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SUGAR BEET
SEED PRODUCTION STUDIES

Thesis for the Degree of M. S.
MICHIGAN STATE COLLEGE

Samuel R. Bird
1940

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SUGAR BEET SEED PRODUCTION STUDIES

THESIS

RESPECTFULLY SUBMITTED IN PARTIAL FULFILLMENT
FOR THE DEGREE OF MASTER OF SCIENCE

AT

MICHIGAN STATE COLLEGE OF AGRICULTURE
AND APPLIED SCIENCE

SAMUEL R. ^{Richard}BIRD

1940

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THESIS

SUGAR BEET SEED PRODUCTION STUDIES

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TABLE OF CONTENTS

	Page
INTRODUCTION.	1
HISTORY OF SUGAR BEET SEED PRODUCTION IN THE UNITED STATES.	
A. Development previous to the World War.	3
B. World War Period.	4
C. Development after 1922.	5
EXPERIMENTAL PROCEDURE IN MICHIGAN.	
A. Overwintering beets in the field.	
1. Paw Paw, Michigan.	8
2. Traverse City, Michigan.	10
3. East Lansing, Michigan.	11
B. Production of stecklings.	11
C. Overwintering stecklings.	
1. Cold frames.	13
2. Pits.	13
3. Root cellars.	14
D. 1938 seed plot experiment.	14
SUMMARY AND CONCLUSIONS.	17
BIBLIOGRAPHY.	18

INTRODUCTION

The production of sugar beet seed in the United States is necessary for the security of the domestic beet industry. Since 1900, sugar beet growers and processors have experienced severe epidemics of *Cercospora* leaf spot (*Cercospora beticola*) in areas east of the Rocky Mountains and slight to complete crop failures due to curly-top (a virus disease) in western United States. Since curly-top does not occur in Europe and since *Cercospora* leaf spot is not of economic importance in seed producing areas of northern Europe, little or no progress has been made by the European breeders to produce varieties resistant to these diseases for the American market. European varieties are usually not so well adapted to the various climatic and soil conditions of the beet growing areas of the United States as American bred varieties. Domestically produced seed has the advantage of being bred and tested for adaptability to our conditions. Also it is generally believed that seed imported from Europe is sometimes old seed which contains just enough new seed to meet the Mudgeburg requirements. A European war may have a disastrous effect upon a supply of beet seed if we were dependent on Europe for our seed as will be pointed out later.

These conditions have stimulated American beet breeding and seed production investigations. At the present time beet seed is being produced principally in the states of New Mexico,

Nevada, Arizona, Utah and California by the overwintering method while most of the seed produced in Colorado is by the conventional European method.

It has been demonstrated by sugar beet companies during the World War period and by the Michigan Agricultural Experiment Station, through unpublished data, that seed of good quality can be produced in Michigan by the conventional European method. Down (3) reports that Michigan-grown seed results in a beet with comparative high tonnage, low sugar content and low purity. However, the cost of producing seed by the conventional method has been so high that no company has been willing to attempt to grow seed in this state since the World War. Cheaper methods of production must be developed before any large quantity of seed will be grown in Michigan.

At the present time strains of sugar beets are being developed in Michigan which have promise of being more resistant to *Cercospora* leaf spot and superior in tonnage and sugar content to many commercial varieties that are now being grown here. The economical production of such seed is essential if the strains are to be used commercially in the state.

The economical production of sugar beet seed might be accomplished if it were possible, first, to overwinter beets in the field in which case the labor required in harvesting, storing and transplanting stecklings would be eliminated, or secondly, to overwinter stecklings successfully in pits or root cellars and then transplant them by machine rather than by hand which has been the practice in the past.

Sugar beet seed production studies reported in this paper include (a) trials in overwintering beets in the field at Paw Paw, Traverse City and East Lansing, (b) overwintering beets in cold frames, pits and root cellars, (c) production of stecklings and (d) the effect of ammonium sulphate and spacing of stecklings on sugar beet seed yields.

HISTORY OF SUGAR BEET SEED PRODUCTION IN THE UNITED STATES

Development Previous to the World War.

The first permanent sugar beet factory in the United States, established in 1879, used European seed to produce the raw material. According to Palmer (5) the first carefully planned experiment in sugar beet seed growing in the United States was made at Schuyler, Nebraska in 1891, by the late Dr. Harvey W. Wiley of the United States Department of Agriculture. Comparisons made in 1892 and 1893 of beets grown from domestic and imported seed showed that domestic seed was superior to imported seed. From six years' data similar results were obtained from experiments at Fairfield, Washington.

Small quantities of commercial sugar beet seed have been grown by several companies for many years, but up to the year 1914, efforts in beet seed growing never expanded much beyond the experimental stage. It must be remembered that all methods of seed growing in the United States up to 1922, were patterned after the conventional European method which involved

the planting of seed for steckling production, harvesting of stecklings, overwintering of stecklings in pits or root cellars and then replanting the stecklings in the spring for production of the seed crop.

This method of beet seed production was expensive and maintenance of quality was difficult for the American farmer due to high labor costs and inexperience in sugar beet breeding problems. A relatively cheap and adequate source of seed could be purchased from Europe, consequently seed production remained insignificant in the United States.

World War Period.

The advent of the World War tested the security and efficiency of the sugar beet industry in the United States and brought to mind how dependent the domestic sugar beet industry was on foreign countries. The annual seed importations for the five prewar years amounted to almost 15,000,000 pounds. During this period the amount produced domestically was negligible.

Securing an adequate supply of sugar beet seed was a serious problem for the American beet sugar producers at the outbreak of the war. The low price of sugar in 1913, and the eliminating of duties on imported sugar the same year to be effective in 1916, produced a gloomy outlook for the domestic beet industry. Due to these conditions sugar beet companies allowed their seed stocks to diminish. As sugar prices went up with the outbreak of the war in 1914,

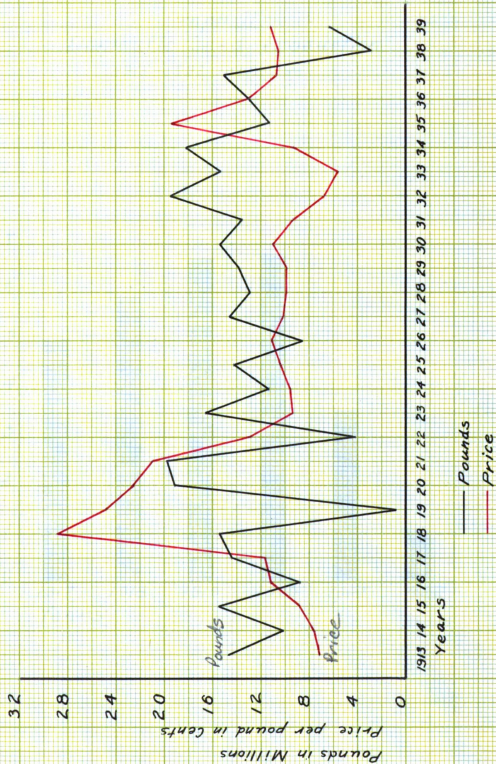
the demand for European seed increased, but due to the naval blockade it was extremely difficult to supply this demand. The same year a few companies were well provided with seed for their 1915 planting but most companies had little or no seed at their disposal. The seed that was imported for the remainder of the war came from Russia since Great Britain was effective in blockading Germany's ports. Graph I (2) shows the amount and price of seed imported from 1913 to 1939, inclusive.

The threat to the survival of the domestic beet sugar industry accentuated by the war, stimulated the production of our own seed by methods similar to those of Europe. Although wages were high and much labor was required for our domestic beet seed production it was a step in insuring a part of our seed requirements. Graph II (6) shows the domestic production of sugar beet seed during and immediately after the war. Previous to 1917 and after 1922, domestic production was negligible. Soon after the war European seed was again imported and seed production in the United States was abandoned except for a few beet sugar companies in the west who continued seed production on a small scale.

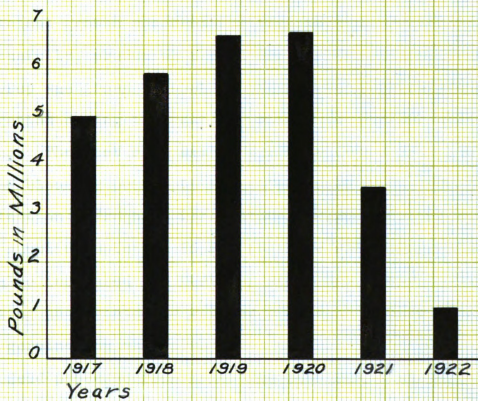
Development After 1922.

The New Mexico Agricultural Experiment Station in cooperation with the United States Department of Agriculture made the discovery in 1922, that sugar beets can be overwintered in the field in New Mexico. Since that time Nevada,

Graph I
Sugar Beet Imports and Prices
1913 - 1939 inclusive



Graph II
Domestic Seed Production
1917-1922 inclusive



Arizona, Utah and California have also been successful in overwintering beets in the field. This discovery was the most important factor in stimulating successful beet seed production in the United States. The above states produced approximately 13,000,000 pounds of seed in 1938 by the overwintering method (1).

Overpeck, Elcock, Morrow and Stroud (4) describes the results of their experiments in producing seed by the overwintering method as follows:

The seed was planted with a beet drill in the fall and sufficient growth occurred for the plants to overwinter successfully, producing a seed crop by the following July. The crop was grown without thinning and was given adequate irrigation during the fall and winter to prevent killing by drying. The beet crop was irrigated at least every week during blooming period to insure high yields of seed of high germination. Frequent irrigations during pollination not only supplied moisture to the soil for the fruiting plants, but also increased the humidity which was effective in increasing seed yields as well as producing seed which gave high germination when planted.

Seed produced from plantings made September 1 and September 15 showed no differences in yields. October 1 and 15 plantings decreased 30 and 80 per cent respectively in seed yields. Seed from September plantings gave an increase in germination of 15 per cent over seed from plantings made in October. Plantings made before August 15 were unsatisfactory

due to hot weather while plantings made in October and later were injured by freezing.

Highest yields of viable seed were obtained from a planting rate of 18 pounds per acre in 22-inch rows without thinning. A reduction of the seeding rate to 9 pounds in 22-inch rows decreased viability of the seed 27.6 per cent.

Heavy adobe soils in a high state of fertility showed no significant response in sugar beet seed yields when phosphate or nitrogen carrying fertilizers were applied alone or as a supplement to manure. Loam or sandy loam soils usually responded to manure applications, especially when supplemented with phosphate applications.

Seed stalks were cut by a mower, immediately shocked by hand and left for a period of one to two weeks before being threshed with an ordinary commercial grain thresher.

This method in comparison to the conventional method eliminates the labor and equipment required for harvesting, overwintering and transplanting of stecklings. It also delays planting from April until September.

EXPERIMENTAL PROCEDURE IN MICHIGAN

Overwintering Beets in the Field.Paw Paw, Michigan.

It was thought that Paw Paw, being in a region in Michigan where winter barley and occasionally winter oats have been successfully grown, might have greater possibilities in overwintering beets than other areas of the state. Therefore, trials were conducted in this area.

In May, 1938, three-quarters of an acre of land was planted to beets with Iogold Oats as a nurse crop on a sandy loam soil near Paw Paw in Van Buren County. After the oats were planted with a regular grain drill, one-half of this area was planted to beets having 7-inch spacing between rows and the other half was planted in 21-inch rows. Fair stands were observed in both plots in the fall, although the plants lacked vigor and good color. The oats were harvested in the usual manner allowing the beets to overwinter in the stubble. Approximately 50 per cent of the beets in each plot survived the winter. During the following spring and early summer those plants that survived the winter never attained normal growth and color, all showing retarded growth similar to symptoms observed in the fall.

Next to the above plots a one-fourth acre area was summer fallowed and planted to beets the middle of August. One-half of this area was planted in rows 7 inches apart and

the other half in rows 21 inches apart. Both plots had a poor stand and vigor in the fall with 50 per cent of each plot surviving the winter and showing somewhat improved vigor in the spring. Approximately 65 per cent of the beets overwintered in a small area in the southwest corner of this plot, showing good growth in the spring and early summer, however, the entire plot was given the same management.

The presence of sheep sorrel in the plot indicated that the soil pH may have been a factor in effecting the differences in stand and vigor. The Soil-tex method of determining the pH was used and from these tests it was found that the degree of acidity was negatively correlated with the vigor and stand of beets. Plots showing very poor stand and vigor gave a pH reading of 4.5 to 5.0 while the better parts had a pH of 6.0.

An attempt to determine whether or not the addition of fertilizer and lime would be effective in stimulating growth and increasing winter survival of the beets was started in the summer of 1939. The final results of this experiment will be available in the summer of 1940. Two tons of commercial lime and 375 pounds of 0-20-20 fertilizer were applied to an acre of ground and the plots were planted July 7. On this area four replications of 10 randomized treatments of ammonium sulphate were laid out. Treatments consisted of:

1. No treatment.
2. 200 pounds at planting time.
3. 400 " " " "
4. 600 " " " "
5. 200 pounds in spring.
6. 400 " " " "
7. 600 " " " "
8. 100 pounds at planting time and 100 pounds
in spring.
9. 200 pounds at planting time and 200 pounds
in spring.
10. 300 pounds at planting time and 300 pounds
in spring.

Seed was sown at the rate of 12 pounds per acre in 22-inch rows. Each plot was 45 feet long consisting of 11 rows with four-foot alleys between replications.

Fair stands were observed in the fall with good response to ammonium sulphate treatments. The growth and vigor of the plants increased with increased applications. Further observations will be made in the spring before and after spring applications are made.

Traverse City, Michigan.

This region usually has a good covering of snow which usually remains until the thawing and freezing period in the spring is past. This condition gave some promise of overwintering beets in the field.

From one year's trial a small percentage overwintered successfully. Further investigations should be carried on to evaluate this region in overwintering possibilities.

East Lansing, Michigan.

In May, 1938, a plot of beets was drilled in rows 7 inches apart in barley and another plot in rows 21 inches apart in barley on the college farm. Good stands and fair growth of beets was observed in these plots until the barley was harvested, after which vigorous growth took place. They came through the winter in very good condition until early spring when periodic thawing and freezing killed almost 100 per cent of the beets. The barley stubble held a uniform covering of snow over the plots, but also served to harbor field mice which damaged about 10 per cent of the beets by eating out the crowns.

Trials in overwintering beets in the field for the past six years at East Lansing have been unsuccessful.

Production of Stecklings.

In growing stecklings the primary objective was to produce small beets so that they may be overwintered in root cellars or pits with a minimum amount of space and that they may be transplanted by machine. Stecklings ranging in size from one-fourth to three-quarters inches in diameter through the crown may be transplanted by a cabbage transplanter and have shown to give fair seed yields.

Seed for the steckling plot for 1938 was planted in very late spring at the rate of 15 pounds per acre in 22-inch

rows. Late planted beets are less affected by leaf spot and have an upright growth which facilitates cutting the tops at harvest time. The crop was not blocked nor thinned which resulted in the production of small beets ranging in size from a lead pencil to about two inches in diameter at harvest time. Otherwise cultural practices of the steckling crop were similar to those given a regular sugar beet crop.

Harvest was prolonged until a relatively late date of about October 31, so that by the time the stecklings were pitted, cooler weather would favor more successful pitting conditions. However, in some years the beets may become frosted if left in the field until the above date in which case some spoilage may occur in storage.

Before lifting the beets with the regular beet lifter the tops were cut with a mowing machine a few inches above the crown. The mower was run over the beets one way and then over the same area in the opposite direction to remove as many leaves as possible. After lifting, the beets were thrown into small piles where they were picked up by trucks and hauled to the pit.

Overwintering Stecklings.

Cold Frames.

Stecklings were grown and overwintered successfully in cold frames, however, this method of producing and overwintering stecklings is not practical due to the high cost of materials and labor involved.

Pits.

Pitting trial made in the fall of 1938 gave very poor results. The pit was located on a sandy soil with a slight slope, making conditions for drainage exceptionally good. The pit was 4 feet wide, 35 feet long and 15 to 18 inches deep. The freshly dug beets were piled in the pit to a depth of about 18 inches, the top of the pile coming to about the ground level. A 6-inch covering of straw and a light covering of soil was applied until colder weather warranted a total soil thickness of two feet. This pit had no ventilation.

Only a very few stecklings came through the winter and these were found on the surface and edges of the pile. The leaves that were left on the stecklings after harvest and the large number of small stecklings caused the roots to pack allowing very little aeration. The persistent warm weather for a period of two weeks after pitting resulted in smothering.

Root Cellar.

Dr. H. W. Brown, Canada and Dominion Sugar Company, Chatham, Ontario, states that stecklings have been overwintered successfully in root cellars in that area.

Stecklings produced in 1939 are being overwintered in a root cellar on the college farm. At the time of this writing (early April) all stecklings were in good condition. Final conclusions regarding this experiment will be made at the time of transplanting.

The 1938 Seed Plot Experiment.

The following experiment was laid out to determine the influence of different spacings of stecklings in the row, between rows and different amounts of ammonium sulphate on sugar beet seed yields.

This experiment was located on sandy clay loam soil on the College Experiment Station farm at East Lansing. The stecklings used were grown and overwintered in cold frames and were transplanted with a cabbage transplanter April 20-23.

Treatments of plots included 18-, 24- and 30-inch spacing between rows and 6-, 12- and 18-inch spacings in the row with applications of ammonium sulphate at the rate of 0, 200 and 400 pounds per acre. All possible combinations of the above treatments were used which made a total of 27 plots. Table I shows the planting plan and yields of seed from each plot and Table II is a summary of each treatment.

Table I.

Planting plan showing the effect of spacing and of ammonium sulphate on sugar beet seed yields.

Plot	Inches between rows	Inches in the row	Pounds of ammonium sulphate applied	Pounds of clean seed per acre
1	30	6	000	693
2	30	12	000	979
3	30	18	000	471
4	18	12	200	353
5	18	18	200	369
6	18	6	200	528
7	24	18	400	311
8	24	6	400	610
9	24	12	400	486
10	18	12	400	402
11	18	18	400	385
12	18	6	400	335
13	24	18	000	245
14	24	6	000	219
15	24	12	000	385
16	30	6	200	689
17	30	12	200	745
18	30	18	200	711
19	24	18	200	477
20	24	6	200	404
21	24	12	200	406
22	30	6	400	768
23	30	12	400	471
24	30	18	400	574
25	18	12	000	346
26	18	18	000	345
27	18	6	000	443

Table II.

Summary of yields of sugar beet seed from various spacings in the row, spacings between rows and amounts of ammonium sulphate applied.

Treatments	Lbs. Clean Seed/Acre
6 inches in row	520.9
12 " " "	508.1
18 " " "	431.7
18 inches between rows	389.3
24 " " "	393.6
30 " " "	677.9
No ammonium sulphate	458.4
200 pounds ammonium sulphate	520.2
400 " " "	482.2
Difference for significance 5% -----	144.52
1% -----	210.27

The 30-inch spacing between rows gave significantly higher yields than either the 24- or 18-inch rows. No significant differences were found in yields between spacings in the row nor between yields from various amounts of ammonium sulphate applied.

No marked differences in leaf spot infection were observed among the various plots, however, infection was heavy in all plots. Since the rows ran east and west the predominating westerly winds may have lessened leaf spot injury in the wider spaced rows due to better aeration. This may partially explain why the 30-inch rows were superior to the narrower rows in seed yields.

SUMMARY AND CONCLUSIONS

The three overwintering trials conducted in Van Buren County overwintered with fair success, although the soil needed lime and fertilizer to induce normal growth. The one year's trial at Traverse City resulted in a small percentage of beets surviving the winter. All overwintering trials at East Lansing have been unsuccessful. No differences were observed between the 7- and 21-inch spacing of row plots in overwintering beets.

Stecklings ranging in size from one-quarter to three-quarters inch in diameter at the crown were transplanted successfully with the cabbage transplanter.

Beet seed sown at 15 pounds per acre in late spring or early summer and left without blocking or thinning produced small stecklings which may possibly be used more economically than large beets in the production of seed.

Stecklings overwintered in pits without ventilation did not survive which indicates ventilation may be necessary. Root cellars show the greatest promise for overwintering stecklings at East Lansing.

Wide spaced rows were superior to close spaced rows in seed yields. Various spacings in the row or various amounts of ammonium sulphate applied had no effect on seed yields.

BIBLIOGRAPHY

1. Agricultural Statistics 1939. Table 172, p. 127
2. Compiled from Department of Commerce Reports.
3. Down, E. E., Tests With Sugar Beets.
Michigan Agricultural Experiment Station Circular
Bulletin 66, 1925.
4. Overpeck, J. C., Elcock, H. A., Morrow, Wm. B.,
and Stroud, R. Sugar Beet Seed Production
Studies in Southern New Mexico, 1931-1936.
New Mexico Agri. Experiment Station Bulletin 252,
1937.
5. Palmer, T. G. Sugar Beet Seed, p. 46.
John Wiley and Sons, Inc., New York, 1918.
6. United States Department of Agriculture Yearbook,
1924, p. 736.

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