Bacterial rot of sugarbeet: Problem and solution

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In the early 1970's considerable acreage of sugarbeets was grown in newly-farmed areas of western Kern County. The beets, grown through hot summer months, were harvested in late fall and winter. Harvest results were disappointing because of a rot that destroyed the center of storage roots, resulting in many low-quality rotted roots and hollow shells at harvest. Thirty to 40 percent of the beets in some fields were severely rotted. This experience prompted the organization of a research and extension team to determine the cause of the rot, the extent of its occurrence in California sugarbeet fields, and what might be done about the problem.

The causal organism

Using techniques employed for isolating other plant pathogenic bacteria, a bacterium was isolated from diseased sugarbeets in early 1972 at U.C.'s Department of Plant Pathology, Berkeley. That summer the organism was used to inoculate healthy sugarbeets grown by the Agronomy Department at Davis. The inoculations produced typical disease symptoms and the organism was reisolated from the diseased plants, thus establishing it as the cause of root rot in commercial fields. The disease-producing bacterium is similar to the common soft rot bacterium, *Erwinia carotovora*, but, because of consistent differences in pathogenicity and cultural characteristics, has been named *E. betavasculorum*.

An extensive survey for this rot in other sugarbeet-growing areas of California by farm advisors of Cooperative Extension and sugar company agriculturalists indicated its presence in most beet-growing areas. Estimated losses of from 5 to 10 percent occurred in many fields.

Contributing factors

Greenhouse experiments at Berkeley, and field trials at Davis and the U.S. Agricultural Research Station at Salinas, established that wounding was necessary for infection and that cultural practices causing wounding could increase rot. Plants proved to be susceptible to infection at all stages of growth and the earlier infection occurred, the greater the crop yield loss. High temperatures were found to favor disease development.

Nitrogen nutrition and plant spacing were investigated as factors contributing to disease because high rates of nitrogen and increased distance between plants in the row stimulate crown growth. This results in more growth cracks at the bases of old petioles and thus more sites for bacterial infection. In contrast to healthy plants, diseased plants showed little response to nitrogen fertilizer. The number of diseased roots and the amount of rot per root increased in response to nitrogen fertilizer. Similarly, as the spacing between plants in the row increased, the percentage of diseased roots increased greatly, and plants spaced further apart than 8 to 10 inches were more seriously affected by the disease than more closely spaced plants. Experiments with several agricultural bactericides showed that they were not very effective.

TABLE 1. Comparative Performance of *Erwinia* Resistant US H11 with Moderately Susceptible US H10.

	Average of Six Trials, Plants Inoculated			Average of 19 Trials Where Root Rot Was Not a Major Factor	
				Sucrose	
Variety	Healthy roots at harvest	Rot per beet	Root yield	Concentration	Yield
	%	%	Tons/acre	%	100 lb/acre
US H10	56	23	36.5	13.6	99.7
US H11	93	4	37.1	13.7	101.7

Variety change

Tests by the USDA at Salinas, Woodland, and Dos Palos established that the newly-released yellows-resistant hybrids, US H9 and US H10, were more susceptible to the bacterial pathogen than were the older sugarbeet varieties. The yellows-resistant pollen parent of these new hybrids proved to be especially susceptible. Apparently, susceptibility to the *Erwinia* pathogen was inadvertently incorporated in the pollen parent when selections were being made for yellows resistance. The sugarbeet pathogen probably has been present in California soils for years but caused only marginal damage to older, relatively resistant sugarbeet varieties. Bacterial rot only became a major problem with the development and widespread use of the new virus yellows-resistant varieties.

An intensive selection program to find resistance to *Erwinia* root rot was begun at Salinas. After three successive selections in the pollinator of the yellows-resistant hybrid, an *Erwinia*-resistant line was developed. This was accomplished without losing the yellows resistance or other desirable characteristics of the pollinator line. This line has been released to sugarbeet breeders and has been used to develop an improved *Erwinia*-resistant, yellows-resistant USDA hybrid, US H11. The high performance of this variety, when inoculated with the pathogen, and when grown under commercial conditions, is shown in the table. Thus, within a relatively short time after the discovery of a potentially serious problem, a cooperative, intensive research program has determined the cause of the problem, elucidated factors that contributed to its severity, and developed what appears to be a satisfactory control in the form of an improved sugarbeet variety.

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