

THE SUGAR BEET IN EUROPE AND AMERICA

Eubanks Carsner¹

Andreas Sigismund Marggraf, Director of the Physical Division of the Prussian Royal Academy of Science, laid the foundation for the great beet sugar industry in 1747 when he published his epochal discovery that

" . . . sugar, this sweet salt, can be made out of our plants as well as out of the sugar cane."

Marggraf, a chemist, was interested in scientific knowledge and not in commercial exploitation of his findings. Franz Carl Achard, student and successor of Marggraf, was led by the achievement of his illustrious master to study and persistently develop good cultural practices for beets and manufacturing methods and finally to found at Cunern near Steinau in Silesia in 1802 the first commercial beet sugar factory. Funds for the enterprise were granted by Friederich Wilhelm III of Prussia. It was during Achard's time that the terms "sugar beet" and "beet sugar" were introduced. Baron von Koppy, an ardent and energetic follower of Achard, in 1805 established a beet sugar factory at Krayn near Strehlen, also in Silesia. The beet sugar industry in Russia was also started in these first years of the 19th century.

Von Koppy, on the basis of Achard's and his own experience with sugar beet growing and beet sugar manufacturing, wrote in 1810;

"There is no crop which has such a strong influence on the improvement of farm management, on the productivity of the soil, on the succeeding grain crop; no other manufacturing compares with beet sugar production in its wholesome influence on numerous domestic industries and on the welfare of the nation."

Many European and American agriculturists, as well as informed industrialists, have held and hold the same opinion.

In France early development of the beet sugar industry drew heavily on the pioneering experience in Germany. Napoleon became interested because of difficulty of getting sugar from the West Indies. By his vigorous support the beet sugar industry developed rapidly and extensively in France. His defeat at Waterloo in 1815 followed by the lifting of the European blockade permitted resumption on an extensive scale of importation of cane sugar. Slave labor in the tropics made competition difficult

¹/Senior Pathologist, Division of Sugar Plant Investigations, Bureau of Plant Industry, Soils and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture

and the French industry declined. Revival and stabilization of the European beet sugar industry is largely due to the efforts and writings of Count Chaptal. The outstanding agricultural contribution of this period to the beet sugar industry was the beginning of sugar beet breeding by the Vilmorin method. Philippe Andre' de Vilmorin did selection work, probably in the latter part of the 18th century, but his son Louis de Vilmorin, through works published around the middle of the 19th century, founded the method of breeding still used generally in Europe for the production of commercial varieties.

American interest in sugar beets and beet sugar stemmed from France. James Ronaldson, first president of the Franklin Institute of Philadelphia (1824-1841) and also president of the Beet Sugar Society of Philadelphia, joined with several friends in financing a trip to France in 1836 by James Pedder for the purpose of investigating and reporting on beet growing and sugar manufacturing. Edward Church and David Lee Child at about the same time formed the Beet Sugar Company of Northampton, Mass. Both organizations imported sugar beet seed and distributed it among farmers. Their efforts, including two important publications, are historically noteworthy even though these did not lead immediately to the establishment of the beet sugar industry on this continent.

The Mormons fleeing across the plains and taking refuge in Utah contributed a picturesque even though disappointing episode to American beet sugar history. "Sugar House", the designation of a ward in Salt Lake City, gets its name from the fact that there the Mormon Church, taking over an enterprise started by the Deseret Manufacturing Company, built the first beet sugar factory in the West, the second in the United States. President Brigham Young had instructed Apostle John Taylor, then a missionary in France, to buy a complete outfit of machinery for making beet sugar. The machinery was bought in Liverpool, shipped by boat to New Orleans and up the Mississippi and Missouri Rivers to Fort Leavenworth, Kansas, and then by an ox train of fifty-two teams across the plains to Utah. The factory was put in operation in 1853 and made syrup but apparently there was no one there who knew how to make sugar.

E. H. Dyer built the first successful beet sugar factory in America at Alvarado, California. The factory was first built there in 1870 and 250 tons of sugar were produced that year. It continued to operate with slowly increasing production for the next three years but operations were discontinued after 1873 and the machinery was sold. Dyer equipped the factory again, enlarged it, and resumed operations there in 1879. That year should be regarded as the time when the first successful beet sugar factory in America was started. The ownership has changed several times. The Holly Sugar Corporation, the present operator, has completely rebuilt and enlarged the factory.

The next successful beet sugar factory was built at Watsonville, California, in 1888, by the Western Beet Sugar Company, predecessor of the Spreckels Sugar Company. Soon after that the industry began to expand steadily. From Ohio and Michigan westward there are now 80 beet sugar factories in 19 states.

Curly top has been the dominant factor in recent important contributions to the advance of the American beet sugar industry. This virus disease earlier caused more loss and later has resulted in greater gains for the industry than any other single factor. Beginning in 1898, devastating curly-top epidemics at frequent intervals swept through some of the factory districts in California, Utah, Colorado, Idaho, Oregon and Washington. There were 21,389 acres planted to beets in the Twin Falls, Idaho, area in 1934 and 18,635 (88 percent) acres were abandoned due mainly to curly top. The yield from the relatively small acreage harvested averaged only 4.88 tons per acre. The destructiveness of this 1934 epidemic is indicated by the fact that in the preceding season, a light curly top year, 25,612 acres were harvested with an average yield of 13.78 tons per acre. Factories costing in the aggregate millions of dollars were abandoned. Fine farming areas gave up trying to grow sugar beets, losing an important cash crop and one greatly needed for the best diversified farming. The industry west of the Rockies was in dire straits when relief came.

Plant breeding and related investigations have resulted in a degree of curly top control so effective that this disease is no longer a limiting factor in the areas where it occurs. Beet sugar factories have been rebuilt in districts previously abandoned. The first curly-top-resistant variety, U.S.1, released for grower use was only moderately resistant. Nineteen separate field tests of this variety in one factory district in 1931 showed an average increase in yield of 4.7 tons per acre over European varieties. Use of U. S. 1 encouraged growers and sugar companies while better varieties were being bred. The progress thus far made in breeding for increased curly-top resistance is indicated by the following tabulated data from a test in 1941. Purposely late planting and artificial measures to increase the severity of the curly-top exposure made the disease conditions very severe.

<u>Variety</u>	<u>Tons per Acre</u>
Old Type (European)	0.00 <u>1/</u>
U. S. 1	6.31
U. S. 33	8.40
U. S. 12	11.25
U. S. 22	14.32
Improved U. S. 22	16.61

1/ No marketable beets produced.

With such a high level of curly-top resistance as has been attained more emphasis can be put on combining it with other valuable characters. Resistance to other diseases, higher sugar content and adaptation to peculiar regional conditions and to evolving mechanical operations are some of the characters that ought to be combined with high curly-top resistance.

Sugar beet seed growing, a new industry in America, was established as a result of the need for multiplying American varieties resistant to curly top. Europe supplied nearly all the sugar beet seed used in the United States up to a decade ago. Now enough seed is produced here to meet all domestic and Canadian requirements and have some for export. Varieties better adapted to various American conditions have been developed and are multiplied in the seed growing districts. These include some varieties resistant to Cercospora leaf spot, a disease serious in areas where curly top does not occur. Establishment of sugar beet seed growing, an outcome of curly top control by breeding resistant varieties, has completed the integration of the American beet sugar industry.

The foundation for the method of sugar beet seed growing generally used in America was laid some years before curly-top resistant varieties became available and led to extensive employment of the method. Instead of the European method of growing the beets in one season, digging and storing the plants over winter and transplanting them in the spring, a much less laborious practice is involved in the American method. The seed is planted in late summer or early fall, the plants allowed to stand over winter in place, usually without thinning, and the seed harvested the following summer. The method permits mechanized procedures that eliminate much of the hand labor involved in the transplanting method. Average yields are higher, too, in the better adapted areas.

The sugar beet seed industry in this country is still young and much remains to be done before it is thoroughly stabilized. Agronomic and physiological investigations have markedly improved cultural practices and guided the selection of climatically suitable areas. By such means the factors influencing thermal induction of flowering are largely subject to control and are now much better understood than they were when sugar beet seed growing in this country was first started.

Mechanization of sugar beet growing operations has received a great deal of investigation in the last few years and encouraging progress has been made especially in the development of harvesting machinery. Rediscovery of the possibility of using mechanically-cracked or "segmented" seed has been an outstanding recent development. The beet seed ball is a multiple fruit and consequently the resulting seedlings are often so closely spaced as to make thinning laborious and expensive. Breaking the seed balls up into pieces containing a reduced number of seed makes possible elimination of some of the thinning effort. Mechanical problems involved in the

satisfactory cracking of the seed balls and the distribution of the segmented seed in planting are being extensively studied. Mechanically cracked seed was introduced from Germany many years ago but did not prove generally acceptable. The difficulties encountered then are largely the same as those troublesome now. The degree of satisfaction obtained with segmented seed in the past season seems likely to lead to such improvements in cracking and planting as to insure permanent adoption of its use.

Russia has led the world in beet sugar production with Germany second and the United States third. Approximately one third of the world supply of sugar comes from sugar beets. The wholesale value of the sugar produced from beets in the United States in 1941, the last year for which statistics have been published, was approximately \$145,000,000. A long advance has been made in a little less than two hundred years since Marggraf reported the results of his research.