Treatment of Sugar Beet Seed with Systemic Insecticides for Control of the Beet Leafhopper[1]

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Control of the beet leafhopper is essential on susceptible varieties of sugar beets grown for seed in the Southwest. This was originally accomplished with a pyrethrum-in-oil spray (1)[3], but DDT has been the accepted method since it became available in 1945 (2). DDT remains active for some time on the larger plants, killing leafhoppers that may move into the field after application. However, control is more difficult on cotyledon and two-leaf beets because of lack of sufficient foliage to hold the insecticides. Seedlings are also more susceptible to curly top than the larger plants. Recent research has, therefore, been directed toward the development of better methods for controlling the beet leafhopper on these seedling beets.[4]. This work is still in progress and the results presented in this paper should be considered a progress report.

In the last few years several systemic insecticides have passed the experimental stage and are on the market. Probably the one best known is Demeton (in Systox). These insecticides enter the circulatory system of the plant, causing the juices to be toxic to certain insects. The insecticide may be introduced into the soil with the irrigation water or applied as a foliage spray. Recent tests at Phoenix, Arizona, have also shown that some of these insecticides are effective for considerable time if the seed is treated before planting.

Greenhouse Tests

In the Salt River Valley of Arizona, sugar beets grown for seed are planted in late August or September. In anticipation of field-plot experiments, tests were made in the greenhouse during the spring and summer on sugar beets grown in pots or flats.

Insecticides included in these studies were the phosphorous compounds, Demeton, Schradan, and American Cyanamid 3911 and 12008. Emulsions of these materials were tested as soil drenches and preplanting seed treatments. Dusts, prepared by American Cyanamid to contain 50 percent of 3911 or 12008 on powdered carbon, were also tested as seed coatings. The dosages for seed treatment were calculated on the basis of 15 pounds of seed per acre.

Soil Applications.

The first of these tests was with soil drenches. Potted plants were irrigated with water containing various insecticides and later leafhoppers were confined on the leaves in a special type of leaf cage. Each cage contained one leaf on which 10 leafhoppers were confined for 24 hours. Treatments were at the approximate rates of 8 and 16 pounds of the active ingredient per acre. The eight-pound rate was adequate, and no additional benefit was indicated for the higher dosage. As shown in Figure 1, both American

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[3] Numbers in parentheses refer to literature cited.

[4] The beet plots on which these experiments were conducted were furnished by the Western Seed Production Corporation.

Cyanamid 3911 and 12008 killed practically all the leafhoppers caged on the plants throughout the experiment, whereas the effectiveness of Demeton dropped off rapidly after about 20 days, but was superior to Schradan.

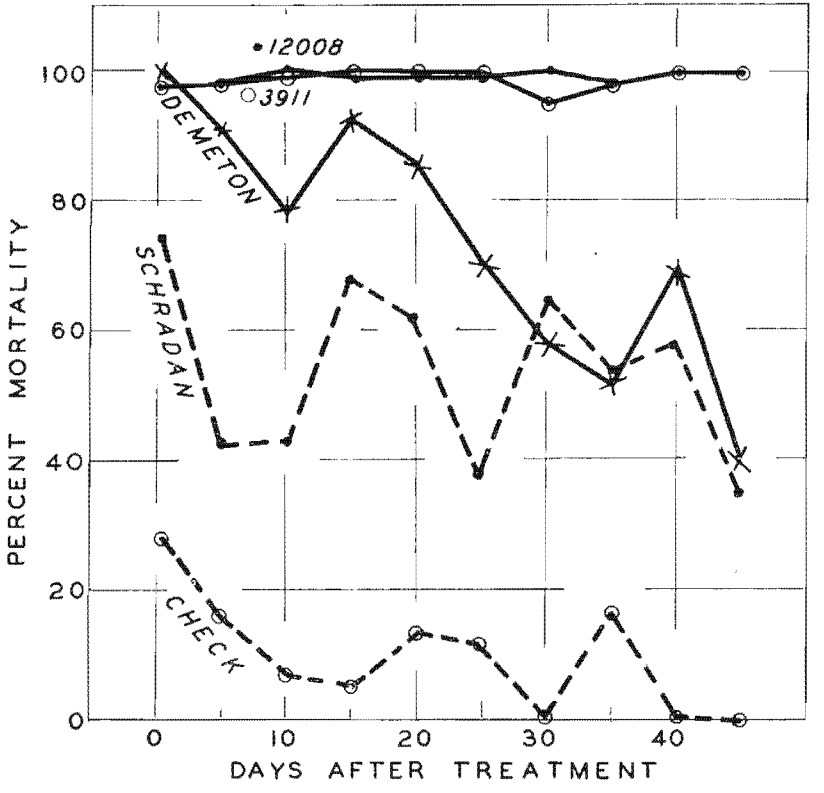

Figure 1.—Mortalities of beet leafhoppers on potted sugar beets subjected to various soil-insecticide treatments. Phoenix, Arizona, 1955.

Seed Treatment.

Tests were also made to determine the effectiveness of seed treatment in the control of leafhoppers on seedling plants. In one test the seed was soaked for 30 minutes in one-percent emulsions of the same materials used in the soil-drench tests. One leafhopper per plant was caged on 25 plants receiving each treatment when the beets were in the four-leaf stage. All the treatments gave good leafhopper control, as shown by the following mortalities:

	Percent
Demeton	100
Schradan	92
American Cyanamid 3911	100
12008	100
Untreated check	20

In another test, the seed was coated with carbon dusts impregnated to contain 50 percent of American Cyanamid 12008 or 3911. By tumbling

in a revolving drum for 15 minutes, approximately 1.1 ounces of the impregnated dust could be made to adhere to one pound of seed. These seeds were planted in six-inch pots and all leafhoppers, caged on the plants 35 days later, died in 24 hours.

Some of the plants from treated seed showed growth abnormalities, therefore, a series of tests was made to determine the plant tolerance of these materials. Seed was treated with various amounts of 12008 or 3911 in 50 percent carbon dusts or various emulsion dilutions. The emulsions were first used as seed soaks, by which the seed was soaked for 30 minutes in emulsions containing 0.5, 1, and 5 percent of the insecticide. There was some indication that the five-percent emulsion reduced the viability of the seed and also caused a high percentage of abnormal plants. Owing to difficulties in treatment and handling of the wet seed, this method was soon abandoned. It was found that a thorough distribution of liquid materials could be obtained in a revolving drum mixer by using only enough water to dampen the seed (1 gallon to 15 pounds of seed) and the quantity of the active ingredient applied to the seed could be more accurately determined. Although the seed was not so wet as when treated by the soak method, there was still the problem of drying it before planting.

Since the previous tests had shown the two materials to be equally effective against the leafhopper, only 12008 was used in the more concentrated emulsions. Treatments were made at rates of ¼, ½, 1, and 2 pounds to 15 pounds of seed. At ¼ pound, the viability of the seed was satisfactory and plants appeared normal, except for a slight cupping of some of the cotyledons shortly after emergence. At ½ pound, seed viability was considerably reduced and at 1 and 2 pounds, none of the seeds germinated. It was therefore concluded, that by this method, any dosage above ¼ pound to 15 pounds of seed was not safe.

Plant-tolerance tests with carbon dusts impregnated to contain 50 percent of American Cyanamid 12008 or 3911 were made at ⅛, ¼, ½, ¾, and 1 pound of the active ingredient on 15 pounds of seed. Viability of the seed was unaffected up to ¾ pound, but materially reduced at the 1-pound rate. No abnormal plants resulted from the ⅛- or ¼-pound treatment, but approximately one-third of the plants appeared abnormal in the ½-pound treatment and from 63 to 100 percent in the ¾- and 1-pound treatments. The abnormalities in the ½-pound treatment seemed to be confined to the cotyledon and two-leaf stages and as the plants developed these symptoms disappeared.

Field Tests

In the fall of 1955, field tests with treated beet seed were made on a series of small plots and also on two five-acre plots. The rates used on the five-acre plots were within the range considered safe from the greenhouse tests, but in some of the small plots, they were somewhat higher, although no adverse effects developed.

Small Plots.

These plots consisted of four rows of beets 35 feet long. The seeds were treated with American Cyanamid 12008 or 3911 in three ways: (A) in 50-percent impregnated carbon dust, (B) in emulsions at the rate of one gallon to 15 pounds of seed, and (C) in an emulsion spray directed into the seed row before the seeds were covered. Special equipment was con-

structed for the last treatment by mounting a spray nozzle directly behind the planting shoe of the planter. The rate of application was set at 13 gallons per acre and the desired quantity of the active ingredient was then diluted with water to 13 gallons.

Each treatment was replicated three times and its effectiveness was determined by caging leafhoppers on plants in the two-leaf and four-leaf stages of development, or 10 and 18 days after emergence of seedlings. In the two-leaf stage glass-vial clip cages were attached to the leaves of four plants on each plot and five beet leafhoppers placed in each cage to make a total of 60 leafhoppers per treatment. When the plants reached the four-leaf stage, cylindrical cloth-covered cages 3½ by 7 inches were used, each cage enclosing two or three plants. Three of these cages were placed on each plot and 25 leafhoppers were placed in each cage to make a total of approximately 225 leafhoppers per treatment. After the cages had remained on the plants for 48 hours, they were removed and the leafhopper mortality determined.

Table 1.—Percent Mortality of Beet Leafhoppers in Cages on Small Plots of Various Seed Treatments.

Insecticide (American Cyanamid Number)	Pounds of Active Ingredient per Acre (15 Pounds of Seed)	On Two-Leaf Plants	On Four-Leaf Plants
	Carbon Dust on Seed		
12008	¼	55	25
	½	91	33
3911	¼	66	28
	½	83	47
	Emulsion on Seed		
12008	¼	47	40
	½	52	16
3911	¼	38	36
	½	62	53
	Emulsion Spray in Seed Row		
12008	1	43	24
	2	85	39
3911	1	51	28
	2	81	18
Check (no treatment)			

The results are given in Table 1. At the two-leaf stage, some mortality was indicated for most of the treatments. Seed treated with the 50-percent carbon dusts produced better results than did seed treated with the emulsions. Good results were also indicated from spraying directly into the seed row, but two pounds of the active ingredient were required to produce about the same results as were obtained with ½ pound when applied in carbon dust on the seed. By the time the plants had reached the four-leaf stage, considerable toxicity to the leafhoppers was lost, but there were still some mortalities due to treatment. These data indicate that, after the two-leaf stage, the effectiveness of the treatment rapidly declines.

Large Plots.

Two five-acre plots of seed beets were planted with treated seed on a commercial field. A beet variety resistant to curly top was chosen, so that leafhopper populations could be observed on both treated and untreated

Table 2.—Numbers of Beet Leafhoppers per Foot of Row on Five-Acre Plots in Different Stages of Development in Which Seeds Were Treated With American Cyanamid 12008.

Treatment	Pounds of Active Ingredient per Acre	Cotyledon (6)[1]	Two-Leaf (8)[1]	Four-Leaf (14)[1]	Six-Leaf (21)[1]	50-75 Percent Foliage Coverage (29)[1]
Emulsion	¼	0.04	0.00	0.44	0.28	0.36
Carbon dust	½	0.02	0.02	0.26	0.20	0.32
Untreated check		0.70	0.64	1.06	1.48	1.12

[1] Numbers in parenthesis indicate days after emergence of seedlings.

portions of the field without the complication of commercial control with DDT. On one plot, the seeds were treated with an emulsion of American Cyanamid 12008 at the rate of ¼ pound per acre (15 pounds of seed) and on the other plot with 12008 in an impregnated carbon dust at ½ pound per acre. The numbers of leafhoppers per foot of row as determined with a counting cage are given in Table 2. Good results were obtained with both treatments. In fact, populations throughout the season on the plots grown from treated seed were well below what might be considered an economic level, whereas on that portion of the field grown from untreated seed they were so high that the field would have been dusted for leafhopper control had it not been a curly-top resistant variety.

Discussion

Although this paper reports only one season's work, the data indicate that it is possible to obtain control of the beet leafhopper on seedling beets by treating the seed before planting. They further indicate that beet plants grown from treated seed may remain sufficiently toxic to the leafhopper to protect them through the four-leaf stage, which in the Salt River Valley would be about two weeks after the seedlings emerge. It is probable that in many instances no further control would be needed.

Observations on both large and small plots indicate that seed treatment with either American Cyanamid 12008 or 3911 gives some protection against lepidopterous larvae in plants in the cotyledon and two-leaf stages. Heavily infested fields would probably have to be dusted once later, but protection to the small plants shortly after emergence could prevent the loss of stands.

Summary

Greenhouse tests with several systemic insecticides showed them to be toxic to the beet leafhopper, both as a soil drench and as a seed treatment. Field tests in small plots and in five-acre commercial plantings showed that seed treatment with the phosphorous compounds American Cyanamid 12008 and 3911 would protect the seedling plants for at least two weeks after their emergence.

References

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