

Germination-Emergence of Sugar Beet Seed as Affected by Treatment and Storage

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A satisfactory stand of seedlings is one of the first prerequisites to growing a satisfactory crop of sugar beets. To facilitate this, efforts have been made to develop varieties with better seedling vigor. Agronomic studies have been aimed at improving cultural practices. All of these efforts, however, are to no avail if the seed issued to growers will not germinate in a satisfactory manner.

Essentially, all of the sugar beet seed issued to beet growers in the United States has some type of fungicide or insecticide, or both, applied as seed disinfectants and seed protectants. These seed protectants are used to give the seed and germinating seedling some protection against parasites. The ideal seed protectant would be one that would protect the seed and germinating seedling from all parasitic organisms without harm to the seed itself. Unfortunately no such protectant is known. For that reason seed is treated in different ways in different parts of the country depending upon the specific needs of the particular areas.

Recently published data by Lawlor et al., (1)² show differences in the fungicidal effect of several fungicides on sugar beet seed with storage periods up to 20 months.

The purpose of this study was to evaluate the effects of storage and different dichloro-lindane rates and combinations on the ability of sugar beet seed to germinate. An additional purpose was to determine how long untreated sugar beet seed could be stored without appreciable reduction in germination-emergence.

Materials and Methods

Seed used for the experiment was from a single seed lot of the Spreckels' variety, S-2, produced in Oregon in 1955, and was stored in a seed warehouse at Spreckels, California. Five, 60-pound bags of unprocessed, commercial seed were taken at random from the stored seed in May, 1956. Approximately 12 pounds of seed was removed from each of the five bags. This seed was not processed and became seed Treatment 1. Processed seed referred to in this article is seed that has been decorticated and screened to a size range of 7/64 - 10/64 of an inch.

The remainder of the seed in the five bags was bulked and processed. After processing, it was divided into four nearly equal

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² Numbers in parentheses refer to literature cited.

parts. One part became seed Treatment 2 for this test. Another part was handled similarly to our commercial phygon-lindane treated seed and is the Treatment 3. Still another part was treated with twice the commercial rate of phygon-lindane and the remaining processed part was treated with three times the amount of phygon-lindane as the commercial seed. These last two treatments are referred to as Treatments 4 and 5, respectively.

Seed from each of the five original treatments was divided into five bags making a total of 25 bags. The bags of seed were stored in the commercial seed warehouse.

Starting in May, 1956, plantings were made and continued at monthly intervals for twenty (20) months after which bimonthly plantings were made of seed from each of the bags of stored seed. When it became advisable to include the additional treatments, sufficient seed was taken from Treatments 1 and 2 so that Treatments 6, 7 and 8 could be prepared and subsequently included.

Treatments for this study consisted of the following:

- Treatment #1: Whole, or unprocessed seed, stored with no fungicide, or insecticide.
- Treatment #2: Processed seed stored with no fungicide, or insecticide.
- Treatment #3: Processed seed stored treated with phygon and lindane at 4 and 8 ounces, respectively, of 50% active material per 100 pounds of processed seed. (Commercial Rate)
- Treatment #4: Processed seed stored treated with phygon and lindane at 8 and 16 ounces, respectively, of 50% active material per 100 pounds of processed seed. (Twice the Commercial Rate)
- Treatment #5: Processed seed stored treated with phygon and lindane at 12 and 24 ounces, respectively, of 50% active material per 100 pounds of processed seed. (Three times the Commercial Rate)

During the course of the test, additional information seemed desirable so the following treatments were added:

- Treatment #6: Processed seed from Treatment No. 2 was treated with phygon, applied as a dust immediately before each planting date at the rate of approximately four ounces of 50% active material per 100 pounds of seed.
- Treatment #7: Unprocessed seed from Treatment No. 1 was treated with phygon applied as a dust immediately before each planting date at the rate of approximately four ounces of 50% active material per 100 pounds of seed.

Treatment #8: Processed seed from Treatment No. 2 treated with both phygon and lindane at the commercial rate just before each planting.

Treatment #8 was added after several seedlings in the treatments involving lindane were observed to be distorted.

The seeds were planted into wooden flats, 14 × 20 inches, containing a mixture of sand and unsterilized field soil. The flats were placed in a well-ventilated greenhouse where no artificial heat was used. Seven rows of seeds, with 20 seeds in each row, were sown in each flat. Each row was a different treatment and each treatment was replicated 10 times at each planting date.

Emergence counts were made on the 10th and again on the 15th day after each planting. The percent emergence is based on the highest count at either date. One seedling, emerging per seedball, was considered sufficient to be counted.

The greenhouse trials are not strictly germination results but are germination-emergence counts. Pathogens could influence these results by taking their toll before the seedlings emerge. However, field plantings are subjected to similar circumstances.

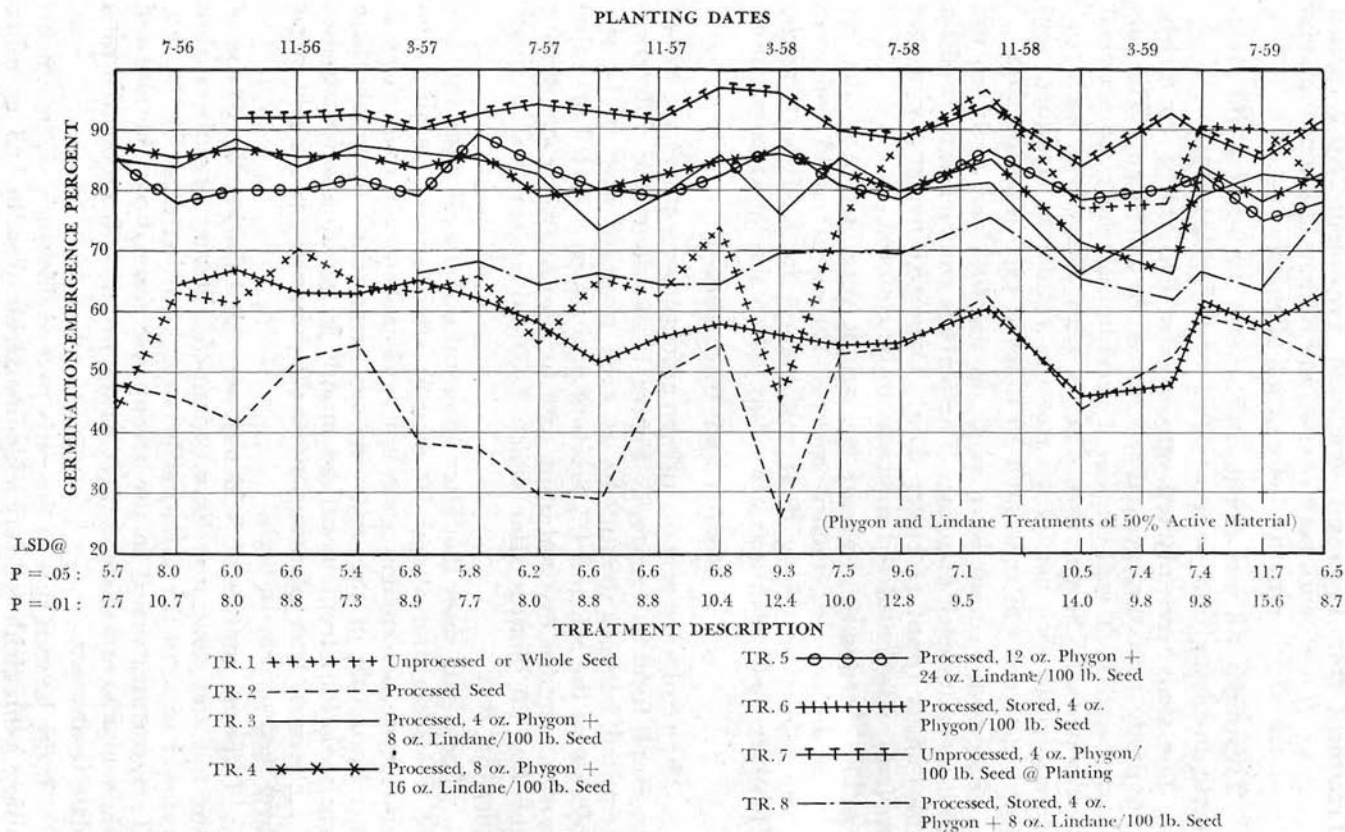
Results and Discussion

The results for germination-emergence percentages are shown in graph form in Figure 1. Figure 1 also shows the differences required between treatments at each planting date to be significant at the 5% and 1% levels of probability. Each LSD value was determined by combining data for two successive months for the first 20 months after which LSD values apply to a single planting date.

These data show that after 40 months of storage from the date of treatment and almost 50 months after harvest, germination-emergence percentages were not noticeably lower than those at the beginning of the study for any treatment. Although there are variations from month to month in germination-emergence percentages, later plantings show the inherent viability of sugar beet seed to remain high.

Different sources of field soil were used during the course of the test and these may have contained different organisms, thus causing some of the variation between planting dates in the test. Temperatures varied in the greenhouse throughout the test and these may have had some effect on the variation from one planting date to another.

It can be seen that in the early part of this study all treatments using a fungicide or fungicide-insecticide usually had germination-emergence percentages equal to or higher than no seed



treatment. This is shown by comparing Treatment 1 with Treatment 7, and Treatments 3, 4, 5 and 6 with Treatment 2. Exceptions to the advantages of fungicide and fungicide-insecticide treatments are expressed after extended period of seed storage.

Results of the first tests show phygon treatment of beet seed increased the germination-emergence percentage approximately the same amount when applied to processed and unprocessed seed. Treatments 6 and 7 are better than Treatments 2 and 1, respectively. However, the effect of the phygon treatment appeared to decrease as storage time increased. After seed was stored approximately 18 months, phygon application did not appear to improve germination of the seed. At this time treatments 6 and 2 became about the same. After storage periods in excess of 24 months, unprocessed seed (Treatment 1) without phygon was quite similar to unprocessed seed treated with phygon (Treatment 7).

Phygon-lindane applications of two and three times the commercial rate neither increased nor decreased the germination-emergence percentage. Treatments 4 and 5 are not different from Treatment 3.

Lindane apparently improved the fungicidal value of phygon when applied to seed immediately after processing. This is suggested because Treatment 3 is higher in its germination-emergence percent than Treatment 6.

It is recognized that some mechanical damage to the seed is sustained in the processing. The damage to good seed in mechanically processing is somewhat offset in the processing operation by the removal of small and light seed.

For about the first two years of the experiment, the unprocessed and untreated seed (Treatment #1) germinated consistently higher than the processed, untreated seed (Treatment #2). After that time, the germination of these two types of seed was very similar. Regarding the difference early in the test, it is not known whether this is simply mechanical damage to the seed, or whether there is a parasitic organism involved.

Processed seed, when stored, then treated with phygon-lindane at the commercial rate just before planting (Treatment 8), only once had a germination equivalent to the phygon-lindane treatment immediately after processing (Treatment 3). This observation could have commercial importance. If processed, untreated seed could be satisfactorily stored for periods of 6 to 8 months,

such seed could be stored in bulk as it is processed, then treated in high-capacity seed treaters just prior to being issued to growers. This would insure growers of getting freshly treated seed without the necessity of providing the tremendous processing capacity that would be required to both process and treat just prior to issuing the seed to growers. These studies would indicate that the practice of treating seed at the time it is processed is a more satisfactory method of handling seed than storing processed, untreated seed for treatment at the time of issue.

After 11 months of storage, several distorted seedlings were noticed when the growing seedlings were left beyond the 15-day germination-emergence count. Distorted seedlings were observed only in treatments involving lindane. Treatments with phygon only, or no treatment, produced no seedling distortions.

The symptoms began to appear approximately 21 days after planting. The distorted seedlings have symptoms similar to plants treated with colchicine. These distortions included shortened and thickened hypocotyls and highly distorted true leaves, or small rosette-type growth in place of the first pair of true leaves. Often the deformed true leaves included the fifth and sixth true leaves. Apparently, normal root development and other physiological functions are disturbed because many of the seedlings died before they reached the six true leaf stage. Field plantings of this same seed verified the results obtained in the greenhouse. Plantings in sterile soil also demonstrated the distortion. Table 1 shows the percent seedling distortion from different phygon-lindane treatments on sugar beet seed after various lengths of storage when grown in a greenhouse in flats containing a mixture of sand and unsterilized field soil. It can be seen from Table 1 that the number of distorted seedlings increases with the higher rates of lindane. Table 1 also shows the percent of distorted seedlings increases rapidly between 11 months and about 22 months of storage after treatment after which no appreciable increase is shown. Prior to 11 months of storage, no seedling distortion could be detected.

Table 1.—Percent seedling distortion from different Phygon-Lindane treatments on sugar beet seed after various lengths of storage under greenhouse conditions.

Treatment description	Length of storage (months)			
	11	16	20	39
Processed, untreated seed	0	0	0	0
Phygon at 4 oz Lindane at 8 oz/100 lbs seed ¹	13	28	35	43
Phygon at 8 oz. Lindane at 16 oz/100 lbs of seed	21	45	47	62
Phygon at 12 oz Lindane at 24 oz/100 lb seed	56	57	73	85

¹ Phygon and Lindane are 50% active ingredient so amount of treatment is twice the amount of active ingredient applied.

Summary

Germination-emergence tests involving 30 successive greenhouse plantings over a period of 41 months have been conducted at Spreckels, California during 1956, 1957, 1958 and 1959 with sugar beet seed of a single variety and lot number subjected to various treatments.

The following conclusions are made from this study:

1. After 40 months of storage from the date of treatment and 50 months from the time of harvest of the seed, germination-emergence percentages were not appreciably different from those at the beginning of the study for any treatment.
2. All treatments involving seed protectants increased the germination and emergence above those treatments having no protectants during the first half of the study; but during the last part of the study, consistent advantages were not apparent for all treatments involving seed protectants compared to treatments without seed protectants.
3. Increasing rates of phygon-lindane applications to 2 and 3 times the commercial rate did not change the emergence percentage.
4. Lindane improved the fungicidal value of phygon for a period of about 20 months of storage when the treatment was applied at the time the seed was processed.
5. Phygon-lindane treated seed (at rates used in this study) stored more than 11 months produced seedlings which developed distortions about 21 days after planting. The percent of seedlings distorted in the lindane treatments increased with increasing rates of lindane.
6. Processing seed appeared to do some damage to the seed, as might be expected. For approximately two years, the unprocessed seed, without protectant, emerged better than the processed seed without protectant. The use of seed protectants appeared to somewhat obscure these differences.
7. If processed seed is to be stored for any appreciable length of time, it should have some type of seed protectant applied to it at the time of processing.

Literature Cited

- (1) LAWLOR, N. JR., J. F. SWINK, H. JEWELL, and D. B. OGDEN. 1957. Results of seed treatment tests. *J. Am. Soc. of Sugar Beet Technol.* IX (6): 529-535.