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Effects of sugarbeet planting date and plant population on sugar yield in the Klamath Basin.

ABSTRACT

The Klamath Basin straddles the inland border of Oregon and California. The Basin supports approximately 200,000 acres of irrigated crop agriculture. In 1989 sugarbeets were introduced as a commercial crop into the Klamath Basin because of increased market potential in California. With the Basin's short growing season, it was assumed that early sugarbeet planting would produce yield benefits. It was also assumed that establishment of this small seeded crop would be difficult during the challenging weather conditions of early spring.

A series of planting date experiments were conducted to aid growers in selecting the optimum time for sugarbeet establishment in the Klamath Basin. To aid growers in making replant decisions, the date of planting experiments were later expanded to include measurement of the effects of plant population.

Methods: The planting date experiments were conducted at the University of California Intermountain Research and Extension Center (IREC) in Tulelake, California and at the Oregon State University Klamath Experiment Station (KES) in Klamath Falls, Oregon. The two research stations are only 25 miles apart but differ significantly in soil type and microclimate. The reclaimed lake bottom soil at IREC is a mucky clay loam with 13% stable organic matter content. The soil at KES is a fine sandy loam with only 1% organic matter content. Both soils are well drained, but are located over perched water tables, with the typical depth of three feet to water from the soil surface at both locations. The daily minimum temperatures during the growing season are often 5-10° F cooler at IREC than at KES.

Initial sugarbeet planting date studies were established at both research stations in 1991, 1992 and 1993. The two most popular sugarbeet varieties at the time, HH55 and Monohikari, were also evaluated. Experimental plantings were arranged in a replicated, split-plot design with planting date assigned to main plots and varieties to sub-plots. Planting began as soon as soil could be worked in the spring, with subsequent plantings made every 7-10 days into the first part of June. Over all experiments, the earliest planting date evaluated was April 3 and the latest was June 11.

To evaluate plant population effects, five additional field studies were conducted (1994, 1995, 1996 at IREC and 1994, 1996 at KES). The studies were designed as replicated complete block, split-plot experiments with planting dates assigned to main plots and plant populations assigned to sub plots. Plots were seeded heavily at each planting date and emerged seedlings were thinned by hand to the target plant populations. Over the course of the five experiments, planting

dates ranged from April 5 to May 31. The average plant populations evaluated ranged from 7,100 to 37,000 plants per acre.

The sugarbeets in all experiments were grown under irrigation, utilizing cultural practices standard for the area. At maturity, in mid-October, beets from each plot were harvested, counted, weighed and sampled for sugar content. From this data beet yield (ton/A), sugar content (%),' total sugar production (lb/A) and gross crop value ($/A) were calculated. Crop values were based on the 1996 grower payment contracts with the refinery (assuming a net selling price of $24/ton of refined sugar).

Results

1991-1993 experiments

In general, beet yields declined with each delay in planting. The average loss in beet yield was approximately 1.7 ton/A for every week planting was delayed after May 1. Surprisingly, the sugar content of the beets was unaffected by date of planting. Most all plantings, early and late alike, produced beets with high sugar content – averaging 17.0 % over all experiments. Monohikari variety had higher sugar content (%) then HH55 in each of the experiments and produced higher total sugar yields (lbs/A). Generally, interactions between varieties and planting date were not significant for the measured yield parameters.

Because beet sugar content was unaffected by planting date, the effect of planting delays on total sugar production and gross crop value mirrored the planting date effect on beet yield. After May 1, each week's delay in planting resulted in loss of sugar yield of approximately 640 lb/A and a $100/A loss in gross crop value.

Regression equations with planting date as the independent variable were fitted to the combined yield data for the initial six field experiments. The best-fit equations is listed below, where D is the planting date expressed as days from January 1:

$$\textbf{Beet Yield (ton/A)} = 15.9 + 0.423\,D - 0.00248\,D^2 \qquad (R^2=0.64)$$

1994-1996 plant population experiments

Multivariate regression analysis of the five combined plant population experiments resulted in the following regression equation for beet yield:

$$\textbf{Beet Yield (ton/A)} = 14.7 + 0.708D + 1.11P - 0.00339D^2 - 0.0168P^2 - 0.00234DP \qquad (R^2=0.59)$$

where P is the plant population in thousands of plants per acre and D is the planting date expressed as days from January 1.

As with the initial planting date studies, yields declined with each delay in planting date. Yields also declined in response to reduced plant populations. Maximum sugar yields were attained with plant populations in the range of 24,000-27,000 plants/A planted the first two weeks in April.

Sugar content of the beets (% sugar) was unaffected by planting date and was only mildly affected by plant populations. With little response in sugar content, the effects of planting date and plant population on total sugar yield and gross crop value closely mirrored the effects on beet yield.

Conclusions: Beet yield, total sugar yields and gross crop value all declined significantly with delays in planting date. This decline occurred with good plant stands and bad, leading to the general recommendation that sugarbeets should be planted early in the spring (first two weeks in April) in the Klamath Basin. Even though yields declined with reduced plant populations, replanting of poor sugarbeet stands should be considered carefully. Fields with poor plant stands established early might out-yield later replanted fields with optimum plant populations. A regression equation relating sugar yields to planting date and plant populations was used to construct a Klamath Basin Sugarbeet Replant Guide. This guide may be used by growers to compare the relative sugar yields expected in fields with poor plant stands with the potential yields of replanted fields. Review of the replant guide lead to the following conclusions: 1) only fields with very poor plant stands should be replanted, 2) replant decisions need to be made early (within three weeks of the original planting date), and 3) fields most likely should not be replanted after May 10.