# Effect of Different Soil and Seed Treatments on the Control of Seedling Diseases of Sugar Beets Under Controlled Conditions<sup>1</sup>

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This investigation to study the effect of different soil and seed treatments in relation to the control of seedling diseases of sugar beet consists of three parts :

1. Different seed treating compounds.

2. Different amounts of treble superphosphate applied to the surface of sugar beet seeds.

3. Different amounts of sodium nitrate and treble superphosphate applied to the surface of sugar beet seeds.

## I. Effect of Different Seed Treating Compounds on the Control of Seedling Diseases of Sugar Beets

Previous experiments conducted with treatments of sugar beet seeds with Ceresan, New Improved Ceresan, and copper sulphate showed that these chemicals had very little value in controlling root rots of sugar beets under Montana conditions.  $(1, 2, 3, 4, 5, 6)^3$  In recent years several new chemicals have appeared on the market which are being recommended for seed treatments.

Experiments were conducted with six different fungicides which included some new chemicals to determine their value for the control of root rots (table 1).

These chemicals were tested on both whole and segmented sugar beet seeds, since in the last few years the use of segmented seeds has been a rather general practice.

Soil from the third year of the alfalfa plot in Rotation 62 B at the Huntley Field Station, Huntley, Mont., was used in greenhouse flats holding about 24 pounds of soil. A high percentage of seedling diseases always occurred in this soil in previous studies. One row of whole and two rows of segmented seed, each containing 20 seeds, were planted in each flat.

The seeds were treated with the chemicals and planted immediately. Regular readings of healthy and diseased beet plants were

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	Soud	treatments used-						
	Beeu	treatments used-		Per one	flat of soil			
		Amt per 100 1	bs. of beet seed	1Calcium	Treble			
	Name of chemical	Whole	Segmented	nitrate	superphos.			
		Ounces	Ounces	Grs.	Grs.			
1.	Ceresan	16	24					
2	New Improved Ceresan	6	8					
3.	Spergon	15	22.5					
4.	Arasan	4	6					
5.	Thiosan	15	22.5					
6.	Red copper oxide	24	36					
7.	Check			1.62	1.8			
8.	Check			16.2	1-8			
				Manure (1/5	of soil volume)			
9.	Check							

Table 1.--Amounts of different seed and soil treatments used.

Soil treatments used

taken approximately for 1 month after emergence. The plants in all flats were then harvested and final readings pertaining to the amount of disease and size and weight of seedlings were taken.

**Results.-**-Table 2 presents the results of this study. Plants developing from seeds treated with all chemicals had a very high amount of seedling disease. In fact, with the exception of a few plants grown from the segmented seeds treated with Spergon and Thiosan. all seedlings were diseased. The height of the seedlings in all flats planted with treated seeds varied between 5 and 7 cm. and the weight between 0.13 and 0.81 gram per plant. There was no significant difference either in height or in weight between the seedlings grown from either whole or segmented seeds.

Beet plants developing from whole and segmented beet seeds in soil fertilized with nitrogen and phosphorus had 53.1 and 33.3 percent diseased seedlings respectively. These plants were considerably taller (14 cm.) and heavier (1.66 and 1.82 grams per plant respectively for whole and segmented seeds) than those grown from the treated seeds in unfertilized soil.

Beet plants developing from untreated sugar beet seeds in soil fertilized witli nitrogen, phosphorus, and manure had 45.9 and 34.6 percent of diseased seedlings grown from whole and segmented seeds respectively. These plants were considerably taller (14 cm.) and heavier (1.75 and 2.00 grams per plant respectively) than those grown from the treated seeds in unfertilized soil.

Plants grown from untreated seeds planted in unfertilized soil were almost all diseased (100.0 and 96.2 percent respectively for whole and segmented seeds). The height and weight of these plants were

	Seed.				Sugar be	At Harvest			
				Number		Percent		Height of	Weight
Finta No.	Treated with	Type used	Soll fortilized	Healthy	Diseased	Healthy	Diseased	beet tops Cm.	per plant Gr.
1-a	Ceresan	Whole	None	0	96	0.0	100.0	Б	71.0
b	Ceresan	Segua.	None	0	35	0.0	100.0	ត	0.13
2-a	N. I. Ceresan	Whole	None	0	97	0.0	100.0	6	6.22
b	N. I. Ceregan	Segui.	None	0	36	0.0	100.0	6	0.42
3-4	Spergan	Whole	None	D	86	0.0	100.0	7	0.52
ъ	Spergon	Segm.	None	5	23	17.9	\$2,1	7	0.80
4-a	Arasan	Whole	None	0	90	0.0	100.0	7	0.41
6	Arasan	Segm,	None	0	36	0.0	100.0	7	0.34
5-a	Thiesan	Whole	None	0	105	0.0	100.0	e	0,21
þ	Thiosan	Segm.	None	2	35	5,4	94.6	6	0.20
6-2	Red copp, ox.	Whole	None	D	87	0.0	100.0	6	0.26
b	Red copp. oz.	Segm,	None	0	39	0.0	200.0	e	0.19
7-я	Check	Whole	NP	45	51	48.9	<b>53.1</b>	14	1.66
ъ	Check	Segm.	NP	16	8	66.7	33.5	14	1.62
8-a	Check	Whole	NPM	40	34	54.1	45.9	14	1.75
ъ	Check	Segm.	NPM	17	9	65.4	34.6	14	2.00
9-1	Check	Whole	None	0	78	0.0	100.0	7	0.28
ь	Check	Segm,	None	1	25	3.8	96.2	7	0.32

Table 2,-Effect of different seed treatments on the control of seedling diseases of sugar beets.

about the same as the average for those grown from the treated seeds planted in unfertilized soil.

**Conclusion.**—These results show that different seed treating compounds used in this experiment produced very little control of root rots of young sugar beets. It is evident that any fertilization which produces vigorous, fast-growing seedlings is more important in, controlling root rots than different seed treatments. The results reported here confirm those obtained in our previous investigations. (1, 2, 3, 4, 5, 6)

## II. Effect of Different Amounts of Treble Superphosphate Applied to the Surface of Sugar Beet Seeds on the Control of

### Seedling Diseases

It is a well-known fact that when sugar beets are planted in wellfertilized soil the seedling's are usually vigorous and show a considerable degree of resistance to different root-rot-producing soil organisms.

In this study an experiment was conducted to evaluate the effect of treble superphosphate on control of seedling diseases when it is applied to the surface of sugar beet seed instead of to the soil. It was thought that fertilizers placed on the surface of sugar beet seeds might produce considerable beneficial effects on the developing young plants, since it would be so close to the growing plant.

Segmented sugar beet seeds treated with different amounts of treble superphosphate of 300 mesh (fume) were supplied by the Great Western Sugar Company, Longmont, Colo. There were seven lots of sugar beet seeds. Each of six lots had been treated with, the following amount of treble superphosphate to 100 pounds of sugar beet seeds: 100 pounds, 70 pounds, 40 pounds, 20 pounds, 10 pounds, and 5 pounds. The treble superphosphate was stuck to the surface of the sugar beet seeds with glue. The seventh lot of seeds was untreated.

The same type of greenhouse flats and soil from the same source were used in this experiment. Six flats were planted, each with one of the above-mentioned lots of seeds, and the seventh with the untreated check seeds. Each flat was planted with three rows of 20 segmented seeds to a row. Another duplicate set of seven flats was planted with seeds as indicated above and to each flat of this set 15.7 grams of sodium nitrate, 1.8 grams of treble superphosphate, and 1/5 of manure (on the basis of soil volume) was added. Regular readings of healthy and diseased plants were taken approximately for 1 month after emergence. At the end of this period the plants in all flats were harvested and final readings pertaining to the amount of disease and size and weight of seedlings were taken.

•	TSP+ (fume) added			At barvest				
No.	to 100 pounds seeds	Ferti)- izers addeđ	Numl Healthy D 13 40 40 42 42 42 42 52 52 0 0	Sugar be	Percent		Height of beet tops	Weight per plant
Flate.	Pounds	to soil	Healthy	Diseased	Healthy	Discaard	Cm.	Gr.
1-a	100	None	13	43	23,2	76.8	7	0.68
Þ	1044	NPM	40	7	85.1	14.9	15	4.45
2-a	70	None	15	46	24.6	75.4	7	0.71
b	70	NPM	42	I	97.7	2.3	17	6.55
3-a	40	None	10	53	15.9	84.1	6.5	0.68
b	40	NPM	42	4	91.8	8.7	8t	5.22
4-a	20	None	8	65	12.7	87.8	7	0.73
b	20	NPM	52	6	89.7	10.3	2.6	5,00
5-1	10	None	-0	61	0.0	100.0	6	0.27
ь	10	NPM	38	4	90.ū	9.5	15	5.89
6 a	5	None	0	665	0.0	100.0	5	0.29
Ð	5	NPM	. 50	4	92.6	7.4	18	5.21
7-2	None	None	0	70	0.0	100.0	5	0.22
Ь	None	NPM	57	6	90.5	9.5	17	4,50

Table 3.-Effect of different amounts of treble superphosphate (fume) applied to the surface of sugar beet seeds for the control of seedling diseases.

•Treble superphosphate

Results.—The results of this experiment are reported in table 3. The plants grown from all treated seeds in unfertilized soil had between 75.4 and 100 percent of seedlings diseased. The plants grown from seeds treated with larger amounts of treble superphosphate (100, 70, 40, and 20 pounds per 100 pounds of seeds) had slightly less seedling diseases than those grown from seeds treated with small amounts of treble superphosphate (10 and 5 pounds per 100 pounds of seeds). The height of the tops of individual plants grown from treated seeds planted in unfertilized soil varied between 5 and 7 cm. and the weight between 0.27 and 0.73 gram. Again, the plants grown from lots of seeds treated with larger amounts of treble superphosphate were taller and weighed more (0.58 to 0.73 gram per plant) than those grown from seed lots treated with small amounts of treble superphosphate phate (0.27 to 0.29 grams per plant).

The plants grown from untreated seeds planted in unfertilized soil had 100 percent disease and individual plants averaged 5 cm. in height and 0.22 gram in weight.

Plants grown from all treated seeds planted in fertilized soil had between 2.3 and 14.9 percent of seedling disease, and varied between 15 and 18 cm. in height and between 4.46 and 6.55 grams in weight. The plants grown from untreated seeds planted in fertilized soil had 9.5 percent of seedling disease and the plants averaged 17 cm. in height and 4.30 grams in weight. The experiment was repeated with similar results. **Conclusions.**—The results show that when treble superphosphate is used in large amounts (100. 70, 40, and 20 pounds per 100 pounds of seeds) it apparently produces a beneficial effect on the developing young beets in unfertilized soil. This was indicated by the slight reduction in seedling diseases and by an increase in the weight of individual beets. Small amounts of treble superphosphate (10 and 5 pounds per **100** pounds of seeds) failed to produce any beneficial effect on sugar beet plants in the same type of soil.

The importance of well-fertilized soil for growing of sugar beets is again shown in this test. Beets grown in fertilized soil either from seeds treated with treble superphosphate or from untreated seed showed a low amount of seedling disease and a much greater weight per plant than those grown from the same type of seed in unfertilized soil.

In general this test shows that if a soil is well supplied with organic matter and mineral nutrients in proper relationship with one another, no benefit is to be gained from treating sugar beet seeds with treble superphosphate. Plants grown from untreated seeds in fertilized soil (7b) produced just as good results as those grown from treated ones in the same soil (1b to 6b).

## III. Effect of Different Amounts of Treble Superphosphate and Sodium Nitrate Applied to the Surface of Sugar Beet Seeds on the Control of Seedling Diseases

When treble superphosphate was applied to the surface of sugar beet seeds only a. slight beneficial effect of this nutrient was observed on the reduction of seedling diseases and on the increase in growth of sugar beets (Part II).

It was thought that if both nitrogen and phosphorus were applied to the surface of sugar beet seeds, possibly a, greater beneficial effect in reducing seedling diseases and also more prolific growth of young sugar beets could be obtained. Therefore, to find an answer to this question the following study was conducted.

Whole and segmented sugar beet seeds were used. In order to make the fertilizers adhere to the surface of the sugar beet seeds, liquid glue (LePage's, Gloucester, Mass.) was used. One part of this glue was mixed with four parts of water. In spraying the sugar beet seeds with a solution of this glue, approximately 8 to 10 cc. were used per each 25 grams of sugar beet seeds.

Sodium nitrate and treble superphosphate were used as the fertilizers. The sodium nitrate was ground and sifted through a 100 mesh screen. In a preliminary test with only one application of glue, 25 grams of either whole or segmented seeds retained only 14 grams of treble superphosphate and much more sodium nitrate which readily dissolves in a solution of glue. Therefore 14 grams of treble superphosphate and the same amount of sodium nitrate, alone or in a combination, were used as a maximum amount for 25 grams of seeds in this experiment. It is quite possible that these chemicals in the maximum of their adherence may have a toxic effect on the seeds, so for this reason they were used in the three gradually decreasing amounts.

Table 4.—Amounts of treble superphosphate and sodium nitrate used for treating sugar beet, seeds.

Whole or segmented seeds	
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25 gran	Amount of chemicals as of seeds	used on the basis of 100 pounds of seeds				
Sodium nitrate	Treb. superphos.	Sodium nitrate	Treb. superphon			
Grams	Grams	Pounds	Pounds			
14	14	56	56			
7	7	28	28			
3.5	3.5	14	14			

Soil treatments with nitrogen, phosphorus, and manure were also used as checks. The same type of greenhouse flats and the same type of soil were used in this experiment as were reported for the first and second parts of this study.

Ten flats of soil were planted with whole and segmented sugar beet seeds. Flats 1, 2, and 3 were planted with whole seeds which were treated with gradually decreasing amounts of chemicals. The seeds planted in the first row were treated with sodium nitrate and treble superphosphate. Those planted in the second row were treated only with sodium nitrate, and those planted in the third row only with treble superphosphate. The same plan was used for planting flats 4, 5, and 6 except that these flats were planted with segmented seeds (table 5).

Flats 7 and 8 (table 5) were planted with untreated seeds without glue. The first row in each flat was planted with whole seeds and the remaining two rows with segmented seeds. The soil of fiat 7 was fertilized with 15.7 grams of sodium nitrate and 1.8 grams of treble superphosphate. The soil of flat 8 was fertilized with the same amounts of chemicals as soil of flat 7 and in addition manure was added on the basis of 1/5 of the soil volume. Flats 9 and 10 were checks. Flat 9 was planted with untreated seeds without glue and flat 10 with the same kinds of seeds coated with glue. The first

Flats No.	Fertilizers used on basis of 100 pounds of seeds					Sugar be	At barvest				
	Rows No.					Number	ımber	iber Percent			Weight
		NaNOs ponnda			T ype of seeds used	Healthy	Disessed	Healthy	Disessed	- beet tops Cm.	per plaut Gr.
1	1.	50	58	None	Whole	9	82	0.0	100.0	6	0.79
	2	56		None	Whole	1	48	2.8	97.7	5	0.45
	8		56	None	Whole	0	42	0.0	100.0	Б	0.39
2	1	28	28	None	Whole	û	38	0.0	100.0	4	0.31
	2	28		None	Whole	9	25	0.0	100.0	6	0.45
	8		28	None	Whole	9	33	0,0	100.0	6	0.52
3	1	14	14	None	Whole	ø	36	0.0	100.0	6	0.22
-	2	14		None	Whole	0	36	0.0	100.0	4	0.28
	5		14	None	Whole	0	24	0.0 ·	100.0	4	0,38
4	1	58	58	None	Segm.	1	16	5.9	94.1	7	1.25
	2	58		None	Segm.	1	15	6.2	93,8	4	0.81
	8		58	None	Segm,	1	20	4.8	95.2	6	1.05
Б	1	28	28	None	Segm,	0	17	0.0	100.0	5	0.38
	2	28		None	Segm.	0	13	0,0	100.0	4	0.25
	8		28	None	Segm.	0	22	0.D	100.0	5	0.55
6	1	14	14	None	Segm.	0	22	0.0	100.0	5	0.38
-	2	14		None	Segm.	Ð	24	0.0	100.0	5	0.33
	5		14	None	Segm.	0	20	0.0	100.0	5	0.30
7	1	None	None	NP	Whole	18	13	58.1	41,9	15	8.03
	2	None	None	NP	Segm.	24	÷	Sö.7	14.3	15	4.04
	8	None	None	NP	Segm.	11	B	55.0	45.0	14	4.16
8	i	None	None	N PM	Whole	21	13	61.5	38.2	18	4,61
	2	None	None	NPM	Segm.	21	2	91,3	8.7	18	6.41
	3	None	None	NPM	Segm.	21	2	91,3	8.7	16	4.52
9	j	None	None	None	Whole	0	25	0.0	100.0	4	0.22
_	2	None	None	None	Segm.	0	19	0,0	100.0	6	0.61
	8	None	None	None	Segm.	ō	25	0.0	100.0	5	0.42
10	1	None	None	None	Whole	0	23	0.0	100.0	á.	0.14
	2	Noue	None	None	Segm.	ú	21	0.0	100.0	i.	0.24
	3	None	None	None	Segm.	Ū.	20	0.0	100.0	Â.	0.14

Table 5.-Effect of different amounts of treble superphosphate (fume) and sodium nitrate applied to the siftface of sugar beet seeds for the control of seedling diseases.

•Seeds coated with glue.

row in both of these flats was planted with whole seeds and the remaining two rows with segmented seeds.

The plants were grown after emergence approximately 1 month. Regular readings of healthy and diseased seedlings were made. At harvest time final readings of healthy and diseased seedlings were made, and the plants were weighed and an average weight per plant was calculated.

Results.—The results of this experiment are given in table 5. Plants grown from all treated seeds in the first six flats had a very high amount of: seedling disease. Practically all seedlings were diseased. The height of the tops of these plants varied between 4 and 6 cm. and the weight between 0.25 and 1.25 grams.

Plants grown from untreated beet seeds planted in soil fertilized with nitrogen and phosphorus (flat 7) had a moderate amount of seedling disease. On an average, the plants grown from segmented seeds had less seedling disease than those grown from whole seeds. The height of the tops of these plants varied between 14 and 15 cm. and the weight between 3.03 and 4.16 grains per plant.

Plants grown from untreated whole beet seeds planted in the soil with complete fertilization (flat 8) had a moderate amount of seedling disease and plants grown from segmented seeds in the same soil had only a small amount of disease. The height of the tops of these plants varied between 16 and 18 cm. and the weight between 4.52 and 6.41 grams per plant.

The plants grown in both check flats (9and 10) were all diseased. The height of the tops of these plants was between 4 and 6 cm. and the weight between 0.14 and 0.61 gram per plant.

This experiment presents some evidence that plants which are grown from whole seeds may have more seedling disease than those grown from segmented seeds. The experiment was repeated with similar results.

Conclusion.—These results show conclusively that sodium nitrate and treble superphosphate applied to the surface of sugar beet seeds fail to produce a beneficial effect either on the reduction of seedling diseases or on the promotion of more rapid development of beet seedlings. Plants grown from untreated beet seeds in soil fertilized with complete fertilizers had only a small amount of seedling disease. The tops of these plants were about three times taller and the weights several times greater than those of the plants grown from treated seeds in unfertilized soil. Adequate and properly balanced fertilization of a soil is much more important in control of seedling diseases of beets than coating of seeds with different mineral fertilizers.

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