

# Phygon Seed Protectant for Sugar Beets

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About ten years ago, research by Naugatuck Chemical, a division of United States Rubber Company, led to the discovery that 2,3-dichloro-1,4-naphthoquinone, later assigned the trade name Phygon, was a potent fungicide. Since that time "Phygon" has been tested extensively by state and federal experiment stations and commercial organizations and proven to be a highly active fungicide having a wide range of effectiveness, both as a seed treatment and foliage spray. For a detailed discussion of the development of Phygon and related compounds as fungicides, the reader is referred to a recent paper by Schoene, et al, which appeared in *Agricultural Chemicals* (5)<sup>2</sup>.

## Phygon Improves Germination

"Phygon" has proven to be effective as a seed treatment on a variety of crops, including beets, sugar beets, corn, peas, spinach, Swiss chard, rice, alfalfa and others. It has proven to be particularly good on sugar beets as is shown by the following data:

Table 1.

Treatment	Dosage ozs./100-lb. seed	No. plants emerging from 100 seed units	
		Greenhouse Cold Test	Field
Phygon	8	147.0	137.0
Phygon	4	70.0	132.5
Phygon	2	13.8	106.5
Check		14.0	59.5

In the foregoing greenhouse tests heavily inoculated soil was used and immediately after planting the seeds were placed in a cold chamber at 45° F. for seven days, thus producing a condition more severe than would be encountered in the field. It will be noted that in the greenhouse 8 ounces per 100 pounds of seed gave significantly higher germination than 4 ounces, whereas in the field 4 ounces per 100 pounds was adequate.

## Phygon Prevents Post-Emergence Damping-off

Further tests showed that Phygon gave not only outstanding performance in improving germination, but also in preventing post-emergence damping-off which is of equally, if not greater, importance. This is illustrated by the following data on sugar beets:

<sup>1</sup> Naugatuck Chemical Division, United States Rubber Company, Naugatuck, Connecticut.

<sup>2</sup> Numbers in parentheses refer to literature cited.

Table 2.

Treatment	Dosage ozs./100 lb. seed	Greenhouse	
		No. plants emerging from 100 seed units	No. Survivors
Phygon	8	167.0	130.3
Phygon	4	160.3	109.0
Phygon	2	163.8	104.8
Phygon	1	135.0	63.5
Check	....	88.0	33.5

### Phygon Is Safe on Seed

From a practical standpoint, one of the chief requisites of an ideal seed treatment is that it be non-injurious to seed even when used in excess dosage and when the treated seed is to be in storage for a prolonged period.

There is convincing evidence that Phygon meets this requirement. In the 1948 report (3), "Cooperative Seed Treatment Tests on Sugar Beets," Dr. A. R. Downie, Chairman, Advisory Committee on Beet Seed Treatment, says: "The results obtained with Phygon are rather encouraging since we have been unable to demonstrate any injurious effects on germination even after the seed has been stored for three years." A storage test on sugar beet seed was started at Bethany, Connecticut, in 1945 and is continuing at the present time. The seed was treated at three dosage levels and stored in a constant temperature room at 50° F. Samples have been removed and germination determined along with an untreated sample stored under similar conditions at six month intervals. There is no evidence of injury as indicated by the following data, which cover a period of 18 months:

Table 3.

Treatment	Dosage ozs./100 lb. seed	Emergence from 100 seed units		
		Immediately after Treatment	6 Mos. after Treatment	18 Mos. after Treatment
Phygon	3.2	127.2	144.0	88.5
Phygon	1.6	84.0	145.3	48.8
Phygon	1.0	67.6	117.3	40.3
Check		38.8	76.6	28.8

### Phygon Performance in Cooperative Tests

Phygon has been widely tested in recent years in the cooperative sugar beet seed treatment tests. In 1946 (2) tests were run in 36 different locations and Phygon was included in each. In the general summary of results, it is stated that Phygon, along with certain other treatments, "appear substantially better than the untreated checks." In 1948 (3) it was included in 22 locations scattered throughout the sugar beet growing areas and it gave significantly better stands than untreated seed in 11 of the 13 tests in which there were significant differences due to treatment. This was the highest rank attained by a non-mercurial treatment. The 1948 data pertaining to Phygon are summarized as follows:

Table 4.

	Untreated	Phygon
Average stand in 22 tests	36.10	49.32
Average stand in 13 tests which had Sig. Dif.	30.78	51.36

Two "Phygon" formulations are available and recommended for sugar beet seed treatment, viz., "Phygon Seed Protectant" for use as either dust or slurry and "Phygon Paste" for slurry or spray treatment.

Dust treatment continues to be an important method. Under some conditions, however, dusts are objectionable to the operator during treatment and to the grower during planting. As experience has demonstrated, these objections can be overcome to some extent by using the slurry method, but according to some workers this method, with the small amount of suspension ordinarily applied, does not provide uniform coverage due to the rough, corky, absorbent surface of sugar beet seed.

In early 1947 (1), Austin Armer, of Spreckels Sugar Company, suggested that Naugatuck Chemical consider development of a Phygon paste formulation which could be sprayed on to the seed, rather than dumped or poured as in the case of slurry, thus giving more uniform coverage. Working in close cooperation with Mr. Armer and Dr. L. D. Leach, of the California Agricultural Experiment Station, several formulations were prepared and physical and biological performance checked. Through this cooperation, a semi-fluid paste readily miscible with water to any desired consistency was developed. This formulation, now called "Phygon Paste," has proven to be satisfactory for both spray and slurry application not only on sugar beet seed, but also on other seeds.

The following information, taken from a report by Dr. Leach (4), gives a comparison of Phygon spray and dust treatment on sugar beet seed.

Table 5.

Treatment	Dosage ozs./100 lb. seed	Emergence from 100 seed units	Survivors from 100 seed units
Phygon (spray)	16	105.5	93.5
Phygon (dust)	16	105.5	92.0
Check		41.5	13.5

The safety and effectiveness of Phygon Seed Protectant and Phygon Paste on sheared sugar beet seed are demonstrated by the following data obtained in greenhouse tests at Bethany, Connecticut. It is of particular interest to note that no injury was caused by either of these formulations at 40 ounces per 100 pounds of seed:

Table 6.

Treatment	Dosage ozs./100 lb. seed	No. plants emerging from 100 seed units		
		Trial 1	Trial 2	Trial 3
Phygon Paste	40.0	115.5	107.8	120.5
Phygon Paste	4.0	113.5	99.3	97.3
Phygon Paste	1.5	86.8	65.8	64.5
Phygon Seed Protectant	40.0	108.8		
Phygon Seed Protectant	4.0	107.8		
Phygon Seed Protectant	1.5	63.2		
Check	--	44.0	53.3	55.5

### Phygon Sugar Beet Seed Treatment Recommendations

As is true with seed treatment in general, the optimum dosage on sugar beets varies with weather conditions and locality. For average conditions, Phygon seed treatment recommendations are as follows:

Phygon Seed Protectant	4 ozs./100 lbs. seed
Phygon Paste	1 pt./600 lbs. seed

### Literature Cited

- (1) ARMER, AUSTIN A.  
Private communication.
- (2) DOWNIE, A. R.  
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1948. Proc. Am. Soc. Sugar Beet Tech., 514-519.
- (5) SCHOENE, D. L., TATE, H. DOUGLAS and BRASFIELD, T. W.  
1949. Agricultural Chemicals, 4 (9) : 24-27, 73.