving quality by breeding; to investigate the important interactions of genotype and environment on quality; to develop a biological control for Rhizoctonia root rot (R. solani) of sugarbeet by breeding for germplasm which is resistant to this important disease and, which at the same time, includes other desirable genetic characteristics such as good combining ability, so that released germplasm might be used directly or indirectly as parental components of hybrid varieties.

H. Research Accomplishments:

Breeding methods experiments have demonstrated the potential of heterosis for improved root yield, sucrose content, purity (a measure of quality), and certain nonsucrose constituents. Comparison of breeding methods designed to capitalize on (1) primarily additive gene action and (2) additive and nonadditive gene action preliminarily indicate that expected

genetic gain may not be totally achieved because of technique limitations in this cross fertilizing species. Experiments on the relation of genotype to quality have indicated that the content of nonsugars in beet juice is conditioned primarily by nitrogen fertility and only secondarily by genotype. However, genetic variance estimates of nonsucrose characters indicates some potential for developing genotypes of higher quality or nitrogen tolerance.

Several sugarbeet lines have been developed by selection and breeding which are relatively resistant to Rhizoctonia root rot. There are probably three or more genes conditioning resistance. Resistance is partially dominant. The sucrose and quality of these lines is good, but their potential as pollinators in hybrid varieties is limited due to their modest combining ability.

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

Establishment of the relative importance of genotype and nitrogen environment to quality at harvest have provided the commercial agronomist and breeder with information essential to short term and long term quality improvement. The release of Rhizoctonia resistant germplasm is the first step in reducing losses due to this disease and in establishing a permanent biological control.

J. Obstacles to Achieving Objectives:

Obstacles to the above objectives are primarily technical and temporal. However, these objectives were outlined to utilize only existing resources (both scientific and material). Additional scientific input from a plant physiologist would allow expansion of these objectives as well as hasten their achievement.

K. Future Plans and Needs:

Development of more effective breeding methods will continue, particularly in the adaptation of hybrid breeding to beets. Further information will be developed on the place of variety improvement in the short term and the long term in quality improvement and fertilizer nitrogen tolerance. The success of this effort hinges on continued close cooperation with a scientist with expertise in plant physiology and biochemistry. Breeding effort will continue toward achievement of total resistance of beets to Rhizoctonia root rot. At the same time resistant lines will be improved in combining ability, and other necessary characteristics which would allow released germplasm to be directly useful in hybrid breeding programs.