

# The Impact of Yellows Control on California Sugarbeets

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## Introduction

It is important for agriculturists, governmental personnel, and the public to become better informed of the extent and nature of losses induced by plant diseases. The well documented yield records of California sugarbeets illustrate the tremendous impact of research on virus diseases of sugarbeet and their partial control.

The sugarbeet, a product of research, has been confronted with crisis after crisis in its role as a supplier of one of the cheapest and purest of foods. One of the most recent maladies to take heavy tolls in the production of this crop has been the complex of aphid-transmitted yellowing virus diseases.

The yellowing virus diseases are serious hazards to stable production of sugarbeet and numerous other crops throughout the world. Since the dawn of agriculture, man has been plagued by the general acceptance of these diseases as being induced by natural factors such as early ripening, drought, excessive moisture, nutritional deficiencies, or soil conditions.

The disease on sugarbeet was first implicated as an infectious entity in 1936 in Europe (9, 10)<sup>2</sup> and was recorded in the United States in 1951 (3). Yellows was first reported from California in 1951, but photographic evidence indicates that it was present in the Salinas Valley as early as 1945 and perhaps as early as 1921 (1). Following its discovery in 1951, yellows was present in epidemic proportions in California until 1968.

Early studies on the yellows complex in California showed reductions in root yields ranging from 2.0 to 47.0 percent and reductions in sucrose content ranging from 0.1 to 3.1 percentage points (2). Natural infection in central California caused a reduction in tonnage of 22.3 percent and a reduction in sucrose of 1.38 percentage points (1).

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<sup>2</sup>Numbers in parentheses refer to literature cited.

### Results and Discussion

A compilation of the sugarbeet production data in California from 1910-1974 shows some interesting trends and gives new insight regarding the economic impact of the yellowing viruses on sugarbeet (Fig. 1). Yields of sugar per acre stood at about 2.0 tons in 1910, but declined severely with the much publicized ravages of beet curly top virus following World War I. Production markedly improved in the late 1920's and early 1930's with the removal from production of areas normally devastated by curly top and the introduction of curly top resistant cultivars in 1934. Production showed a steady increase until about 1950, when production reached 3.0 tons of sugar per acre. This was a period of constantly improving curly top resistance and cultural practice improvements. During this period, there were many factors that contributed to the generally increasing yields, including superior varieties and improved soil and crop management techniques. Research on fertilization methods and materials, stand establishment, irrigation methods, deep tillage, and insect and nematode control procedures was a factor in these increasing yields.

In spite of the introduction of varieties combining bolting, curly top, and downy mildew resistance; the introduction of hybrid varieties; the introduction of monogerm seed; the increased use of nematicides and herbicides; the increasing use of mechanical harvesting systems; the implementation of a beet leafhopper control

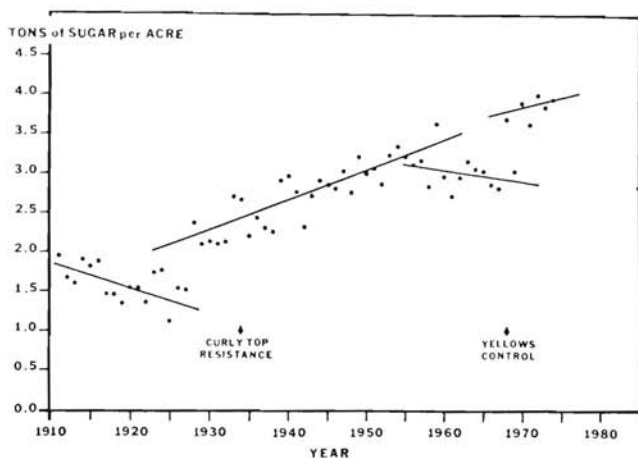


Figure 1.—Sugarbeet production in California for the period 1911 to 1974. Four distinct production trends are related, for the most part, to virus diseases and their control. (Data collected by the California Beet Growers Association, Ltd.)

program; and a system of better fertilizer management, there was a period from about 1950 until the late 1960's when yields significantly declined. Decreased yields during this period of increasingly sophisticated sugarbeet technology were directly related, for the most part, to losses due to the yellows virus complex. Beginning about 1950, there was a gradually increasing trend by the sugarbeet industry to overlap growing periods in various portions of California. This practice resulted in an increase in the incidence of the yellows virus complex and was accompanied by increasingly severe yield losses. Also, over this same period of time, the prevalent beet curly top virus isolates gradually increased in virulence (5, 6).

Epidemiological studies in California in the late 1950's (4) confirmed European reports that there was a close correlation between virus yellows incidence and the proximity of overwintered beet fields. During this period of extremely heavy yellows losses, sugarbeet growers and processors agreed to maintain a period of time between the completion of harvest of the old crop and start of planting the new crop. These "beet-free" periods varied among the different beet growing districts in the state but were put into general use for the 1968 crop. During the beet-free periods, there was an attempt to prevent the presence of sugarbeets in the ground and a cooperative effort was made to clean up weed beets.

The large 1968 crop (Fig. 1) and early rains prevented completion of this harvest, resulting in a breakdown in the beet-free periods and increased high yellows incidence and, consequently, low yields in 1969. During this same period, beginning with the 1968 crop, the commonly grown varieties were largely replaced by two hybrid sugarbeet varieties having moderate resistance to virus yellows (7).

Although there are several factors that have contributed to improved yields in the state since 1970, the general absence of destructive attacks by the yellowing viruses brought about by the implementation of beet-free periods has been the factor that is most obvious to growers, processors, and sugarbeet researchers. Factors that may also have contributed to these yield increases include a higher yielding ability of the new hybrid varieties, more water for irrigation in the San Joaquin and Sacramento Valleys, economic changes favoring sugarbeets over other crops (resulting in a more equitable share of land and production money), and a relatively low incidence of the beet curly top virus.

The dramatic effects of the beet-free periods in 1968, the decreased yields in 1969 when these periods were not instituted, and the maintenance of high yields since 1970, coupled with the much more gradual effects of variety, water, and land improvement, point strongly to the virtual absence of yellows as the major contributing factor to the higher yields.

When the average yields of sugar per acre for the last five growing seasons (1971-1975) are compared to the period 1950-1967 (before the yellows control program and advent of resistant varieties), there is a statewide average difference of 0.86 tons of sugar per acre. This has meant an increase of \$217,969,000 received by farmers over this 5 year period, mainly due to yellows control. When the dollars generated by these yield increases are translated into purchases made by growers, into wages paid to farm workers, into purchases by farm and factory workers, and into expenditures of sugarbeet tax revenues made by governments, the impact of yellows control has contributed over \$792,000,000 to the economy of the state. The impact of yellows control is fully comparable to the impact obtained with curly top virus control 40 years earlier. Calculations are based on sugarbeet production figures compiled by the California Beet Growers Association and crop value figures reported by the California Crop and Livestock Reporting Service. Calculations of the impact of sugarbeet dollars on the state's economy are based on the calculations of California agricultural economists reported by Ronald Reagan (8).

The financial benefits of the partial control of the yellowing viruses of sugarbeet are only a small part of the financial impact of sugarbeet research to California growers and consumers. For instance, if the yields of sugar per acre for the last 5 years are compared to the production for the period 1911 to 1967, the estimated loss due to diseases, improper cultural practices such as nematode and weed control methods, irrigation, nutrition, and less efficient cultivars amounted to over 100 million tons of sugar. At 1971-1975 average prices, this is equivalent to direct losses of over \$1.8 billion to California sugarbeet growers and \$6.6 billion to the economy of the state — a value dwarfing to insignificance the cost of the research which has led to the prevention of these staggering losses.

### Summary

A compilation of the sugarbeet production data in California from 1910-1974 shows some interesting trends and gives new insight regarding the economic impact of the yellowing viruses on sugarbeet. A statewide increase of 0.86 tons of sugar per acre for the last five growing seasons, attributed mainly to yellows control, has meant an increase of \$217,969,000 received by farmers over this period. When the dollars generated by these yield increases are translated into general effects on the economy of the state, yellows control has contributed over \$792,000,000 over this 5-year period.

### Literature Cited

- (1) BENNETT, C. W. 1960. Sugar beet yellows disease in the United States. U.S. Dept. Agr. Tech. Bull. 1218, 1-63.
- (2) BENNETT, C. W., C. PRICE, AND J. S. MCFARLANE. 1957. Effects of virus yellows on sugar beet with a consideration of some of the factors involved in changes produced by the disease. J. Am. Soc. Sugar Beet Technol. 9:479-494.
- (3) COONS, G. H. AND J. E. KOTILA. 1951. Virus yellows of sugar beets and tests for its occurrence in the United States. Phytopathology 41:559.
- (4) DUFFUS, J. E. 1963. Incidence of beet virus diseases in relation to overwintering beet fields. Plant Dis. Rep. 47:428-431.
- (5) DUFFUS, J. E. AND I. O. SKOYEN. 1977. Relationship of age of plants and resistance to a severe isolate of the beet curly top virus. Phytopathology 67:151-154.
- (6) MAGYAROSY, A. C. AND J. E. DUFFUS. 1977. The occurrence of highly virulent strains of the beet curly top virus in California. Plant Dis. Rep. 61:248-251.
- (7) MCFARLANE, J. S. AND I. O. SKOYEN. 1968. New sugar beet varieties reduce losses from virus yellows. Calif. Agric. 22:14-15.
- (8) REAGAN, R. 1970. Letter to My Fellow Americans. California Sugar Beet 1970:35.
- (9) ROLAND, G. 1936. Recherches sur la jaunisse de la betterave et quelques observations sur la mosaïque de cette plant. Sucr. Belge. 55:213-217.
- (10) VAN SCHREVEN, D. A. 1936. De vergelingsziekte bi de biet en haar oorzaak. Meded. Inst. Suikerbiet. 6:1-36.