CONTROL OF DAMPING-OFF OF SUGAR BEETS BY TREATING SEGMENTED SEED WITH CERTAIN FUNGICIDES AND NUTRIENT SALTS [1]

John O. Gaskill and W. A. Kreutzer [2]

Two field experiments were conducted in northern Colorado in 1943 for the purpose of studying methods of controlling damping-off of sugar beets by means of seed treatment. The objectives were as follows: 1. To compare two metallic fungicides (yellow cuprocide [3] and new improved ceresan [4]) and two nonmetallic fungicides (arasan [5] and spergon [6]); 2. to compare three dosage rates for new improved ceresan; 3. to study the effect of treating seed with varying amounts of nitrate and phosphate; and 4. to compare ceresan treatment with treatments consisting of ceresan plus nitrate and phosphate.

Methods

Segmented seed of a commercial sugar-beet variety was used for both experiments. Essential details regarding the 20 treatments employed are given as footnotes in table 1.

One experiment was located in a high-fertility field near Ault, Colorado, where potatoes had been grown in the preceding year. No manure or commercial fertilizer was applied for the 1943 crop. Soil moisture was excellent at time of planting (June 4), and remained satisfactory until the test was concluded. The other experiment was located on the federal Sugar-Beet Field Station at Fort Collins. Alfalfa was grown in this field in 1941 and 1942 and produced satisfactory yields. The land was plowed in April 1943, and was not fertilized. A heavy rain fell within 4 or 5 hours after the seed-treatment test was planted (May 29),

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1/ Contribution from the Division of Sugar Plant Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture, and the Botany and Plant Pathology Section, Colorado Agricultural Experiment Station.

2/ Associate Pathologist, U. S. Department of Agriculture, and Associate Pathologist, Colorado Agricultural Experiment Station, respectively.

3/ 93 percent yellow cuprous oxide.

4/ 5 percent ethyl mercury phosphate.

5/ 50 percent tetramethylthiuramdisulfide.

6/ 98 percent tetrachloroparabenzoquinone.

and soil moisture was ample until stand data were recorded. Crust breaking was performed mechanically before emergence without apparent injury to the seedlings.

Each experiment was laid out with 18-foot, single-row plots, randomized-block design, and 6 replications. Planting was done by means of a hand drill, depositing 2 grams of seed, exclusive of treating compounds, in each plot -- a rate, for 20-inch rows, of approximately 6½ pounds per acre.

Diseased seedlings were taken periodically in each field, from rows comparable to the check plots, starting about the time when emergence began and continuing until the seedling death rate became nominal. Platings, on nutrient agar, were made from these specimens in order to determine the agent or agents responsible for damping-off in each test.

All living seedlings in each plot were counted approximately 4 weeks after date of seeding. Damping-off appeared to have run its course before these counts were made.

Results

Damping-off occurred chiefly before emergence. Platings made from such plants, as well as platings made from diseased plants after emergence, indicated that a species of Pythium was the principal organism causing damping-off in both experiments.

Field results based on seedling counts are given in table 1. These data may be summarized as follows:

1.- In every case, in each field, the seedling stand obtained from seed treated with any fungicidal dust exceeded the check by a highly significant figure (greater than the 1-percent point).

2.- In the Ault field, yellow cuprocide and the 5-ounce and 8-ounce applications of new improved ceresan were significantly better than the non-metallic treatments, arasan and spergon. However, at Fort Collins, arasan was significantly better than yellow cuprocide and the 8-ounce rate of new improved ceresan.

3.- Regarding dosage rate for new improved ceresan, the results indicate clearly that 3 ounces per 100 pounds of seed was below the optimum, in both fields. Comparison of the 5-ounce and 8-ounce rates shows that the latter exceeded the former at Ault, while the 5-ounce rate was higher at Fort Collins. In each instance the difference was far in excess of the 1-percent level of significance. From these results it seems probable that a generalized optimum cannot be determined. However, considering the data obtained for all three ceresan rates, it appears rather definite that a dosage of 5 ounces per 100 pounds of seed would be preferable to any lighter application under conditions such as those existing in the Fort Collins and Ault fields during the course of this experiment.

4.- The use of phosphate (solution or dust) alone, failed in every case to produce a stand as high as the check. Combined results for both fields show: (a) Each treatment of phosphate alone, except for the lightest application (treatment 4 -- i.e. 2.00 pounds of fume phosphate per 100 pounds of seed), gave an average stand significantly below that of the check; and (b) this reduction in stand was highly significant in the case of the two heaviest treatments -- No. 3 (35 percent sodium-phosphate solution) and No. 6 (14.90 pounds of fume phosphate per 100 pounds of seed). Reduced vigor also was observed for plants of these two treatments.

5.- Seed treated with sodium nitrate, alone, produced stands which were below the check in the Fort Collins field (alfalfa land). One of these differences was highly significant and the other approximated the 5-percent level of significance. On the other hand, in the Ault field (potato land) the same nitrate treatments showed a slight gain over the check (for seed soaked in 17.5 percent sodium-nitrate solution) and a highly significant gain (for seed soaked in 35.0 percent nitrate solution), respectively.

6.- Stand obtained from seed treated with any combination of phosphate and nitrate (with no fungicide) in every case was below that of the check. Combined results for both fields show that the differences, between the check and two of these treatments (8 and 13), approached the 5-percent level of significance, and that the differences, between the check and the other two treatments of this type (10 and 14), were highly significant.

7.- At Ault, seed treated with a combination of nitrate solution and phosphate, in addition to a 5-ounce dosage of new improved ceresan (treatments 9 and 11), gave stands which exceeded that obtained for seed treated with the 5-ounce dosage of ceresan alone (treatment 18) by highly significant differences.

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(Note: The writers have found, since the experiments reported in this paper were completed, that fume phosphate will adhere to segmented sugar-beet seed satisfactorily, in quantities as high as 40 pounds per 100 pounds of seed, when water alone instead of glue solution is used as a wetting agent.)

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Table 1.- Summary of treatments used and seedling counts obtained in two sugar-beet seed-treatment experiments, Ault and Fort Collins, Colorado, 1943.

(Results for each experiment are given as 6-plot averages)

Treatment No.	Fungicide: Kind	Fungicide: Rate per 100#	a/ Fume phosphate per 100# seed	b/ Sodium phosphate solution	c/ Sodium nitrate solution	Seedling Counts: Ault (Potato land)	Seedling Counts: Fort Collins (Alfalfa land)	Seedling Counts: Aver.
		oz.	lb.	%	%	No.	No.	No.
1	Check--no treatment	-	-	-	-	33.3	56.2	44.8
15	Arasan	12	-	-	-	50.7	99.8	75.3
20	Yellow cuprocide	12	-	-	-	98.8	84.5	91.7
16	Spergon	32	-	-	-	53.5	85.7	69.6
17	New imp. ceresan	3	-	-	-	50.7	87.0	68.8
18	" " "	5	-	-	-	68.3	105.3	86.8
19	" " "	8	-	-	-	103.3	84.0	93.7
7	-	-	-	-	17.5	34.3	38.3	36.3
2	-	-	-	17.5	-	25.7	42.7	34.2
8	-	-	-	17.5	17.5	28.5	45.5	37.0
9	New imp. ceresan d/	5	-	17.5	17.5	97.7	97.2	97.4
10	-	-	7.46	-	17.5	23.0	35.5	29.3
11	New imp. ceresan e/	5	7.46	-	17.5	98.5	89.5	94.0
12	-	-	-	-	35.0	51.3	44.0	47.7
3	-	-	-	35.0	-	24.5	41.3	32.9
13	-	-	-	35.0	35.0	25.5	47.0	36.3
14	-	-	14.90	-	35.0	22.0	31.8	26.9
4	-	-	2.00	-	-	31.5	53.5	42.5
5	-	-	7.46	-	-	27.2	44.2	35.7
6	-	-	14.90	-	-	16.8	34.3	25.6

	Ault	Fort Collins	Aver.
Variance analyses for individual fields:			
General mean	48.26	62.37	55.31
Calculated F-value	41.20	32.51	
1-percent point of F	<2.39	<2.39	
Differences required for significance:			
5-percent point	12.9	12.6	9.0
1-percent point	17.1	16.7	11.8
Variance analysis, combining both fields into a single experiment:			
Calculated F-value for treatments			66.13
Calculated F-value for interaction of fields and treatments			7.75
1-percent point for F			<2.31

a/ Fume phosphate (powdered treble superphosphate, containing not less than 43 percent available P_2O_5), when used at rates above 2 pounds per 100 pounds of seed, was held by means of a 2-percent glue solution applied to the seed as a spray. When used in conjunction with nutrient solutions, fume phosphate was added after the seed had been soaked and dried. The use of glue as a sticker for fume phosphate was suggested by Dr. H. E. Brewbaker of the Great Western Sugar Company.

b/ Seed soaked 2 minutes in a solution containing $NaH_2PO_4 \cdot H_2O$; drained; dried.

c/ Seed soaked 2 minutes in a solution containing $NaNO_3$; drained; dried.

d/ Ceresan was applied after the seed had been soaked and dried.

e/ Ceresan was mixed with fume phosphate and applied after the seed had been soaked and dried.

Note: this article (being) completely checked by CEW & JPJ (3-18-44) — no errors of any consequence were found. JOJ.