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EFFECT OF DEPTH OF PLANTING
AND SEED TREATMENT ON
EMERGENCE OF PERFECT AND
IMPERFECT SHEARED
SUGARBEET SEED

Thesis for the Degree of M. S.
MICHIGAN STATE COLLEGE
Donald Prentice Satchell
1947

THESIS



This is to certify that the

thesis entitled

"Effect of Depth of Planting and Seed
Treatment on Emergence of Perfect and
Imperfect Sheared Sugarbeet Seed."

presented by

Donald P. Satchell

has been accepted towards fulfillment
of the requirements for

M.S. degree in Soil Science

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EFFECT OF DEPTH OF PLANTING AND SEED TREATMENT ON EMERGENCE
OF PERFECT AND IMPERFECT SHEARED SUGARBEET SEED

by

DONALD PRENTICE SATCHELL

A THESIS

Submitted to the School of Graduate Studies of Michigan

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1947

THESIS

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EFFECT OF DEPTH OF PLANTING AND SEED TREATMENT ON EMERGENCE OF PERFECT AND IMPERFECT SHEARED SUGARBEET SEED

I. INTRODUCTION

It has long been the hope of the Sugar Beet industry to eliminate the hand labor now necessary to thin the beets. The hand labor amounts to thirty-seven per cent of the total cost of producing sugar beets according to the data of Wright (15). The industry has attempted to solve this problem by shearing the beet seed in the hope of getting single seeded segments. The sheared seed has several advantages over the unsheared, or whole seed ball, seed in that the sheared seed may be planted at a reduced rate which results in easier thinning, less disturbance of the beets at thinning, and less competition prior to thinning. A disadvantage of the sheared seed is the difficulty in securing an adequate stand, due either to poor germination or to poor emergence, to use the mechanical blocker or cross blocking with a cultivator.

In the following pages is described an investigation of some of the factors thought to influence the germination and emergence of sugar beet seed.

II. REVIEW OF LITERATURE

Rudolfs (8) in a study of the stimulating effect of various salt solutions on several kinds of seed reported that the rapidity of germination varied with the kind of seed and that some were benefited by dilute solutions of the various salts.

Stone (10) reporting on the development of analytical methods in European seed laboratories states that beet seed should be soaked for four hours in pure water and then after changing the water, soak

for three more hours prior to a germination test.

More recently Jackson (4) showed the beneficial effect of soaking on beet seed germination, and also that soaking for two hours gave as good results as longer periods.

Garner and Sanders (3), believing the thickness of the pericarpal tissue to be the causal factor in the poor germination of sugar beets, milled some of the seed and also soaked some seed in sulphuric acid. They reported accelerated and increased germination with these treatments, but failed to show consistent benefit in the field.

Tolman and Stout (11) used synthetic growth regulating substances as a dust applied to the seed and also as a spray on the foliage. They reported no significant benefits either in the field or in the greenhouse.

Tolman and Stout (12), in a study to explain the beneficial action of washing, concluded that in sugar beet seed-ball extracts the toxic effect on germinating seed was due largely to ammonia released by enzymatic hydrolysis. They state, "The removal of water soluble nitrogen fractions from the pericarpal tissue affords an explanation of the beneficial effects of washing or soaking some seeds prior to germination tests." Little benefit was reported from washing the seed when planted in the field.

Tolman and Stout (13), in a more recent work, showed that in the shearing process sometimes the true seed is exposed. In this study there was about twenty-five per cent of the sheared seed units that were so broken as to expose the true seed. In tests conducted they found no difference in germination of the perfect sheared seed and the whole seed ball with single germs. In the imperfect sheared seed 15 to 20 per cent germinated abnormally. In soil tests very few of the

abnormal germinating seeds emerged when planted at a depth greater than one-half inch. As a result of these tests the authors believe that the seed should be planted as shallow as moisture will permit.

The moisture requirement for germination was studied by Leach, Bainer and Doneen (5). These workers found that beets would germinate at a water content just slightly over the permanent wilting percentage, and that pelleted beet seeds required a longer emergence period than either whole or segmented (sheared) seed. They also found that at the lower temperatures the seed required a longer emergence period. Although the higher temperatures and increased moisture favor emergence, Afanasiev (1) reports that these are the most favorable conditions for seedling disease injury.

Young (16) states that control of seedling diseases can be effected with the use of: 1. adequate organic matter; 2. if the disease is known to be severe, 400 to 500 pounds of 0-20-0 fertilizer planted with the seed; 3. loose soil in good tilth; and 4. thinning and cultivation as soon as possible.

Farnsworth (2), working with some heavy soils in Ohio, came to the conclusion that if the soil has an air capacity of 12 per cent, aeration should no longer be a limiting factor for the growth of sugar beets.

Vogelsang, Schupp and Reeve (13) report that pelleting of sheared sugar beet seed gives a more uniform seed distribution at planting time.

There has been extensive investigation by the plant breeders to develop unilocular seed. Owens, Smith and Musser (6) report some progress. Russian workers have also reported the development of single germed strains.

III. METHODS OF EXPERIMENTATION

Seed and Seed Treatment

Three kinds of sheared seed were used. The first, variety unknown, was used for greenhouse plantings 1 and 2, and field planting I. The second, US 215 x 216, 1944-45 production, was used in greenhouse planting 3 and field planting II. The third was the pelleted seed. The pellet number was 801 $\frac{1}{2}$ and was pelleted with 7 $\frac{1}{2}$ % Cupricide, and 10% treble super phosphate, contained in an inert binder, based on the dry weight of the seed before pelleting.

The seed treatments are listed below. Treatment 1 is the control or untreated seed. In greenhouse planting 1 and 3 and field planting II, all seed, unless otherwise stated, and the pelleted seed was dusted with a fungicide. In greenhouse planting 1, the fungicide was Ceresan and in greenhouse planting 3 and field planting II, the fungicide was Arasan. Treatment 2 is the washed seed. In all cases this seed was washed for two hours. The washing was accomplished by placing approximately one pound of seed in a four-gallon glazed earthenware jar into which tap water was introduced from the bottom. The seeds were held in the jar by a cheesecloth fastened over the mouth of the jar. Treatment 3 is the salt (NaCl) treated seed. This seed was washed as in treatment 2 and then placed in the various salt solutions. In greenhouse planting 1, immersion was for two hours and in the rest of the plantings for one hour. Treatment 4 is also salt treated but differs from treatment 3 in that at the end of the immersion period in the salt solution the seeds that were floating were selected for use in this treatment. This treatment in field planting II and greenhouse planting 3 consisted of washing in water for an hour, placing in the

salt solution for an hour, separating the floating seed from the seed that sank, and then washing in water for another hour. Treatment 5 differs from treatment 4 in that the seed selected was that which sank in the salt solutions. Treatment 6 in the field plantings was an attempt to puddle the soil by adding water to the soil over the planted seed. The seed used and the method of planting were identical to treatment 1 in every other respect. Treatment 7 was the use of the pelleted seed described previously. The germination of these seeds is shown in Table 2.

Soil and Planting

Field Plantings

The field plots were set up in a split plot design with three replications. Planting was done with a Plantet Jr. hand planter. The rows, completely randomized within a given depth, were 20 inches wide and 30 feet long in planting I and 20 inches wide and 60 feet long in planting II. Figure 1 shows the plot design of the field plantings.

The first planting was made on a Hillsdale sandy loam that showed a marked tendency to puddle (figure 5) and the second planting was made on a Conover silt loam that did not exhibit this tendency to any extent (figure 6). Unfortunately these plantings were not made at the same time due to the wet spring. Field planting I was made the tenth of June, and planting II on the eighth of July, 1947.

Greenhouse Plantings

The soil used in all greenhouse plantings was a Brookston silt loam obtained from the Ray Cook farm in Clinton County. The containers used were wooden flats.

Planting I

This planting was made April 27, 1947. Four rows were made

in each flat. Fertilizer (2-16-8) was added at the rate of 200 pounds per acre in all flats except flat 10. The seeds were dusted, except for flat 10, with Ceresan and planted one inch apart, 100 to a flat.

In flats 1, 3 and 9, the soil was moist enough to compact, but was below the lower plastic limit. Compaction was accomplished by means of a 12 mm. glass rod which was placed over the seed. Pressure was applied on the rod. The seeds were covered with loose soil to the depth stated. The remaining treatments were made as previously described, and as enumerated in Table 1, planting 1. The depth of planting was one-half inch unless otherwise stated.

Planting II

The spacing of the seed, two inches apart, was made by a pegged board placed on the air dry soil. One segment was placed by hand in each mark and pushed to the proper depth with the blunt end of a wax pencil. The number of segments per flat was 240, except for flat 9, which contained 195. The date of planting was June 11, 1947. The treatments are as previously described and as listed in Table 1, planting II.

Planting III

Planting III was made on the 15th of July, 1947. The spacing and planting was done as it was in planting II. The treatments, previously described, are contained in Table 2.

Counting and Watering

The counts were made until a constant or decreasing value was obtained for all flats. The total count was made and also a count of "beet hills" that is, the spacing was such that seedlings per segment could be counted.

The watering, done with tap water, was accomplished by use of a flaring rose attachment on the hose. This applied the water in a fine spray which was done to prevent puddling of the surface soil. The flats were watered heavily at each application which was made when the surface appeared air dry. This method of watering was used in an attempt to control seedling diseases.

IV. DISCUSSION AND RESULTS

Greenhouse Planting 1

Soil-seed contact was thought to be an important factor in the germination and emergence of sugar beet seed. Since it was shown by Tolman and Stout (12) that the pericarpal tissue released ammonia when it was hydrolysed it seemed logical to assume that the clay would adsorb the released ammonia by base exchange and that the adsorption would be greater if the soil-seed contact was increased. Also compaction would decrease the pore size near the seed therefore it was assumed that the water would be more available giving a more rapid emergence. With these thoughts in mind two flats were set up in the laboratory in which the soil was compacted at the seed level in one and in the other the soil was left loose. Watering was accomplished by placing the flats in a shallow pan containing water. The germination and emergence in the loose flat was considerable the better. No counts were made of this planting. This treatment was included in the planting in the greenhouse and, as before, there was considerable difference in favor of the loose soil (18%) at the one-half inch level. In view of these results the compaction treatment was discontinued. Also included in this planting were treatments 2, 3, 4 and 5. The results are

given in Table 1. The washing seemed to give no benefit over the control. The separation in the salt solution appeared to be significant, giving a 26% difference in favor of the floated seed.

Greenhouse Planting II and Field Planting I

These two plantings were made with the same seed and as much as possible the same treatment. It was thought since the separation was between perfect and imperfect sheared seed that the difference should be greater at the greater depths as pointed out by Tolman and Stout (13).

Treatment 3 was included to see if the salt had any effect by itself. The pelleted seed was included in the greenhouse planting in an attempt to determine the comparative rate of emergence. Other workers have reported a longer emergence period for the pelleted seed at comparatively low temperatures.

A statistical analysis was made of the results from the field planting. The final table of the statistical analysis is shown in Table 4. The treatment was highly significant and the depth significant.

A higher concentration of salt was used in this treatment in an effort to more completely separate the perfect and imperfect seed and to see if such a concentration might not be somewhat toxic. A preliminary germination test on seed soaked in 14% NaCl solution showed no toxicity.

The seed was not treated with a fungicide in an attempt to find out if the salt had any effect on seedling injury due to disease. No significant difference in incidence and injury due to disease appeared among the treatments. Fertilizer was not added because of the difficulty in even distribution and would, therefore, add an immeasurable factor.

Significant differences were shown between treatments, with the exception of treatment 2 and 3. A significant difference between depth 1 and 3 was shown but not between 1 and 2, or 2 and 3.

The differences shown in the field were not as great in the greenhouse planting, except between treatments 2 and 3, which would appear to be significant.

The rate of emergence of the pelleted seed appeared to be slower (Table 3). This is in agreement with the results of other workers. Treatment 5 seems to be slower in emergence than treatment 4.

The low emergence obtained in all treatments in this planting seem to indicate the benefits of the use of a fungicide for seedling disease control.

Greenhouse Planting III and Field Planting II

Tolman and Stout (12) showed that the benefit from washing varied greatly with the seed used. The seed selected for these plantings showed very little damage due to shearing. This seed was used to determine if the separation was between perfect and imperfect sheared seed, and if such a separation would be beneficial where the seed showed little shearing damage. It was also hoped in this planting to determine the effect of aeration on emergence.

The results are given in Tables 2, 5 and 6. It is seen in the statistical analysis, no significant differences were obtained either due to treatment or to depth. It is the author's belief that the results for depth 1 are low in the field planting due to poor coverage. The field had been worked at right angles to the direction of planting and in the depressions the seed was not covered. However since this trouble would be experienced in any field planting at this depth

no attempt was made to correct it.

The results of the greenhouse planting are in good agreement with the field planting and also showed no significant differences. Both, however, showed a slight depression due to the use of the salt.

As was expected, the pelleted seed gave a better distribution of the seed in the row.

In an attempt to determine the cause of the great difference between the two plots, soil samples were taken and the total pore space and distribution of pores were made.

TABLE 7 - PORE SPACE DETERMINATIONS

Field Planting I	Total Pore Space	Non-Capillary Pore Space	Capillary Pore Space
Sample 1.	59.5	29.3	30.2
2.	64.2	32.5	31.7
3.	63.0	36.1	26.9

Field Planting II	Total Pore Space	Non-Capillary Pore Space	Capillary Pore Space
Sample 1.	74.0	36.6	37.4
2.	75.6	40.0	35.6
3.	79.2	43.7	35.5

* The pore space is expressed as the per cent of the total volume of the sample.

The samples were taken in order of stand and growth, i.e., sample 1 represents the poorest growth, sample 2, the average growth and emergence, and sample 3 represents the best growth and emergence. It is seen that there appears to be good correlation in spite of the limited number of samples. The differences would probably have been greater in undisturbed samples. Field planting I had soil that was

quite compact (Figure 5) and it was next to impossible to secure cores of soil that were completely undisturbed. The soil in the second planting was loose and samples were easily taken in a nearly undisturbed state (Figure 6). The samples were taken with a Coile sampler and the distribution of pores was determined on a pF table using the method of Learner and Shaw (6). Further evidence that poor aeration and compaction was a major factor in the differences obtained was that the beets had the same spindly appearance as those grown by Smith (9) on artificially compacted soil. In view of this evidence it is believed that the figure (12%) obtained by Farnsworth (2) for minimum air space is too low, at least in soils that show a tendency to puddle on the surface.

V. SUMMARY AND CONCLUSIONS

The results of this investigation suggest the following points:

1. That compaction of the soil is detrimental to the emergence of sheared sugar beet seed. From a practical standpoint this means a loose seed bed, use of soil that is not easily puddled, and the liberal use of organic additions in a rotation that included sugar beets.
2. The use of salt solutions offer a possible method of separating perfect and imperfect sheared sugar beet seed when the seed is damaged in the shearing process.
3. Pelleting of the sheared seed gives a better seed distribution but requires a longer emergence period.
4. The seed should be planted as shallow as possible in soil that has a tendency to puddle and in this soil should be planted at a higher rate. One inch seems to represent the maximum depth to be used where the moisture content of the soil is adequate.
5. Planting at one-half inch depths require a level surface when planted in the field.

Figure 1. General pictures to show differences due to depth in Field Planting I. The more distant plot also showed this difference. From right to left the first six rows were Depth 2, the second Depth 1, and the six rows on the left were Depth 3. Soil differences as shown by growth appeared to be great. It is noticed that treatment 6 is almost a failure at Depth 2 and Depth 3.

Figure 2. This picture shows the difference obtained in emergence between Depth 1 and Depth 3 in Field Planting I. The row to the left of the Depth 1 card and the row to the right of the Depth 3 card are the same treatment. (treatment 4)

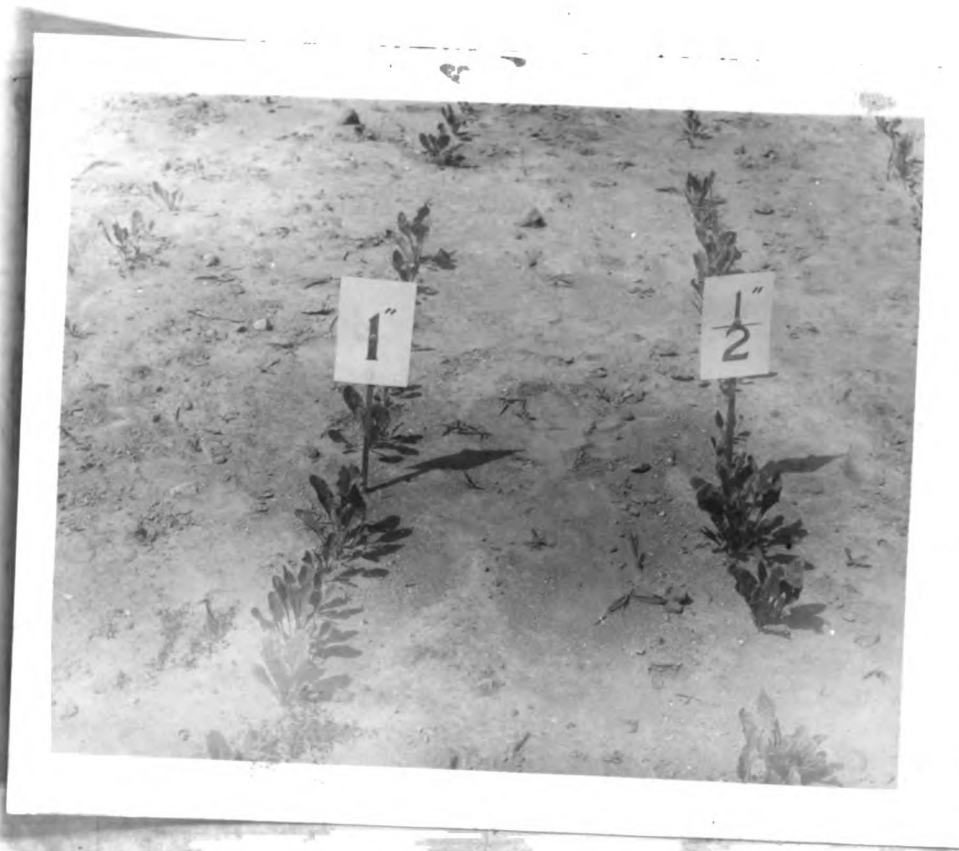


Figure 3. This picture does not show the typical difference obtained between Depth 1 and Depth 2. There were no border rows that were of the same treatment. The row containing the Depth 1 card and the row to the left of the Depth 2 card are the same treatment.

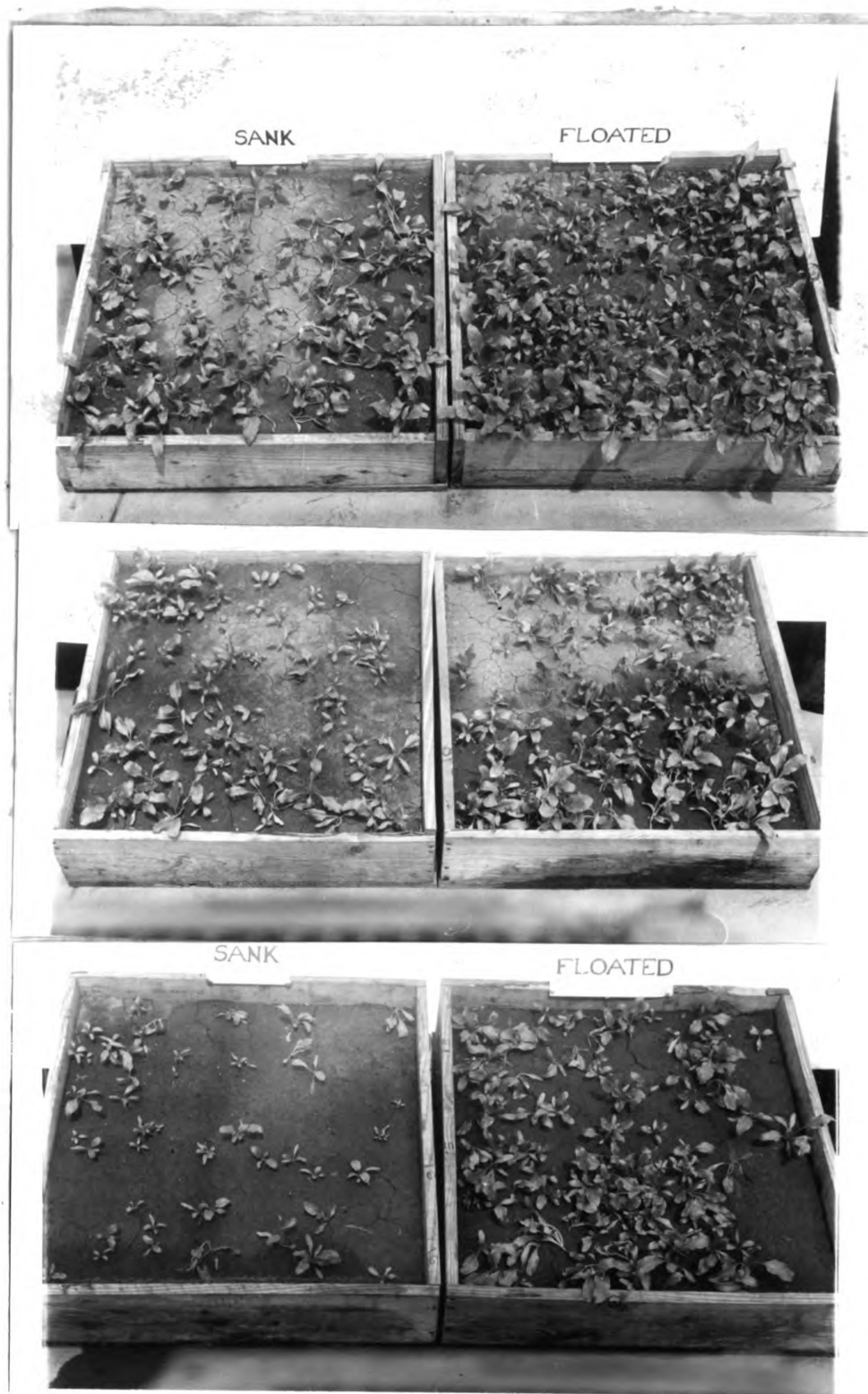


Figure 4. The top picture is Depth 1, the middle-Depth 2, and the bottom-Depth 3. The right flat in each case is treatment 4. The higher percentage of emergence obtained with treatment 4 over treatment 5 is observed. The effect of depth is clearly evident in these photographs. These flats were part of Greenhouse Planting II.

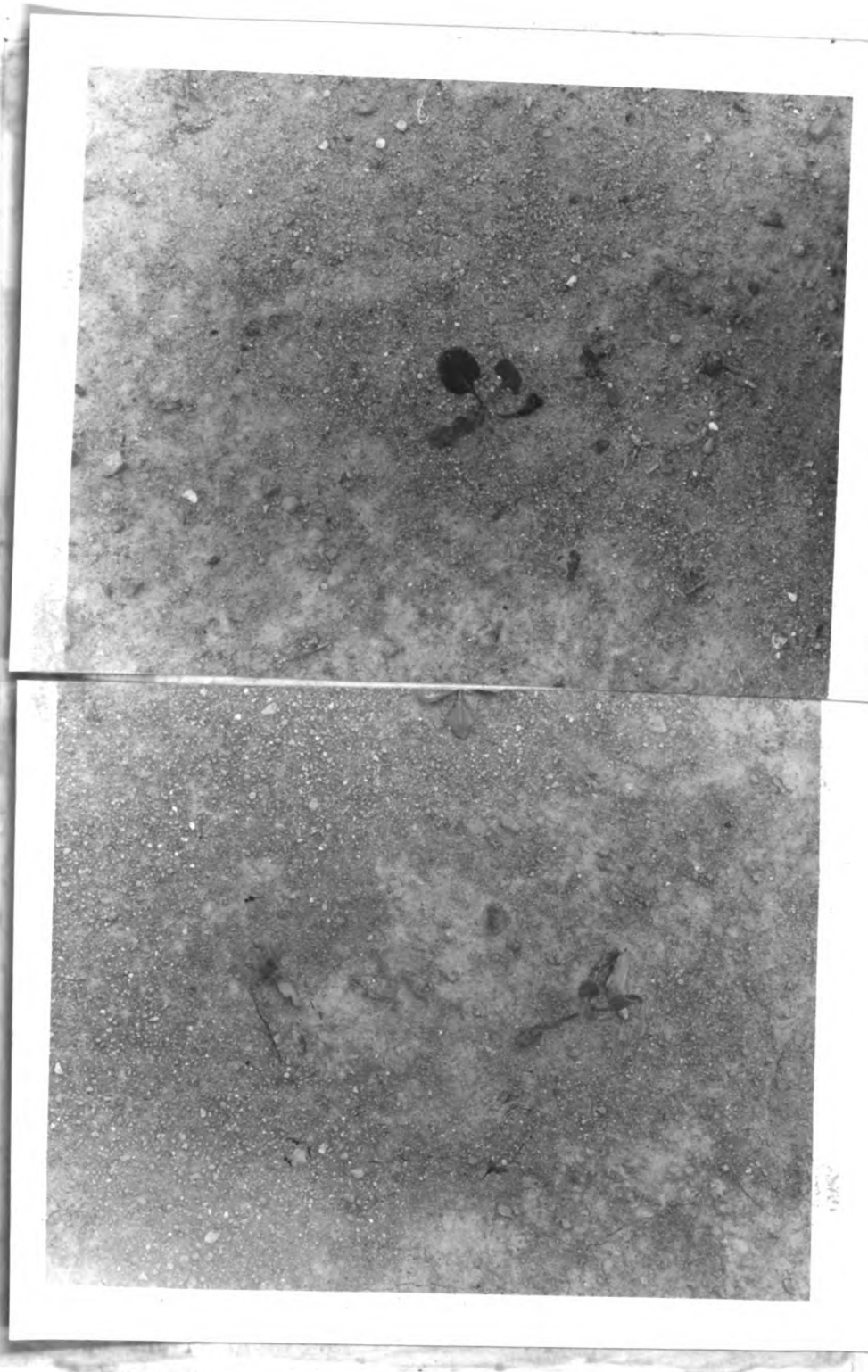


Figure 5. This close up of the soil in Field Planting I shows its puddled condition, and the poor growth and emergence of the beet seedlings. This picture was taken sixty-three days after planting. The beets are typical of much of this planting, and are small and spindly. Compare this photograph with figure 6.



Figure 6. The granular structure of the soil of Field Planting II is shown in this photograph. The beets in this picture are typical of the entire planting, and show vigorous growth and a dense stand. This photograph was taken forty-five days after planting. Compare with figure 5.



Figure 7. A general view of Field Planting II showing the uniform excellence and growth obtained in this planting. Little difference could be observed due to depth of planting or to treatment.

TABLE 1.

SUMMARY OF GREENHOUSE PLANTINGS

Planting I

Flat	Seed Treatment	Total Seedlings	Per Cent Emergence
1.	1/2 Inch pressed.	86	64
2.	1/2 Inch control.	103	82
3.	Surface planted pressed in slightly.	80	69
4.	Washed two hours in water.	108	79
5.	Washed two hours in water; soaked two hours in 2% NaCl. Seed used floated.	112	76
6.	As in Flat 5 except the seed used sank in 2% NaCl solution.	78	64
7.	Repeat of Flat 5.	116	82
8.	Repeat of Flat 6.	69	56
9.	1 Inch pressed.	76	59
10.	1/2 Inch with no fertilizer or Ceresan.	98	66

Remarks: All flats had 200 pounds of 2-16-8 fertilizer applied in the row except Flat 10. All were treated with Ceresan except Flat 10. The soil used was a Brookston silt loam. Date of Planting was April 27, 1947.

Planting II

Flat	Seed Treatment	Total Seedlings	Per Cent Emergence	Seedlings Per Segment
1.	1/2 Inch Control	178	55.8	1.3
2.	Washed 2 Hours in Water (1/2")	224	60.5	1.5
3.	As in 2 and soaked 1 Hour in 10% NaCl (1/2")	156	46.0	1.4
4.	As in 3 and the seeds used (1/2") floated in the salt solution	242	63.5	1.6
5.	As in 4; seeds sank (1/2")	141	42.5	1.4
6.	Pelleted (1/2")	191	61.7	1.3
7.	1 Inch Control	114	38.7	1.2
8.	Washed 2 hours in water (1")	162	46.0	1.5
9.	As in Flat 3 (1")	70	22.0	1.6
10.	As in Flat 4 (1")	170	48.0	1.5
11.	As in Flat 5 (1")	112	34.2	1.4
12.	Pelleted (1")	129	48.4	1.1
13.	As in Flat 4 (1-1/2")	159	43.0	1.5
14.	As in Flat 5 (1-1/2")	64	20.4	1.3

Soil Used: Brookston silt loam.

Date of Planting: June 11, 1947.

Seed Used: Variety is unknown, but is the same as used in Field Planting I.

SUMMARY OF GREENHOUSE PLANTINGS

Planting III

Depth 1			
Treatment	Total Seedlings	Per Cent Emergence	Seedlings Per Segment
1.	268	70.8	1.6
2.	259	70.4	1.5
3.	243	66.3	1.5
4.	266	70.8	1.6
5.	248	68.7	1.5
Depth 2			
1.	253	72.2	1.5
2.	244	66.7	1.5
3.	274	71.7	1.6
4.	237	66.3	1.5
5.	249	68.4	1.5
Depth 3			
1.	210	63.7	1.4
2.	202	61.3	1.4
3.	202	60.0	1.4
4.	184	56.7	1.4
5.	186	55.8	1.4
Pelleted	157	54.8	1.2

Seed Used: US 215 x 216, 1944-45 production. This is the same seed and treatment as Field Planting II except the pelleted seed is not planted at the $\frac{1}{2}$ inch and 1 inch level; also treatment 6 is not included.

Germination Tests*

Seed used for Field Planting I and Greenhouse Planting II

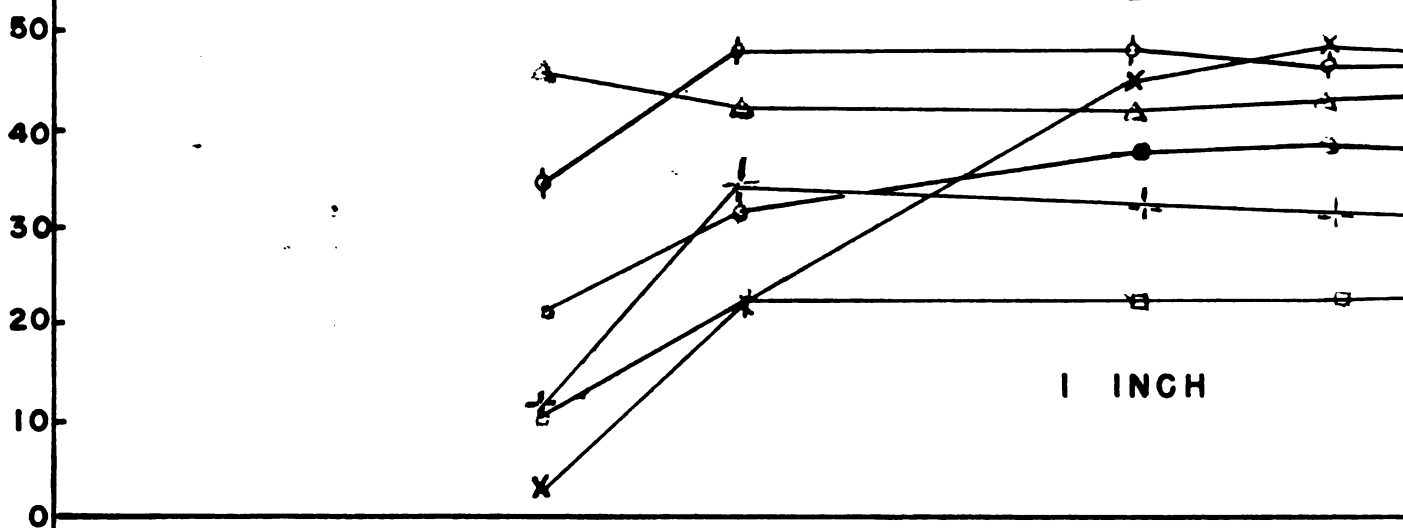
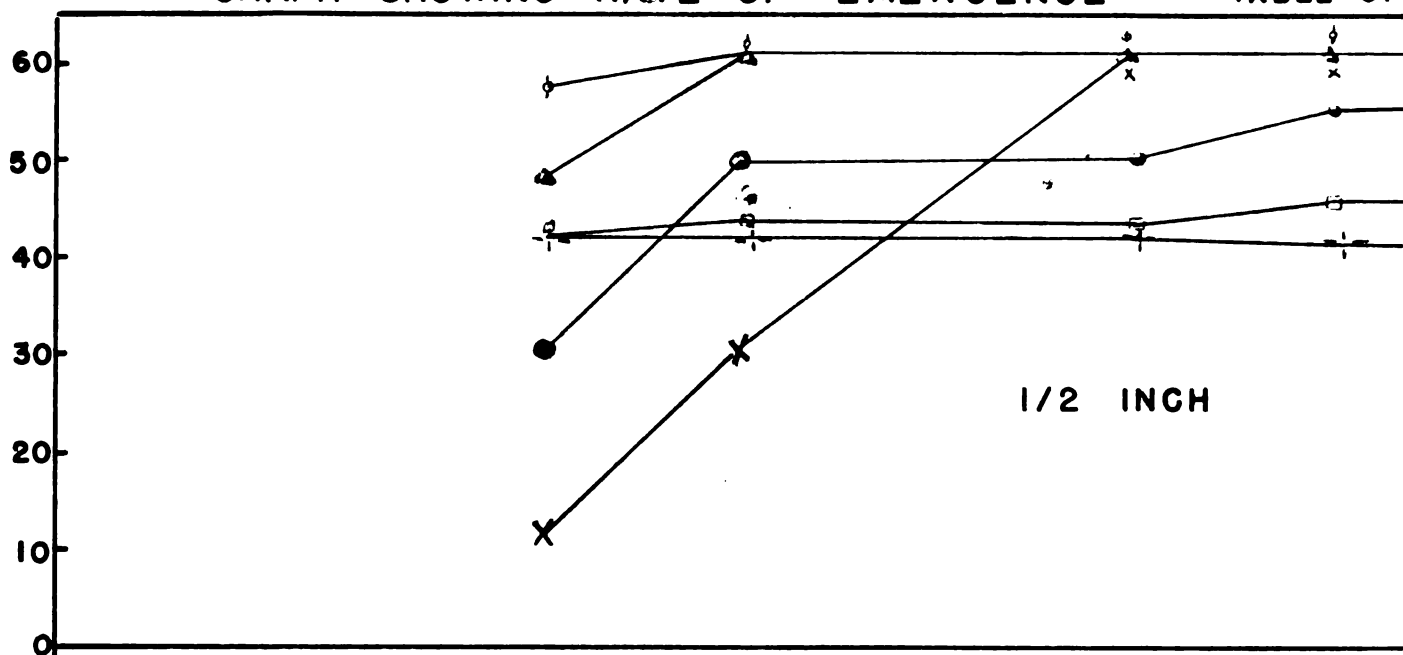
Treatment	Per Cent Germination	Treatment	Per Cent Germination
1.	74	4.	81
2.	82	5.	70
3.	70	Pelleted	47
Seed used for Field Planting II and Greenhouse Planting III			
1.	82	4.	86
2.	85	5.	75
3.	77	6.	82

* These tests were made by the Michigan State Department of Agriculture, Seed Division.

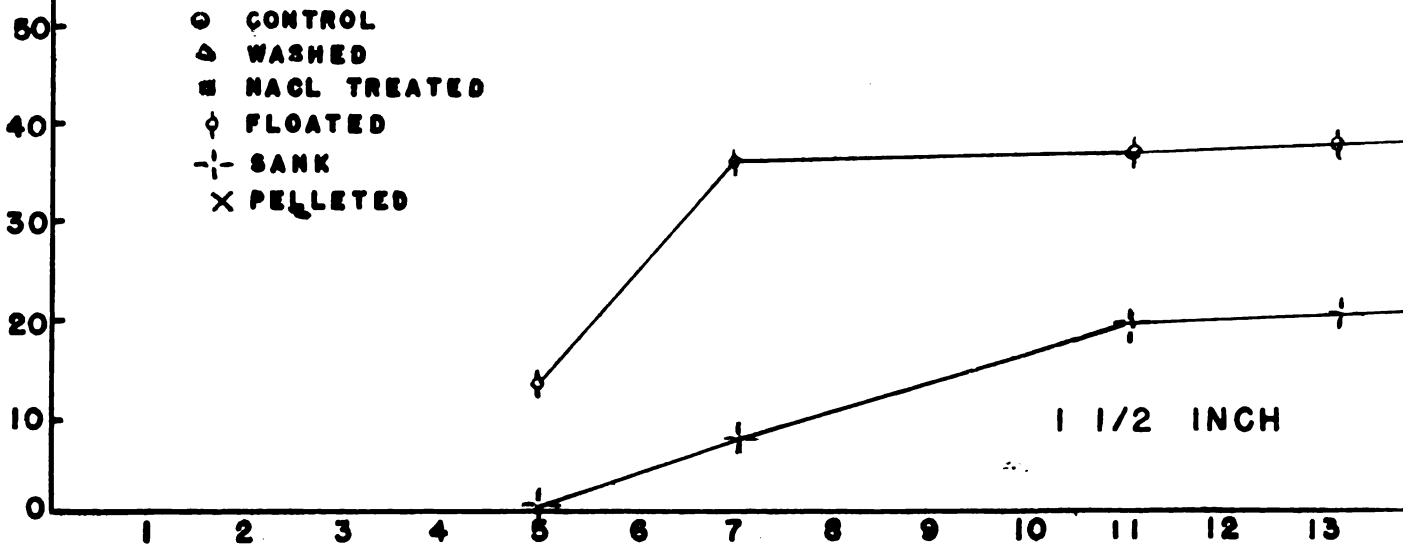
GRAPH SHOWING RATE OF EMERGENCE

TABLE 3.

PERCENT EMERGENCE



KEY TO SYMBOLS USED



SUMMARY OF FIELD PLANTINGS

Field Planting I

	Depth 1	Depth 2	Depth 3	Mean
1.*	19.0**	11.7	5.2	11.97
2.	35.8	22.1	10.4	22.77
3.	36.6	25.0	7.0	22.87
4.	40.1	31.6	12.7	28.13
5.	31.4	18.2	4.8	18.13
6.	9.2	2.3	3.3	4.93
Mean	28.68	18.43	7.23	

* Refers to seed treatment.

** Per Cent Emergence.

Treatment 1. Control.

Treatment 2. Seed was washed two hours in water.

Treatment 3. Seed was washed two hours in water and then soaked one hour in a ten per cent solution of sodium chloride.

Treatment 4. As in treatment number 3, but the seed that floated in the ten per cent sodium chloride was selected.

Treatment 5. As in treatment number 4, but the seed that sank was selected.

Treatment 6. After the seed was sown, water was poured over the soil in the seed row.

SUMMARY OF PRE-THINNING COUNT

Field Planting I

Depth 1 ($\frac{1}{2}$ inch)	Treatment	Inches Containing Beets	Times Factor*	Per Cent Emergence	Maximum Gap (inches)
	1.	11.8	26.8	19.0	26.8
	2.	36.2	36.2	35.3	10.8
	3.	30.0	38.7	36.6	12.0
	4.	32.5	42.3	40.1	10.0
	5.	31.5	31.8	31.4	12.8
	6.	5.4	12.3	9.2	40.7
Depth 2 (1 inch)	1.	6.8	15.4	11.7	36.7
	2.	24.8	24.8	22.1	15.2
	3.	21.2	27.3	25.0	14.3
	4.	28.0	36.4	31.6	12.3
	5.	22.5	22.7	18.2	14.0
	6.	1.4	3.2	2.3	71.4
Depth 3 ($1\frac{1}{2}$ inch)	1.	3.2	7.3	5.2	62.8
	2.	12.0	12.0	10.4	27.7
	3.	7.5	9.7	7.0	33.2
	4.	12.2	15.9	12.7	27.8
	5.	5.5	5.6	4.8	51.3
	6.	1.9	4.3	3.3	68.5

* This factor was used because the rate of seeding varied so greatly, and this column represents the result of multiplying the "inches containing beets" by a factor for comparison.

TABLE 5.

SUMMARY OF PRE-THINNING COUNT

Field Planting II

Seed Treatment	Inches Containing Single Beets	Double	Multiple	Per Cent Emergence	Per Cent Singles	Maximum Gap (inches)	
Depth 1 (1/2 Inch)							
1.	51.2	24.2	15.0	12.0	80.2	47.3	6.0
2.	52.7	25.3	13.2	14.2	83.5	48.0	4.7
3.	50.5	24.5	14.5	11.5	90.0	48.5	5.3
4.	64.3	19.2	17.0	11.5	84.2	40.2	6.5
5.	44.5	18.4	15.2	11.0	77.4	41.2	8.2
6.	46.7	23.7	12.3	10.7	73.0	50.7	7.8
7.	51.3	27.8	15.3	6.2	80.0	58.2	6.5
Depth 2 (1 Inch)							
1.	57.8	23.7	20.2	16.0	102.0	39.6	4.3
2.	61.7	26.9	18.5	16.3	100.5	43.6	4.7
3.	49.8	23.8	16.0	10.0	84.4	47.8	5.7
4.	53.7	25.7	15.3	13.0	92.6	47.2	5.5
5.	48.5	22.3	15.3	10.8	83.4	46.0	5.7
6.	49.7	20.2	14.8	14.7	89.5	40.6	7.0
7.	47.5	27.3	12.2	8.0	73.5	57.6	5.7
Depth 3 (1-1/2 Inches)							
1.	51.7	22.0	16.0	13.7	84.9	42.5	5.7
2.	46.7	23.5	13.5	9.7	70.0	50.3	6.5
3.	48.6	24.7	14.0	9.8	82.4	50.3	7.7
4.	45.3	24.2	11.8	9.3	72.5	52.3	8.0
5.	45.0	21.2	13.7	10.2	78.5	47.0	6.8
6.	41.2	21.2	11.2	8.8	65.4	51.4	8.2
7.	46.0	22.3	12.0	4.7	71.0	63.7	7.0

SEED TREATMENTS

- Treatment 1. Control.
 Treatment 2. Washed two hours in water.
 Treatment 3. Washed two hours in water, and soaked one hour in 2% NaCl.
 Treatment 4. Washed two hours in water, but not consecutively i.e., washed one hour, soaked in 8% NaCl one hour, washed one hour. The seed that floated in the 8% NaCl solution was selected.
 Treatment 5. As in treatment 4, except that the seed that sank was used.
 Treatment 6. Water was added in the row on the soil after the seed was planted.
 Treatment 7. Seed was pelleted with 10% treble super phosphate and 7½% Cupri-cide. This was contained in an inert binder.

MISCELLANEOUS

Date of Planting: July 8, 1947 Seed Used: US 215 x 216
 Date of Counting: August 2, 1947 1944-45 Production.
 Soil Type: Conover silt loam Sheared.
 Approximate rate of seeding: 7 pounds per acre.

TABLE 6.

TABLES OF STATISTICAL ANALYSIS

Field Planting I

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Total	53	9,902.49		
Block	2	213.04	106.52	7.47*
Treatment	5	3,280.42	656.08	46.04**
Bl. x Tr.	10	142.46	14.25	.49
Depth	2	4,110.67	2,055.33	12.09*
D. x Bl.	4	680.18	170.04	5.84**
D. x Tr.	10	893.47	89.35	3.07*
D. x Bl. x Tr.	20	582.25	29.11	

Difference required for significance of Treatment: 3.96.
 Difference required for significance of any one Tr.: 29.55.
 Difference required for significance of depth: 12.06.

Field Planting II

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Total	62	10,686.82		
Block	2	815.08	407.54	2.52
Treatment	6	1,251.54	208.59	1.55
Bl. x Tr.	12	1,618.66	134.89	1.40
Depth	2	2,398.76	1,199.38	6.59
D. x Bl.	4	727.69	181.92	1.89
D. x Tr.	12	1,566.24	130.52	1.36
D. x Bl. x Tr.	24	2,308.85	96.20	

No significance found.

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