Results of Seed Treatment Tests

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Chemical materials for seed treatment are being placed on the market in increasing numbers each year. Since seed treatment is a standard practice in most of the territories where sugar beets are grown, a need for information about these new materials has been created. This paper presents the results of three-years' testing of various fungicides in several locations of the American Crystal Sugar Company's operation. Results also are present on the effects of two fungicides applied at different rates on stored beet seeds and the effectiveness of these fungicides under field conditions after several months in storage.

Tests were designed in 1954 to include seven seed treatments and an untreated check in an 8 x 8 Latin square. The Company's standard procedure of Phygon treatment was used as a check and was also included as one of the seven treatments. The plot size was single rows ten feet long and the seed used was processed 7/64 to 9/64 inch segments with a laboratory germination of 90 percent. One seed per inch, or a total of 120 seeds per plot, was planted with a belt planter.

1954 Results

The 1954 tests were repeated at the following locations: Rocky Ford, Colorado; Mason City, Iowa; and the Red River Valley of Minnesota. Each of these locations had two tests, with a third test conducted at Mason City under root-rot conditions. The composite results of these tests are shown in Table 1 for individual and mean rankings of the eight treatments at the seven different locations.

The mean ranking in the above table shows Orthocide 75 ranked first in all seven tests as to the number of plants which survived. In nearly all tests it was significantly above the untreated check. Manzate rated second, Phygon third and Ceresan (NI) as fourth. However, in only one case was Manzate statistically better than Phygon and in two of the seven tests it was significantly better than New Improved Ceresan. In the majority of the tests, Orthocide 75 was not statistically better than the other top three treatments, however, it did obtain top ranking in all tests and this should not be overlooked.

With the promising performance of Orthocide 75 in the 1954 tests, it seemed advisable to obtain additional data in replicated tests with other chemical fungicides. The tests conducted in 1955 were very similar to those carried out the previous year, except that two different rates of Orthocide 75 (8 and 12 ounces) were included and the tests were conducted over a wider range of areas.

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Table 1.—Individual and Mean Ranking of the Eight Treatments at Seven Different Locations in 1954.

Treatment	Rate per 100 lbs. seed	LOCATIONS[1] 1	2	3	4	5	6	7	Mean
Orthocide 75	12 oz.	1	1	1	1	1	1	1	1.0
Manzate	8 oz.	2	4	2	3	3	2	2	2.6
Phygon	4 oz.	3	3	3	5	2	5	3	3.4
Ceresan (NI)	6 oz.	5	5	4	2	4	4	4	4.0
Arasan	2 oz.[2]	4	2	8	7	6	3	5	5.0
Ceresan (M)	6 oz.	6	6	7	4	5	8	6	6.0
Chemical 275 (PCNB)	8 oz.	7	7	5	6	7	7	8	6.7
Check	—	8	8	6	8	8	6	7	7.3

[2] Arasan was applied at 2 ounces per 100 pounds. although the recommended rate was 6 to 8 ounces.

[1] Location 1. Rocky Ford, Colorado
2. Rocky Ford, Colorado
3. Mason City, Iowa
4. Stewart, Minnesota
5. Mason City, Iowa (Root Rot Nursery)
6. East Grand Forks, Minnesota
7. Moorhead, Minnesota

1955 Results

In 1955, tests were designed to include six seed treatments and an untreated check in a 7 x 7 Latin square. The size of plot and method of planting were the same as used in 1954, with the exception of California where the plots were hand planted with seed spaced three inches apart and 100 seeds per plot were used.

The tests were conducted in five different areas; one each in California and Iowa, two each in Montana and Colorado, and three in Minnesota. The individual and mean rankings of the seven treatments at the nine locations are given in Table 2.

Table 2.—Individual and Mean Rankings of the Seven Treatments at the Nine Locations in 1955.

Treatment	Rate per 100 lbs. seed	LOCATIONS[1] 1	2	3	4	5	6	7	8	9	Mean
Orthocide 75	12 oz.	1	4	6	1	1	1	3	2	3	2.4
Orthocide 75	8 oz.	3	1	1	6	6	5	4	1	2	3.2
Phygon	4 oz.	2	5	3	4	2	2	2	3	6	3.2
Manzate	8 oz.	6	2	2	2	4	3	5	4	1	3.2
Ceresan (NI)	6 oz.	4	6	4	5	3	4	1	6	4	4.0
Arasan	8 oz.	5	3	5	3	5	6	6	5	5	4.8
Check	—	7	7	7	7	7	7	7	7	7	7

[1] Location 1. Clarksburg, California
2. Missoula, Montana
3. Missoula. Montana
4. Rocky Ford, Colorado
5. Rocky Ford, Colorado
6. Mason City, Iowa
7. Mankato, Minnesota
8. Moorhead Minnesota
9. East Grand Forks, Minnesota

Orthocide did not give the outstanding performance in 1955 that it did in 1954. However, Orthocide 75 at the 12-ounce rate did rank first. If the total number of seedlings counted in all locations is considered, Orthocide, at the 12-ounce rate, would rate first and the 8-ounce application would rate second.

The mean rankings show three different treatments to be equal for second, but in actually ranking by total number of seedlings, they are as shown in the table in the following order: Orthocide 75 at 8-ounces, Phygon, and Manzate.

Perhaps as a general trend, Orthocide at the 12-ounce rate gave better stands in the southern beet growing areas, while in northern locations, the 8-ounce rate gave better stands since the 12-ounce rate caused some damaging effects. This interaction of treatment and location was a consistant factor in the nine-location tests. The four tests conducted in the northern area, (Montana and the Red River Valley) produced better stand counts from the 8-ounce treatments, while the other five tests, in more southernly locations, showed better results from the 12-ounce treatment.

In the tests where seedling diseases were not present, there were no beneficial reactions from the use of Orthocide, but in the tests where significant differences were detected, it was found that one or the other Orthocide treatment ranked top.

Three of the individual tests are shown in Table 3 to bring out these points. In the California test the 12-ounce rate of Orthocide was higher than any other treatment; in the Montana tests the 8-ounce treatment ranked top. Both are tests showing significant differences. From a test conducted at Mankato, Minnesota, in the absence of damping-off organisms, it should be noted that non-significant effects resulted from treatment. Both rates of Orthocide gave mean results as shown in Table 3.

Table 3.—The Mean Germination of Three Tests in Three Different Locations Showing a Treatment-Location Interaction.

Treatment	Rate per 100 lbs. of seed	California Percent Field Germination	Montana Average Seedling Count	Mankato Average Seedling Count
Orthocide 75	12 oz.	66.6	79.6	103.4
Phygon	4 oz.	58.3	85.9	104.4
Orthocide 75	8 oz.	57.3	98.8	102.4
Ceresan (NI)	6 oz.	52.9	84.6	110.7
Arasan	8 oz.	46.4	81.6	93.6
Manzate	8 oz.	46.0	93.9	96.9
Check	—	42.1	73.6	92.3
General Mean		52.8	85.4	100.5
LSD (19:1)		6.0	6.7	NS
LSD (99:1)		8.0	9.0	NS
C. V.		10.6%	7.0%	13.7%

Conditions were nearly ideal for conducting the California test. There was a very good seed bed and good moisture at the time of planting. Seed balls were hand planted and spaced three inches apart. Counts were made of the percentage of seed balls having emergence, not on total seedlings.

All treatments, with the exception of Orthocide at the 12-ounce rate, were significantly better than the check in the Missoula test. The four top-ranking treatments produced results highly significant over the check. Visually there was no difference between various treatments for seedling vigor or indication of damage to seedlings. Apparently the 12-ounce rate of Orthocide caused a reduction in stand even though damage was not noticeable.

In the Mankato test there were no significant differences between any of the treatments at the five-percent level. No visable evidence of damping-off was noticed in this area.

From the data accumulated in the past two years from replicated plot tests, it would appear obvious that Orthocide 75 may have great possibilities as a seed protectant. There are, however, certain other characteristics which a good fungicide must have before it can be used on beet seed. For example, a fungicide must not lower the germination of the seeds even though it is stored in a warehouse for a year or more.

Storage Results

Therefore, an experiment was set up to determine whether or not Orthocide 75 had any effect on stored beet seeds. The experiment also was designed to test different rates of application, since a high dosage of a fungicide might decrease the germination to a greater degree than a low dosage. The writers also were interested in whether or not Phygon will decrease the germination when it is applied at heavy dosages, therefore it was included at the different rates as a check. An untreated check was included so that the comparison between treated and untreated samples could be calculated.

The five different dosages, 4, 6, 8, 10, and 12 ounces per 100 pounds of seed were chosen, since an additive increment (in this case 2 ounces) will allow for the testing of any possible trends such as linear, quadratic, etc.

The experiment was set up in a 5 x 5 + 1 factorial completely randomized design. Five samples of 100 seeds for each treatment were counted and germinated each month. The experiment was planned to stop after 20-months' data had been obtained. The analyses of these findings are reported in Table 4.

In general the check (no treatment) has kept a germination higher than either treatment, but not statisically different. The same was true of Orthocide over Phygon. Although significant differences were detected for the months of July and August in 1956 and January of 1957, these were hard to explain. It may be an interaction with temperatures, or to random chance variations.

Table 4.—Germination Data for Various Rates of Orthocide and Phygon for 20 Months.

Tretament	Application Rates	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	April
Orthocide 75	4 oz.	89.6	78.4	84.4	89.5	84.4	82.2	87.5	88.2	89.2	85.6	82.0	77.4	81.6	88.6	88.6	88.4	84.2	83.2	88.2
Orthocide 75	6 oz.	84.0	79.8	85.2	86.6	85.0	81.6	85.7	87.8	89.0	90.2	83.4	79.2	84.8	84.8	83.2	87.6	87.8	86.0	84.8
Orthocide 75	8 oz.	86.6	85.4	90.0	89.5	85.6	84.6	89.6	88.2	85.4	86.4	83.4	79.8	85.8	86.4	87.6	84.2	88.6	85.4	85.6
Orthocide 75	10 oz.	85.4	81.8	88.6	90.0	84.0	84.6	90.0	88.4	84.6	89.0	86.8	81.8	85.2	85.6	87.0	89.0	87.8	86.0	88.0
Orthocide 75	12 oz.	85.4	81.4	83.4	90.8	87.6	80.2	86.2	89.4	87.6	87.6	86.6	83.4	81.6	87.2	86.4	83.4	81.4	84.2	88.4
Check	—	88.0	85.0	87.6	90.6	89.0	84.6	89.8	88.4	89.6	87.2	88.0	82.6	86.0	87.2	86.3	85.6	88.8	85.8	85.2
Phygon	4 oz.	86.4	84.4	86.8	87.2	84.6	83.6	87.6	84.6	84.6	87.4	85.8	80.0	81.4	82.0	86.6	85.6	85.4	81.6	87.8
Phygon	6 oz.	86.6	82.0	84.0	88.4	87.2	83.2	86.4	87.0	87.2	86.0	82.2	79.4	80.6	86.2	85.8	82.8	82.0	85.0	84.0
Phygon	8 oz.	85.4	84.8	88.2	83.6	85.0	78.0	87.6	83.4	87.8	87.8	76.6	70.4	83.4	84.6	83.6	85.4	81.4	87.2	87.0
Phygon	10 oz.	85.6	79.8	85.4	89.8	86.4	82.6	84.0	87.6	86.4	86.6	81.0	77.2	85.2	83.4	83.0	85.8	84.2	86.0	84.2
Phygon	12 oz.	86.2	85.2	86.4	86.4	88.0	82.0	85.6	86.2	87.0	82.8	84.4	80.4	80.4	85.2	83.6	85.8	85.2	83.8	87.2
General Mean		86.3	82.5	86.4	88.4	86.1	82.5	87.3	87.2	87.1	87.0	83.9	79.2	83.3	85.6	85.7	85.8	85.2	84.9	86.4
F. Values		0.5	1.85	1.60	1.30	0.86	0.76	1.0	0.92	0.86	1.42	2.62*	3.12**	1.18	1.2	1.39	1.41	3.63**	1.13	1.56

(F = 2.06 at the 5% point of significance)
(F = 2.75 at the 1% point of significance)

Means for 19 Readings	
85.33	85.70 (Orthocide)
85.08	
86.22	
86.51	
85.38	
87.15	87.15 (Check)
84.92	84.49 (Phygon)
84.53	
83.75	
84.43	
84.84	

The mean of the two treatments and check for all months and rates are shown in Table 4. There were no statistical differences between any of these treatments and all gave satisfactory germinations at the end of 20 months.

From the data in Table 4, it was obvious that fungicidal treatments used in these tests were not detected as being detrimental to germination of beet seed even after 20 months in storage. The question then was to determine whether or not these fungicides would still be effective after 20 months in storage, in controlling damping-off organisms.

1956 Results

To determine their effectiveness after 20 months in storage, samples of each of the seed lots which were in the storage test were planted in the field in replicated tests. The plots which were single rows ten feet long and one seed per inch, or a total of 120 seeds, were planted by a belt planter. The eleven different treatments were replicated five times in a 11 x 5 randomized block design and these tests were repeated at three locations; Rocky Ford, Colorado; Mason City, Iowa; and East Grand Forks, Minnesota. The results of these tests are shown in Table 5 as individual and mean rankings of the eleven treatments at the three locations.

Table 5.—Individual and Mean Ranking of Eleven Treatments at Three Different Locations.

Treatment	Rate per 100 lbs. seed	LOCATIONS[1] 1	2	3	Mean	Ranking
Orthocide 75	4 oz.	2	9	4	5.0	(5)
Orthocide 75	6 oz.	3	2	8	4.3	(4)
Orthocide 75	8 oz.	1	5	5	3.7	(2)
Orthocide 75	10 oz.	4	3	2	3.0	(1)
Orthocide 75	12 oz.	9	1	1	3.7	(2)
Check	—	10	11	11	10.7	(11)
Phygon	4 oz.	8	10	3	7.0	(7)
Phygon	6 oz.	7	7	9	7.7	(9)
Phygon	8 oz.	5	4	7	5.3	(6)
Phygon	10 oz.	6	6	10	7.3	(8)
Phygon	12 oz.	11	8	6	8.3	(10)

[1] Location 1. Rocky Ford, Colorado
2. Mason City, Iowa
3. East Grand Forks, Minnesota

No significant differences were detected among the various treatments at Mason City, Iowa, or East Grand Forks, Minnesota. However, at Rocky Ford significant differences were detected as shown in Table 6.

In Table 6 significant differences between treated seed and non-treated seed existed. This is to be expected if damping-off organisms were present. There also was a significant difference between the two fungicides in favor of Orthocide 75 even after 20 months of storage.

Even though significance was reached only in one of the three tests, we can conclude that Orthocide 75 has no adverse effects on beet seed even after 20 months of storage. This was the primary question which the test was designed to answer.

Table 6.—Analysis of Variance for Seed Treatment Test at Rocky Ford, Colorado, 1956.

Source of Variation	D/F	Sums Squares	Mean Squares	F Value
Blocks	4	1343.0	335.8	
Treatments	10	3041.0	304.1	2.44*
Check vs. Treated	1	635.2	635.2	5.10*
Between Fungicides	1	976.8	976.8	7.83**
Between Rates	4	1365.1	341.3	2.73*
Fungicides x Rates	4	63.9	16.0	0.13
Error	40	4991.0	124.8	
Total	54	9375.0		

The trend of the results as shown in Table 5 also showed Orthocide 75 to be more effective after this storage period than Phygon, and Phygon was better than no treatment.

The data also show that seed treated with Orthocide 75 at rates from 8 to 12 ounces to be equally effective.

Summary

Two years of replicated field results were reported using various chemicals for seed treatments. Orthocide treatment was outstanding in both years. In 1954 it was superior to all other treatments, however, in 1955 it appeared to have an interaction with location.

Orthocide and Phygon at various rates did not decrease the germination of the seed after 20 months of storage.

Orthocide treated seed still remained superior in field tests even after being stored for 20 months.