# Experiences in the Practical Use of a Continuous Spray Treater

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For many years it has been an established fact that in most of the sugar beet producing areas of the United States forms of fungi occur in the soil, which are partly, and sometimes totally, responsible for the loss of seedling stands. Plant pathologists have demonstrated that satisfactory stands can be established in fields where the level of causal organisms is a limiting factor by resorting to careful seed treatments with fungicides (1) (2) (3)[2]. During the past two years another seed treatment has been used extensively in California which has been economical and effective in the control of wireworms. The pure gamma isomer of benzene hexachloride is used in this treatment (4) . It can be applied to the seed as a supplementary treatment with a fungicide, or alone.

Prior to the conception of the idea of applying treating materials as suspensions of wettable fungicides, either as a slurry or a spray, the accepted method of application consisted of dusting the seed with dry powder fungicides. In many cases as much as 1 percent by weight on seed had to be used to obtain satisfactory seed protection. Serious repercussions arose as a result of the offensive nature of the treating materials being used. They were a hazard to the health of the operator of the seed treater and of the labor handling the seed in the field. Many processors could not ignore the complaints of labor and discontinued completely the treating of seed. This left no alternate for the grower who had to plant treated seed in order to secure a satisfactory stand. He had to treat his own seed or take the risk of loss of stand. Some small measure of relief was obtained from excessive dustiness when formulations were placed on the market which required as little as 0.25 percent by weight on seed to secure protection.. These products were still powders—they were dusty, obnoxious to handle, and toxic. Furthermore, the average grower's homemade equipment was, and still is, inadequate to cope with the proper, well dispersed application of small volumes of treating materials on large volumes of seed.

The slurry method was a progressive step in the technique of treating seed. Dustiness attendant to the actual operation of the machine was eliminated. However, in runs with a slurry machine it was found that there was poor uniformity of coating with treating materials even when well-decorticated sugar beet seed was treated. Dispersion of materials was inferior to that obtained by spray treating. By the same token it was found that emergence and survival of seedlings in Pythium-infested soil was lower than in the case of seedlings from spray treated seed (5) .

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[2] Numbers in parentheses refer to literature cited.

The original concept of spray treating sugar beet seed was embodied in a batch spray treater designed by Armer in 1948 (6). A commercial model of a continuous spray type seed treater, designed by Kepner and Leach (5) of the University of California, was constructed by the Blackwelder Manufacturing Company of Rio Vista, California. In design the machine does not differ radically from the experimental model except in the addition of certain operating parts and their locations. Many of the integral parts of the experimental model were, perforce, constructed for temporary use and therefore built of non-permanent materials. The commercial machine is a rugged, well constructed piece of equipment.

A well designed control system is employed which assists the operator in accomplishing a precision job of treating. The entire system, consisting of electric switches, pressure gauges, signal lights, and electric horn, is mounted on a panel board conveniently located at the discharge end of the treater. By means of this installation the operator is kept conscious, at all times, of the following important operating conditions: (a) Seed supply entering the treater; (b) Flow of treating material through the spray nozzle; and (c) Maintenance of mechanical agitation of the suspended treating material in the treatment supply tank. The two first mentioned function automatically. A brief description of the system follows:

The walls of the seed hopper are constructed of light, flexible, galvanized iron. A micro switch has been installed, the plunger of which has been adjusted to a clearance of .005 inch between same and one wall of the hopper when empty. In this no-seed position the seed indicator light circuit is open and the signal horn circuit is closed. This control will function when the supply of beet seed in the hopper has been reduced to approximately 20 pounds. Two 0-60 psi pressure gauges and a pressure differential switch actuate the automatic signal indicating either normal or restricted flow of treating materials through the spray nozzle. One gauge is connected to the inlet end of the tank-to-nozzle feed line and the pressure differential switch. The other is connected to the nozzle and the pressure differential switch. In operating practice, at the required nozzle pressure for a predetermined spray application, experience has shown that a constant differential exists between nozzle and tank pressure when the flow of liquid through the nozzle orifice is not obstructed. It follows, therefore, that any condition causing partial or total clogging of the nozzle would result in partial or total loss of this differential of pressure. Under our specific treatment requirements, this differential is about 8 psi. We have adjusted the pressure differential switch to actuate the signal system when the pressure loss reaches 3 psi. The light and signal horn function just as in the case of seed supply. The third control, which is manually operated, simply consists of a light which indicates whether the spray tank agitator motor is in operation.

When precision spraying with inflexible amounts of suspensions of abrasive materials per given volume of seed is required, nozzle orifice erosion can readily become a serious factor in the application of exact dosages. A flow glass arrangement has been installed in the spray tank system whereby the time of flow, in seconds, of a fixed volume of water can be determined for the purpose of ascertaining the operating pressure and/or degree of erosion of the nozzle orifice currently being used. The floor plan for the installation of the treater and the equipment therewith, called for fitting the treater into, and making it an integral part of, the exising seed processing equipment. A hopper was constructed near the gravity table so that processed seed could be discharged, if desired, directly into it and transferred by airlift to the treater seed supply tank. Alternatively, seed from selected lots which had already been bagged could be fed into this hopper

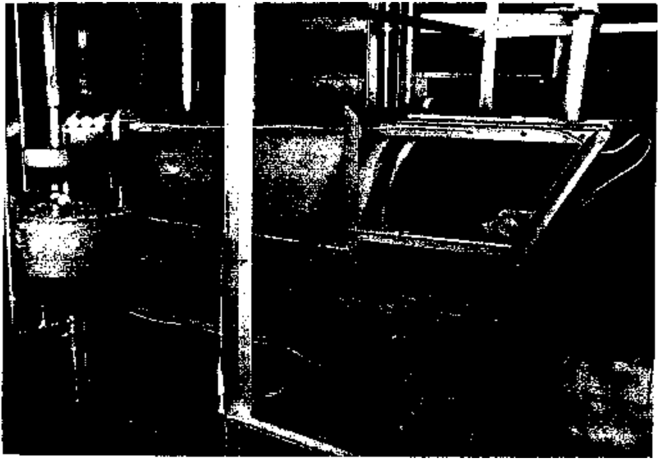

Figure 1. A continuous spray type seed treater.

if it became necessary to draw from a stockpile of processed seed. Since the treater is arranged to discharge treated seed into this same hopper, it follows that the treater seed supply tank cannot be filled during treater operation. When the treater is started, the airlift is made to discharge, by valve arrangement, into the sacking station supply tank. From here the treated seed is bagged-off. Both of the aforementioned tanks have a capacity of 4,000 pounds of seed each.

An airlift elevator was installed instead of the conventional bucket-type elevator for the transferring of seed to and from the treater. It was felt that the following advantages would accrue from this type of installation: (a) Less danger of mechanical damage to the seed; (b) Additional cleaning of seed in the transfer; and (c) Some drying effect on seed from the treater during transfer to the sacking station supply tank. In actual operation we have found that these results have been attained. The installation of a separate airlift to handle the treated seed would be an improvement over the present installation. The advantage of such an installation is obvious.

In the construction of the commercial unit, the treater spray tank was attached to the frame of the machine. All of the necessary connections, electric, water, et cetera, between the integrated parts of the unit were completed by the manufacturer. On installing the machine for operation, we attempted to utilize all of the means possible which made for ease and convenience of the operator. The spray tank was piped so that we could blow all, or unused, portions of the treating materials back into a mixing tank located on the deck above the treater. We make full use of the compressed air piped to the spray tank in all of our flushing-out operations following a run. Convenient sewering connections have been installed from the tank. The extreme overall dimensions of the treater are: Length—10 feet, width—6 feet, and, height—6 feet 8 inches. The actual floor space occupied by the treater and the framework supporting the two seed tanks measures 17 feet long by 14 feet deep. Ample walking space around the machine is included in these measurements.

In the interest of brevity, this paper will not attempt to describe all of the details connected with the operation of the machine. The most important of these will be described.

We are currently using Phygon XL wettable powder (2.3—dichloro—1,4—naphthoquinone) as a fungicide and 75 percent Lindane (from the pure gamma isomer of benzene hexachloride) as a wireworm repellent. These two materials are weighed together in the proper proportions to formulate a predetermined quantity of completed mix, which, when applied at the rate of 2 quarts per hundredweight of beet seed, will give dosage applications of 0.25 and 0.33 percent, on seed, for Phygon and Lindane, respectively. To keep down dust, the materials are slurried immediately after weighing. They are then transferred to a mixing tank where a dye is added and the suspension volume made up to the mark with water. Following several minutes of thorough agitation, the mix is then discharged, by gravity, into the treater spray tank. In its passage into the treater tank the mix is filtered through a 60-mesh screen. The spray tank agitator is started when the mix is being-run into the spray tank and is kept running as long as any mix remains in said tank. The tank is pressurized by opening the compressed air supply valve. Previous experience with the nozzle being used and the pre-determined degree of erosion which occurred during the previous run will help the operator to determine the approximate nozzle pressure required to accomplish proper treatment at a given flow rate of seed. Knowing from experience the operating pressure differential between tank and nozzle, as indicated by the two gauges, we pressurize the tank accordingly to the desired psi. A diaphragm valve affords accurate rapid adjustment to air pressure. It is necessary to determine the bushel weight of seed prior to making a run so that the proper rotor speed setting of the seed metering device can be made which will give the desired rate of flow.

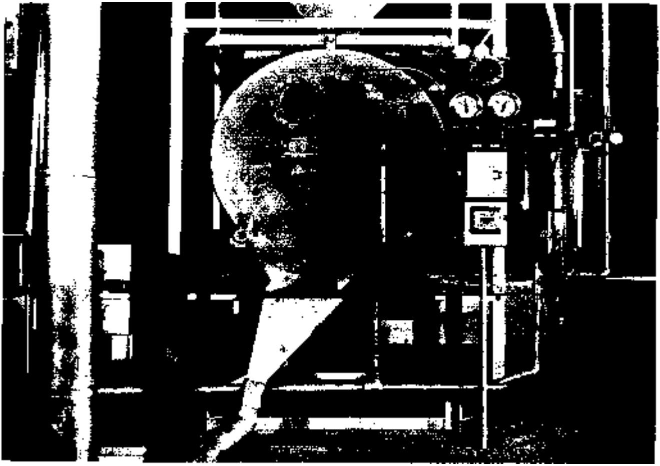

**Figure 2. This view shows in more detail the continuous spray type seed treater.**

When the machine was first put into operation we encountered numerous aggravating delays from nozzle clogging. This was influenced to some extent by the manner in which we prepared our suspension, but in greater measure by the limited size of the nozzle which had to be used for the application of treating materials at the rate of 1 quart per hundredweight of seed. This condition was corrected by the simple expedient of cutting the concentration of mix to half of that previously used, increasing the nozzle capacity approximately 33 percent, removing the nozzle screen completely, and adjusting the operating pressure and seed flow rate to the application of 2 quarts of mix per hundredweight of seed.

Some serious nozzle erosion threatened to interpose a problem. This was corrected in the early stages of operation by substituting hardened stainless steel nozzle tips for the conventional stainless steel tips first used. Stainless steel tips had to be discarded after treating 7,000 pounds of seed. With hardened stainless steel tips, we have treated as much as 43,500 pounds with a single tip.

The flow rate of seed can be controlled over a wide range with the seed metering device. We have treated beet seed at the rate of 3,120 pounds per hour when applying mix at 1 quart per hundredweight of seed. For our purposes we have found that rates of flow in excess of 50 pounds per minute are not practical. We, therefore, add the maximum allowable amount

**Table 1.—Protection Obtained with the Continuous Spray Treater as Compared with Dust Treatment.**

| Seed Lot and Treating Method | Seedlings per 100-seed Unit | | |
|---|---|---|---|
| | Pasteurized Soil | Pythium-infested Soil | |
| | Emergence | Emergence | Survivors |
| U.S. 56, lot 108 | | | |
| Nontreated | 164 | 50[4] | 7 |
| Spray treated[1] | 183 | **147** | **88** |
| Dust treated[2] | ...... | 149 | 61 |
| U.S. 15, lot 134A | | | |
| Nontreated | 175 | 58 | 11 |
| Spray treated[1] | 172 | 144 | 97 |
| Dust treated[1] | .. | 152 | 102 |
| U.S. 15, lot 134B | | | |
| Nontreated | 158 | 78 | 19 |
| Spray treated[1] | 151 | *137* | 90 |
| Dust treated[2] | .... | 153 | 102 |
| U.S. 15, lot 136 | | | |
| Nontreated | 170 | 58 | 10 |
| Spray treated[2] | 160 | 145 | **110** |
| Dust treated[3] | . . | 128 | 67 |

[1] Combination treatment, using 4 oz. Phygon XL and 5⅓ oz. 75% Lindane per 100 lbs. of decorticated beet seed.
[2] Treated with Phygon paste at 4 oz. per 100 lbs. of seed.
[3] Treated with Phygon XL at 4 oz. per 100 pounds of seed.
[4] Blackface figure indicates significant difference from dusting (blackface is for 99:1 odds and italic is for 19:1 odds).

of moisture (approximately 4 percent) with a nozzle size approaching that which would give least interruption from clogging. We have obtained very satisfactory treatment with seed flow rates in the neighborhood of 40 pounds per minute. This is about the rate at which we now generally treat our beet seed.

All of our seed is dyed during the process of treating. We make use of dyes for purposes of observing the uniformity of distribution of treating materials, and identifying the particular kind of seed treatment. Green is used to identify repellent-fungicide treated seed; red to identify repellent-treated seed; and yellow to identify fungicide-treated seed. The dyes used are neutral water soluble materials. Excellent coverage is obtained with the spray treater using 3 grams of dye per hundredweight of seed. A concentrated solution of dye is added to the suspension of treating materials before completing the mix to the desired volume.

It has been observed that when 2 quarts of suspended treating materials (approximately 4 percent moisture on seed) are applied, some apparent swelling of seeds takes place. Bushel weight determinations on 30 lots of seed before and after treatment indicate an average loss of 1.40 pounds per bushel after treatment. Screen tests verify this increase in seed size. There was a significant increase in the percentage of seed remaining on the 91/2 /64 inch screen (processed size 7-91/2 /64 inch) after treatment. All seed, however, passed through the 10/64 inch screen.

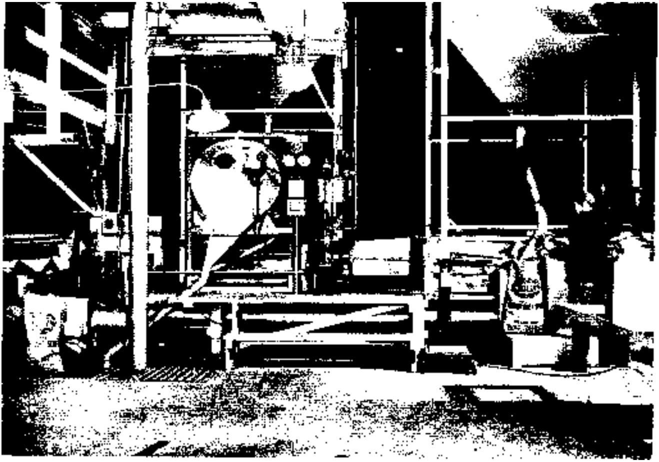

Figure 3. A commercial model of a continuous spray type seed treater in action. This view shows how the installation was worked out in a plant.

Numerous greenhouse germination trials have been completed, using samples of seeds taken from many of the lots which were treated with fungicides applied by the continuous spray treater. In the majority of cases, spray-treated seeds gave significantly higher stands than non-treated seeds in Pythium-infested soils. In general, there were no significant differences in emergence and survival counts between carefully dusted and spray-treated seeds. Some of the results are set forth in Table 1.

## Summary

The Continuous Spray-Type Seed Treater is essentially a high volume machine capable of applying with positive precision, both as to uniformity and quantity, suspensions or solutions of treating materials.

The degree of accuracy, and by the same token the degree of protection, obtained in seed treatment will depend upon the skill and conscientiousness of the operator. Trustworthy seed treatment is paramount and all other considerations, within reasonable limits, are unimportant. A skilled operator should be employed to treat seed with this machine.

The requirements for installation of a continuous spray treater are such that the equipment can easily be fitted into the production line of any well arranged seed processing plant. Since the machine has a practical operating capacity of about 2,500 to 3,500 pounds of processed beet seed per hour, it is obvious that storage supply tanks become a desirable part of the installation. In like manner, an elevator, preferably airlift, capable of taking away the full output of the treater should be installed.

Mechanical troubles have been few and unimportant. There are no complicated parts to the treater and all are accessible for maintenance and repair. Service requirements are nominal. The drum is self-cleaning.

The high capacity and cost of the machine limit the possibility of its coming into general use by other than large seed processors.

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