Effects of Freezing of Sugar Beets Being Overwintered in the Field For Seed Production in Western Oregon[1]

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Introduction

Normal winter temperatures in western Oregon are nearly ideal for producing complete thermal induction for seed stalk formation in early fall planted sugar beets which are left over winter *in* the field. Temperatures seldom drop below 20° F. and the average for the three winter months of December, January, and February is usually around 40 to 45° F. Beets planted during the period from early July to early September usually survive such temperatures with very little loss from freezing. However, seed yields in the Willamette valley have frequently been below expectations. This may be due in part to the small size of roots of the seed plants. In tin's area where temperatures are very favorable for thermal induction roots of the beets usually do not develop further after growth is resumed in early spring. Subsequent growth is associated only with seed stalk formation. Another possible cause of low seed yields is the rather heavy defoliation of plants which usually takes place during the late bloom stage. Causes of the defoliation are not well known.

The winter of 1948-49 was exceptional in that the mean monthly temperature for December was 1° below normal, for January it was 9° below normal and 1° below in February. The mean minimum temperatures for these three months showed a wider divergence with, respectively, 4°, 11°, and 2° below normal. For nearly a month the temperature remained below freezing, and minimum temperatures of around 5° F. were reported for several locations in the seed growing area. Figure 1 shows comparative temperatures of the 1948-49 winter season and the normal for the Corvallis Station. As a result of the prolonged cold many beets had badly frozen crowns.

Literature Review

Evidence has been presented by Owen et al. (3)[3] to show that a prolonged temperature exposure of around 40° F. is optimum for thermal induction of flowering in sugar beet plants under low photoperiod conditions. Either warmer or colder temperatures are less effective. Pentleton (4) found that beet plants which have been partially reverted to vegetative condition

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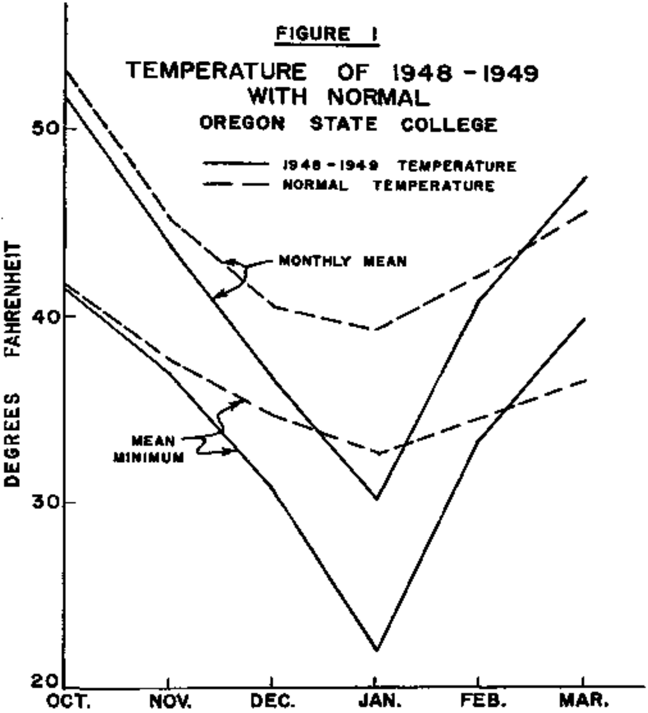
[3] Numbers in parentheses refer to literature cited.



after having been well conditioned for bolting will usually produce a larger root and considerably more seed than similar roots fully induced for bolting. Similar behavior seems to occur if the plant is only partially conditioned for bolting. Such roots classified by Owen (2) as semi-vegetative continue to develop root tissue at the same time as they are developing seed stalks. Such a contingency is dependent on the beets not being so vegetative as to fail to develop normal seed stalks. Stout (5) discussed the accumulation of substances which cause bolting in beets and presented evidence that it is of a chemical nature. Chroboczek (1) showed that the thermal induction stimulus in beets is concentrated in the crown.

Field Observations

In late February, 1949, in western Oregon many beet fields had a very discouraging appearance. Several were abandoned as unsuited for profitable seed production. Plants appeared to be too badly frozen to recover. The larger, earlier planted beets suffered most. Subsequent events, however, showed that these early appearances were misleading. Nearly all roots not completely killed eventually recovered and produced normal seed stalks. Fig. 2 shows some typically frosted roots in the early spring and Fig. 3 shows the typical appearance following seed production. In most cases the root bridged around the damaged tissue with new growth.

Seed yields of many of the commercial fields which were in top rank condition *in* the fall and suffered most from frost damage ranged from 3,500 to 5,000 pounds of seed per acre. In previous years yields of the best fields had been 2,000 to 4,000 pounds. Data are not available but observations indicated that the average root size at harvest time was considerably above normal. It was also apparent that in most fields the plants showed more tendency than usual to continue vegetative growth after harvest. No data are available as to relative defoliation.

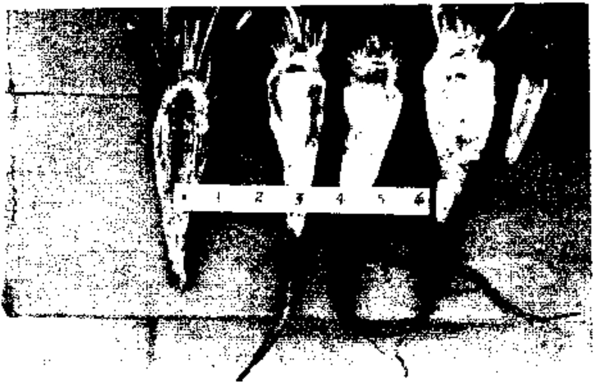


Figure 2. Appearance of some of the larger beet roots in early spring after growth was resumed, showing badly frosted tissue around the crown.

Discussion

During a considerable portion of the winter the temperature was either above or below the optimum for thermal induction of flowering. Under such conditions it may be that an insufficient amount of the postulated chemical was formed in the plants to produce the degree of thermal induction usually obtained in this area. As a result the plants remained in a partial or semi-vegetative condition, thus producing more vigorous seed stalks.

If the thermal induction substance is of a chemical nature and is concentrated in the crown tissue, as has been postulated, freezing and subsequent sloughing away of a portion of the crown tissue might conceivably remove some of it. Such a circumstance would also tend to hold the plants in a semi-vegetative condition.

Figure 3. Appearance of some frosted beet roots after having grown normal seed stalks.

Summary and Conclusions

Due to exceptionally cold weather in western Oregon in the winter of 1948-49 sugar beets being overwintered in the field for seed production were badly frozen.

When growth resumed in late February a high percentage of the roots had more or less decayed crown tissue from the freezing. Appearances indicated that the decay might spread and destroy the whole crown.

Contrary to expectations most beets recovered, made normal seed stalks and better than average seed yields.

The suggestion is made that the improved seed yield was due in part to the beets being semi-vegetative. Under such conditions new root tissue may continue to develop while seed stalk formation takes place; whereas, under conditions of more complete thermal induction, no further root growth takes place after spring growth has resumed.

The lack of complete thermal induction may have been due to insufficient time during the winter when the temperature was optimum for forming the necessary bolting factor substance, or possibly due to loss of such substance from the crown tissue after it had been formed as a result of freezing injury.

Literature Cited

(1) CHROBOCZEK E.
1934. A study of some ecological factors influencing seedstalk development in beets *(Beta vulgaris).* New York (Cornell) Agri. Exp. Sta. Mem. 154: 84 pp. Illus.

(2) OWEN, F. V.
1941. Asexual propagation of sugar beets. Journal of Heredity 32: 187-192.

(3) OWEN, F. V., CARSNER, EUBANKS, and STOUT, MYRON
1940. Photothermal induction of flowering in sugar beets. Jr. Agric. Res. 61: 101124.

(4) PENDLETON, R. A.
1948. Thermal induction and reversal in relation to seed production. Proc. Amer. Soc. Sugar Beet Tech. 1948: 192-195.

(5) STOUT, MYRON
1946. Relation of temperature to reproduction in sugar beets. Jr. Agric. Res. 72: 49-68.