# Field Trials With Soil Row Treatment for the Control of Damping-off of Sugar Beets

TORREY LYONS, L. D. LEACH AND F. J. HILLS[1]

In greenhouse experiments, chemical soil-row treatments have given good control of sugar beet seedling diseases caused by three of the four pathogens principally responsible for these diseases in California (1)". Results were usually favorable when *Pythium. ultimurn,* Trow, *P. aphanidermatum* (Eds.) Fitsp., and *Rhizoctonia solani* Kuhn were the pathogens involved, but the treatments were not very effective in controlling attacks of *Aphanomyces cochlioides* Drech.

In order to obtain information as to the effects of soil-row treatments under field conditions, several field trials were conducted in 1953. This paper reports the results of these trials.

## Procedure

For simplification, a single fungicide at a single rate of application was used in each trial. Captan (N-trichloromethylmercapto-4-cyclohexene-l, 2-dicarboximide) was used in most of the experiments. Several greenhouse trials had shown this material to be as effective as others in controlling the various pathogens.

Fields in which damping-off had destroyed the first planting or fields with severe damping-off history were selected for the trials. To obtain information on the pathogens involved, soil was collected at the site of each trial at the time of planting. The soil sample representing each trial was made up of sub-samples taken from the center of each replication. Sugar beets of the variety U. S. 41 were grown in this soil in flats inthe greenhouse. Diseased seedlings were diagnosed in water culture. Soil reaction and total salt content of each soil sample were also determined.

The fungicide in the field trials was applied with equipment designed and built by R. Kepner of the Department of Agricultural Engineering, University of California, Davis. This equipment consists of a five-gallon pressure tank containing an agitator mounted on a platform which can be clamped on a planter. Rubber hoses lead from the outlet valves to one or two fan-type spray nozzles clamped behind each planter shoe.

Two nozzles were used to deliver the fungicide to each row when planter construction allowed sufficient room. One spray fan was directed downward, slightly diagonal to the row, to cover the seed and sides of the open furrow. The second spray fan was set parallel with the row, and directed on the soil closing the seed furrow.

If only one nozzle was used, the spray fan was set diagonal to the seed furrow and directed to cover the seed and sides of the open furrow.

[1] Farm Advisor, Plant Pathologist, and Extension Agronomist, respectively, University of California, Davis, California.

[2] Numbers in parentheses refer to literature cited.

Pressure used was approximately twenty-five pounds per square inch and was provided by connecting a five-pound $CO_2$ bottle with pressure regulator valve into the tank.

An attempt was made to apply 2 pounds per acre (based on a 20-inch row spacing) of actual captan using a formulation of a wettable powder containing 75 percent captan. The actual dosage delivered, however, varied between trials from 1.9 to 2.9 pounds per acre due to different pressures and planter speeds. Arasan S. F. (75 percent tetramethylthiuram disulphide) was used in trial 8 at 1.4 pounds of active ingredient per acre.

Approximately 25 gallons of water per acre was applied if one nozzle was used, and 50 gallons if two nozzles were used.

Most of the field trials consisted of eight replications of paired plots. Each plot was 4 rows wide and 50 to 100 feet in length. Treated and non-treated plots were planted with the same planter shoes. Treatment effects were evaluated by counting total seedlings in the center 100 inches in each row of each plot. Two seedling counts were made in each trial, one shortly after emergence was complete to reflect total emergence, and another just before thinning to evaluate the effect of the treatment on seedling survival. It should be noted that trial 4 was established when the field (including trial 3) was replanted, the initial stand having been destroyed by damping-off organisms.

## Results and Discussion

The emergence and survival of sugar beet seedlings grown in the greenhouse in soil from the location of each field experiment are shown in Table 1. Table 2 indicates the pathogens involved in these flats of soil as deter-

**Table I.—Emergence and Survival of Seedlings in Greenhouse Flats of Soil from Sites of Field Experiments. Values Given Are Seedlings per 40 Seed Units.**

| | Trial Number | | | | | | |
|---|---|---|---|---|---|---|---|
| **Treatment** | **1** | **2** | **3 and 4*** | **5** | **6** | **7** | **8** |
| | | | **Emergence—13 days after planting** | | | | |
| Non-treated | 10 | 25 | 15 | 10 | 14 | 24 | 20 |
| Phygon seed treatment | 43 | 36 | **27** | 50 | 48 | 37 | 45 |
| | | | **Survivors—13 days after planting** | | | | |
| Non-treated | 0 | 16 | 2 | 3 | 6 | 5 | 3 |
| Phygon seed treatment* | 29 | 29 | 12 | 50 | 37 | 9 | 18 |

[1] Trials 3 and 4 were conducted on the same area, No. 4 being established when **the** field was replanted.

[2] 25 gms. Phygon in suspension sprayed on 100 gms. of seed.

**Table 2-—Water Culture Diagnosis of Diseased Seedlings from Flats of Field Soil. Values Given Are Percent of Total Seedlings Diagnosed.**

| | Trial Number | | | | | | |
|---|---|---|---|---|---|---|---|
| **Pathogen** | **1** | **2** | 3 **and 4** | 5 | **6** | **7** | **8** |
| Pythium ultimum | 78 | **100** | 18 | 17 | 3 | 30 | |
| **P.** aphanidermatum | **0** | **0** | 18 | 5 | 0 | 0 | |
| Rhizoctonia solani | **11** | **0** | 0 | 78 | 97 | 30 | |
| Aphanomyces cochlioides | **11** | 0 | | | | | |
| Total seedlings diagnosed | 27 | 7 | 22 | 18 | 29 | 30 | **210** |

mined by water culture diagnosis of diseased seedlings. The effects of soil-row treatment on seedling emergence and survival in the 8 field trials are given in Table 3.

**Table 3.—Effect of Soil-Row Treatment on Damping-ofF of Sugar Beet Seedlings in Field Trials. Values Given Are the Number of Seedlings per 100 Inches and Are Means of Eight Replications.[1]**

| Treatment^ | Trial Number 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| | | | | Emergence | | | | |
| Non-treated | 38 | **92** | **19** | **9** | 118 | 95 | 154 | 76 |
| Treated | 38 | 105[3] | **23** | 10 | **130=** | 100 | 158 | 95' |
| | | | | Survivors | | | | |
| Non-treated | _ . | **50** | 9 | 5 | 92 | 70 | 102 | 39 |
| Treated | —.7 | **57** | 20' | 6 | 104° | 74 | 139' | 51[3] |

1 Trial 8 consisted of six replications.
2 Captan was the fungicide used in trials 1-7 and Arasan SF in trial 8.
34 Indicate F values exceeding the 5 percent and 1 percent levels of significance respectively.
5 Observed F 4.30, required F at the 5 percent level 5.99.
6 Observed F 4.47, required F at the 5 percent level 5.99.
7 The trial was thinned before a survival count was made. A count of 28 skips over 12 inches per 100 feet of row was obtained in both non-treated and treated plots.

In three of the trials (trials No. 3, 7 and 8) soil-row treatments significantly increased the number of surviving seedlings. In one other trial (trial 2), a significant improvement in seedling emergence was observed which might have resulted in a measurable improvement in numbers of surviving seedlings had not a mechanical thinner gone over the area before survival counts were made. In only one of the above 4 trials, however (trial 3), was the loss of seedlings in check plots great enough to result in a stand failure. In this case, soil-row treatment gave sufficient protection to preserve enough seedlings for a commercially acceptable stand.

In trials 1, 5 and 6, significant treatinent differences were not observed, and satisfactory stands were obtained without row treatment.

It is interesting to note that row treatment was quite effective in controlling severe damping-off in trial 3, but failed to do so when this field was replanted (trial 4). Satisfactory explanation for success of the row treatment in the first planting and failure in the second cannot be given from the data available. One possible explanation, however, in the light of previous greenhouse trials (1) is that under the cooler and drier environmental conditions of the first planting, attack by *Aphanomyces cochlioides* may not have been as severe as it was in the second planting when conditions were more favorable for its development. At the time of the second planting, temperatures were warmer and soil moisture higher due to rain and a higher water table.

It appears that soil-row treatments with captan were most successful when all or most of the seedling infection was caused by *Pythium ultimum.* In other cases where *Rhizoctonia solani, P. aphanidermatum* and especially *Aphanomyces cochlioides* played an important part; the control was less effective and in severe cases failed to provide satisfactory control.

Results of the greenhouse diagnosis (Table 2) did not indicate that *Pythium ultimum* was important in trial 7; however, this pathogen was causing the seedling infection at the time of the emergence count, as determined by diagnosis of seedlings collected from the field.

While these trials offer some encouragement for the use of row treatment, they have fallen far short of achieving the degree of control that the greenhouse trials indicate might be possible. It is possible that the method of field application may be partially responsible for the relatively poor control obtained in the field trials. Future work should investigate methods of field application, as well as search for more effective fungicides.

## Summary and Conclusions

Eight field trials were conducted to determine the effectiveness of soil-row treatment under various field conditions. It was found that:

1. The stand of sugar beet seedlings was improved by spraying fungicide in the row as the seed was planted in four out of eight trials.

2. In the two cases where damping-off was severe, soil-row treatment resulted in a commercially acceptable stand in one case, and failed to do so in the other.

3. Soil-row treatment tended to give the greatest protection when *P. ultimum* was the active pathogen.

4. More field and greenhouse trials are needed to develop a more effective treatment.

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## Literature Cited

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