Resistance of Inbred Varieties of Sugar Beets to Aphanomyces, Rhizoctonia, and Fusarium Root Rots[1]

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Several hundred varieties of sugar beets were tested for their resistance to Aphanomyces, Rhizoctonia, and Fusarium root rots during 1950 to 1955. Among these varieties were inbred lines and open pollinated commercial varieties. Although some of the commercial varieties showed a high degree of resistance to some of these root rots, it was decided not to test them further because they do not genetically represent a uniform population. Because of this, it is impossible to duplicate the same results with their progenies. Therefore, the main emphasis in this work was placed on testing the reaction of inbred varieties to root rots.

The inbred varieties of sugar beets were supplied by the Sugar Beet Breeders Forum. The following method was adopted for testing resistance of beet varieties to Aphanomyces, Rhizoctonia, and Fusarium root rots. Each variety of beets was tested for each disease in four seven-inch pots filled with Huntley soil. Prior to each planting, pots filled with soil and saucers were steam sterilized for four hours at 15 pounds pressure. Usually, 20 whole beet seeds were planted in each pot. Seeds were disinfected with New Improved Ceresan about one month prior to planting. Each pot of soil can be considered as a replication. Soil was inoculated immediately after the seeds were planted. The inoculum was composed of several cultures of each of the following pathogenic organisms whose pathogenicity was previously proven: *Aphanomyces cochlioides* Drechs.; *Pellicularia filamentosa* (Pat.) Rogers, (*Rhizoctonia solani*); and *Fusarium oxysporum* f. *betae* (D. Stewart) Snyder and Hansen. The beets were harvested about six weeks after emergence. Readings of healthy and diseased beets were taken during the growing period and at harvest.

Only those varieties which showed a uniformly high degree of resistance in all four replications were saved for further testing, the remaining varieties were discarded.

Five young beets of the resistant varieties were transplanted in individual pots and were grown until their roots were about one to two inches in diameter. They were then placed in a cold room for vernalization for about 10 weeks. Following this treatment the roots were sent to either D. F. Peterson of the Holly Sugar Corporation or H. E. Brewbaker of the Great Western Sugar Company for seed production under inbred conditions in the field. The seed produced from these beets by the two cooperators will be returned to Bozeman and again submitted to a pathogenicity test for a specific disease for which the beets were selected. If the progenies of the beets retain a high degree of resistance, they will be considered resistant.

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The seed stock will be returned to the agency which furnished the original material.

It has been observed that sometimes the complete test, in which a large number of beet varieties was tested, showed a uniform low percent of disease for a certain root rot. It is believed that some environmental conditions must be responsible for this situation. The same cultures of fungi used prior to this test, or afterwards, usually give a good pathogenicity test. The only way to clarify this point is to repeat the test.

To make sure that cultures retain their high level of virulence, their pathogenicity was regularly checked in separate tests. Those cultures which became low in pathogenicity were usually discarded and new isolations were made from infected seedlings.

The results of testing sugar beet varieties for resistance to Aphanomyces root rot are rather disappointing up to the present time. From several hundred varieties of beets tested, not a single one showed a sufficiently high degree of resistance. A number of varieties submitted by other investigators as being somewhat resistant to this disease completely failed to show resistance in our tests. Very often in the test in which two to three dozen beet varieties were tested, which involved 2 to 3 thousand young beets, only about a dozen beets remained free of disease. It is not known whether these beets were resistant or just escaped being infected. These surviving beets are being used for production of seed. The progeny will again be used in pathogenicity studies.

Better results were obtained in testing beet varieties for their resistance to Rhizoctonia and Fusarium root rots than to Aphanomyces. Among several hundred varieties of beets tested for these diseases, 19 varieties showed a high degree of resistance to Rhizoctonia root rot and 22 varieties to Fusarium root rot. Four varieties showed resistance to both Rhizoctonia and Fusarium root rots. Progenies of most of these beets will be tested for resistance to these diseases during the winter of 1955-56.

The difficulty involved in finding resistance to Aphanomyces root rot is probably due to the nature of the fungus. Sexual reproduction occurs very readily, so there is always the possibility of the formation of new physiologic strains which may differ in pathogenicity. The presence of physiologic strains complicates this type of work.

It is known that sexual reproduction occurs in *Pellicularia filamentosa*, therefore it is possible that new physiologic strains may also arise in this fungus.

Fusarium oxysporum f. *betae*, which is responsible for Fusarium disease of beets, belongs to the Imperfect Fungi. It does not have sexual reproduction. Due to lack of many physiological strains, it will probably be easier to find resistance in beets to this disease than to Aphanomyces or Rhizoctonia root rots. However, the possibility of the occurrence of mutants in Fusaria, which may also have different pathogenic properties, should not be overlooked.