

PROGRESS REPORT

THE EFFECT OF CLIMATE ON SUGAR BEET YIELDS IN
WESTERN MONTANA

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Climate exerts a very strong influence on the yield of a sugar beet crop. Pierce and Wood (1) in 1946 found the growth of the beet during the summer months to be related to soil temperatures. The relationship of mean temperature to sugar beet yields was reported by the authors in 1946 (2). In this earlier work by the writers, the yield and annual mean temperature data for 13 years showed such a close correlation that it was found possible to accurately predict the beet yield by comparing the mean temperature data of other years with yields produced.

In 1946, this work was carried further with predictions of yield being made from less than the full 12 months of mean temperature. Comparisons and predictions were made early in April on only six months of mean temperature, in July on nine months of data, and the final prediction in October on the full twelve months of information. This data is shown in Table 1, and is compared in the following graphs:

Table Number 1

Year	Six* Months Mean Temp.	Nine** Months Mean Temp.	Twelve*** Months Mean Temp.	Tons Beets per Acre	% Sucrose
1933	31.3	38.6	45.0	10.34	17.39
1934	38.5	44.8	49.3	13.45	17.20
1935	33.9	39.3	45.6	10.30	18.04
1936	29.9	39.2	46.2	11.08	17.32
1937	30.0	37.9	45.2	10.08	17.52
1938	35.0	41.7	48.3	13.10	16.83
1939	34.9	41.5	47.9	12.13	17.78
1940	35.8	42.9	49.4	13.96	16.58
1941	36.1	42.7	48.0	12.51	17.52
1942	31.7	38.7	46.6	11.12	17.73
1943	31.5	38.3	44.9	9.52	17.34
1944	32.4	39.6	45.8	10.50	17.38
1945	34.1	40.1	46.0	11.02	17.50
1946	35.5	41.7	47.5	13.04	16.07

* October thru March. ** October thru June. *** October thru September.

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Six Months Mean Temperature Comparison:

Graph number 1 shows the comparison of six months of mean temperature with final beet yields in tons per acre. The graph shows conclusively that during the past fourteen years the weather for the entire year follows the general trend of the first six months. Thus, before the crop is planted it is possible to have a fairly accurate estimate of the final yield.

Nine Months Mean Temperature Comparison:

Graph number 2 compared the nine month period, October thru June with beet yields. The comparison appears to be more closely related than that for the six month period, with the mean temperature line following the direction of the yield line.

Twelve Months Mean Temperature Comparison:

Graph number 3 compares mean temperature of the twelve month period with actual yields. The correlation on this graph is very apparent, and in no season does the yield line fluctuate far from the average mean line. This graph was shown in part in the 1946 paper (2), and is shown here to include the 1946 growing season.

Nitrate Fertilizers Effect on Yield:

It is important to note on Graph number 3 that since 1933 the line indicating yield did not cross the mean temperature line until 1945. This "cross over" was brought about by the use of nitrates, side-dressed between the beet rows shortly after thinning. About one-third of the 1945 acreage was side-dressed with nitrate fertilizers, bringing the yield line for 1945 just above the temperature line. In 1946 a much greater part of the crop received nitrates, resulting in the wider difference in favor of the yield line.

1946 Yield Predictions from 6, 9 and 12 Months Mean Temperature:

The mean temperature of the first six months of the 1946 season, October thru March, was well above normal. Only three years showed a higher average mean, and those three crops were among the four high production years. A large part of the acreage would be side-dressed with nitrates, and everything pointed to a near record crop. On the basis of this six months mean temperature thru March in comparison with the same period for other years, an estimate was made early in April of 13.05 tons beets per acre.

During May of 1946, two heavy freezes struck the area producing beets for the Missoula factory, wiping out a large acreage, and reducing stands very greatly on the remaining acres. It was estimated that stands of fields not replanted were reduced by at least twenty-five percent. Practically all of the earlier beets that were thinned or ready to be thinned were destroyed, resulting in twenty-three percent of the harvested acres being replants. These fields that were replants were again planted late in May, with a loss of at least four weeks' growing time for almost one-quarter of the acreage.

After these frost losses it did not appear possible that any prediction would be in line with previous data and yield. However, early in July a prediction was made on nine months of mean temperature. This estimate was 12.70 tons per acre.

The final estimate of the probable yield was made early in October, using the mean temperature for the entire twelve months. The estimate was 12.95 tons beets per acre.

The actual tonnage harvested was 13.04 tons beets per acre.

Percent Sucrose Compared with Mean Temperature:

Graph number 4 compares annual beet sucrose percent with annual daily mean temperature. This graph was also shown in part in the previous paper (2), and is shown here to include the 1946 crop.

The 1946 crop shows the lowest sugar content of the fourteen years, .51 percent below the record crop of 1940 when the sugar content was only 16.58 percent. This extremely low sugar content in 1946 may be due to several reasons; October was the wettest month of October in the history of the Missoula factory. November was also wet and unusually cold. This excess amount of moisture during harvest undoubtedly added to the moisture in the beets, making more tonnage and at the same time reducing the sugar content. This record amount of rainfall and snow created problems in hauling beets from the fields, and many beets went into storage piles with frozen tips, due to the excessively low night temperatures. As a result of this, storage losses were higher than normal.

Due to the frost damage in May, harvest stands were very poor, with some fields showing only fifty percent stands. All fields not replanted did not average over sixty-five beets per one hundred feet of row. These poor stands contributed to the low sugar content.

Conclusions:

Predictions of yields can be made early in April by comparing six months of mean temperature of other years with beet yields. Before the crop is planted, it is possible to have a fairly accurate estimate of final yield.

In July, using nine months of mean temperature, more accurate estimates may be made.

By using the full years mean temperature, yields may be predicted very closely.

It is possible to increase the sugar beet crop yield by the use of nitrate fertilizers above that indicated by the mean temperatures.

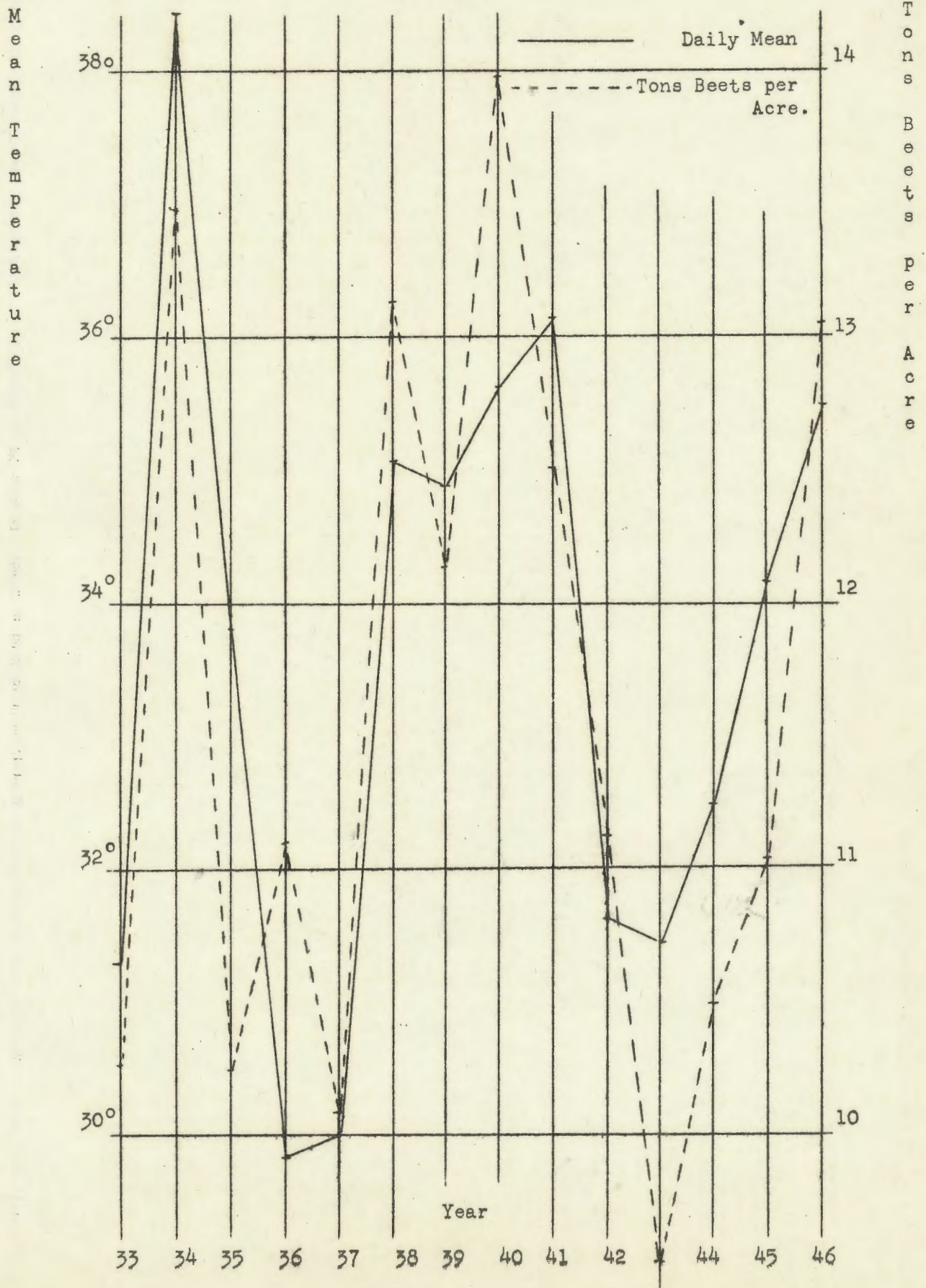
High mean temperatures are generally reflected in lower sucrose content, and lower mean temperatures generally indicate a higher sugar content.

Literature Cited:

- (1) Pierce, L. T., and Wood, R. R., Effect of Temperature upon the Growth Rate of Sugar Beets. A.S.S.B.T. 1946 - Now in Press.
- (2) Swift, E. L. and Cleland, Frank A.. The Effect of Climate on Sugar Beet Yields in Western Montana. A.S.S.B.T. 1946 - Now in Press.

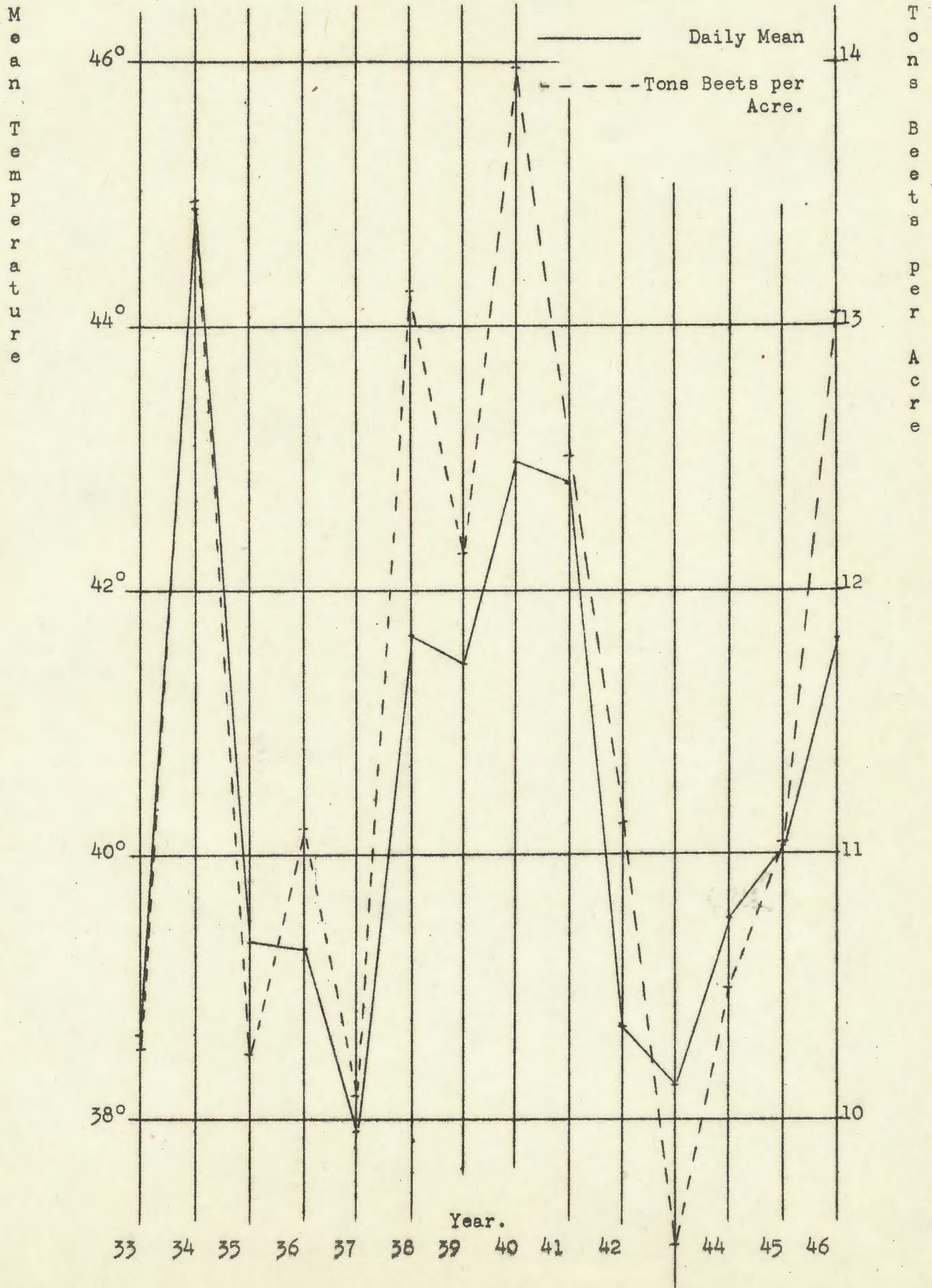
Graph # 1

6 Months Mean Temperature Compared with Yields in Tons Beets per Acre.



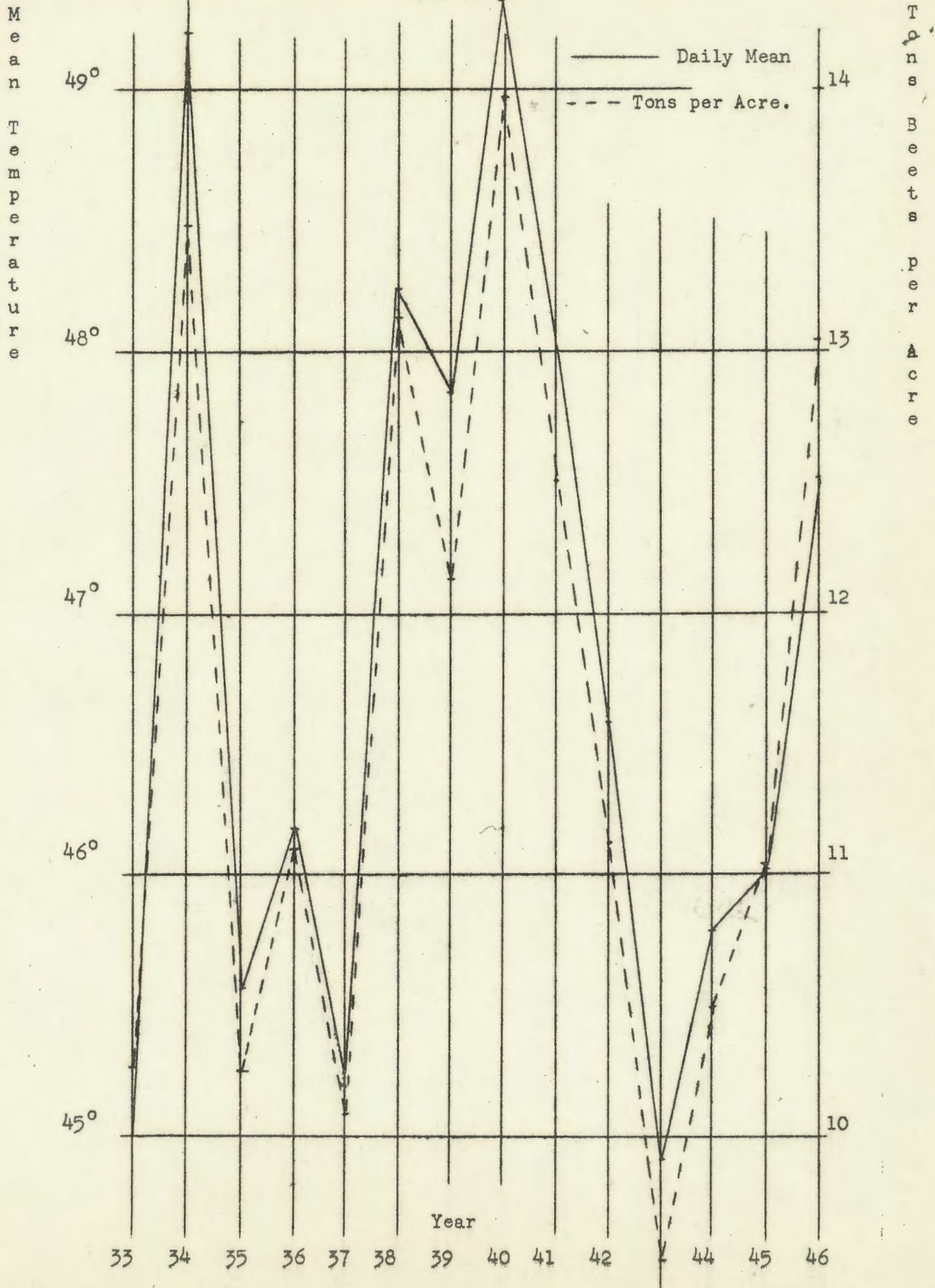
Graph # 2

9 Months Mean Temperature Compared with Yields in Tons Beets per Acre.



Graph # 3

12 Months Mean Temperature Compared with Yields in Tons Beets per Acre.



Graph # 4

12 Months Mean Temperature Compared with Average % Sucrose.

