# Corn Earworm in Grain Sorghum

## Phosdrin and Thiodan show promise as substitutes for DDT in two experiments with aerial applications to infested fields

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**Damage to grain sorghum** by the corn earworm—*Heliothis zea* (Boddie)—has been especially severe in Butte and Glenn counties. Certain fields examined in 1957 and 1958 showed 90%–99% of the heads to be infested. Usually 1–4 larvae per head were found although some heads had 10–16 larvae.

Applications of 10% DDT dust at the rate of 2–3 pounds of actual toxicant per acre have provided satisfactory control of the corn earworm but presented a residue problem.

Two experiments were conducted in 1958 to determine the amounts of residual DDT on the grain at intervals—following spray and dust applications—prior to harvest and to investigate the possibilities of controlling the pest with materials other than DDT.

One experiment was in a field of Double Dwarf 38 milo and the other in a field of RS610, a new commercial hybrid variety. All of the tested insecticides were applied by aircraft once in each experiment. With the exception of the 10% DDT dust treatment, the insecticides were applied as sprays at the rate of 10 gallons per acre. Because aerial equipment was used, the treatments were not replicated within the field. In the Double Dwarf 38 experiment the plots were 132′ wide—four plane passes—and 1,100′ long. The RS610 plots were 66′ wide—two plane passes—and 870′ long.

Earworm populations were determined in pre- and post-treatment counts by recording larvae present in 200 heads selected in each plot.

Seed heads from DDT spray and dust treatments and checks in the RS610 experiment were obtained at regular intervals after treatment to determine DDT residues. The first samples were taken four days after the insecticides were applied. Collections were made at weekly intervals thereafter with the last samples taken 39 days after treating. On each date 50 heads were selected at random from each treatment. The heads taken on the first three sampling dates were too green to thresh and the DDT analyses were made on the entire seed heads. Succeeding samples were threshed and analyses were run on the grain.

Another series of similar samples for residue analyses was taken from a field of Double Dwarf 38 which had been treated once commercially with 10% DDT dust at 25 pounds per acre.

DDT residues were considerably higher in the sprayed samples than in corresponding samples taken from the dust plots. The data are somewhat erratic in that DDT residues on heads taken from both spray and dust treatments, 25 days after treating, were higher than those taken earlier or later except for the samples taken at four days in the sprayed plot. That inconsistency is difficult to explain because it occurred in both treatments sampled on this date. Except for this sample it appears that little or no DDT residues were present on the threshed grain 18 days after treating with DDT dust. However, with the spray, residues of approximately 2.0 ppm—parts per million—DDT occurred on the threshed grain 39 days after treating.

The insecticides, as tested, had little or no effect in reducing the number of infested heads because the majority of the heads in both experiments were infested prior to treatments. The slight differences observed were not significant and probably due to sampling variation.

The effect achieved by the insecticides was indicated by reductions in numbers of larvae following the applications. Control was poor in the Double Dwarf 38 experiment. Reduction in larval popula-

**Control of Corn Earworm Attacking Grain Sorghum Heads. Double Dwarf 38 Variety. Chico, 1958.**

| Insecticide[a] | Toxicant per acre (lbs.) | No. of infested heads per 200: Pre-treatment 8/27/58 | Post-treatment 9/2/58 | No. of larvae per 200 heads: Pre-treatment 8/27/58 | Post-treatment 9/2/58 | Per cent reduction of larvae below pre-treatment counts |
|---|---|---|---|---|---|---|
| Check | .. | 190 | 188 | 189 | 80 | 57.7 |
| Dylox 50% sol. powd. | 1.0 | 183 | 185 | 164 | 52 | 68.2 |
| Thiodan E.C. | 1.0 | 198 | 182 | 189 | 64 | 66.1 |
| Thiodan E.C. | 0.5 | 188 | 190 | 183 | 39 | 78.7 |
| Phosdrin E.C. | 0.5 | 188 | 189 | 155 | 82 | 43.1 |
| Phosdrin water sol. | 0.5 | 192 | 183 | 134 | 56 | 58.2 |
| Dibrom 8 E.C. | 1.0 | 192 | 193 | 177 | 108 | 39.0 |

[a] Insecticide applied by air in 10 gallons of spray per acre on August 28, 1958.

**Control of Corn Earworm Attacking Grain Sorghum Heads. RS610 Variety. Orland, 1958.**

| Insecticide[a] | Toxicant per acre (lbs.) | No. of infested heads per 200: Pre-treatment 9/2/58 | Post-treatment 9/8/58 | No. of larvae per 200 heads: Pre-treatment 9/2/58 | Post-treatment 9/8/58 | Per cent reduction of larvae below pre-treatment counts |
|---|---|---|---|---|---|---|
| Check | .. | 138 | 182 | 254 | 256 | 00.0 |
| Dylox 50% sol. powd. | 1.0 | 191 | 183 | 575 | 69 | 89.1 |
| Thiodan E.C. | 1.0 | 186 | 168 | 497 | 25 | 95.0 |
| Phosdrin E.C. | 1.0 | 160 | 183 | 471 | 14 | 97.1 |
| Guthion E.C. | 0.5 | 197 | 196 | 464 | 70 | 84.9 |
| DDT E.C. | 2.0 | 198 | 191 | 408 | 5 | 98.8 |
| DDT 10% dust | 2.5 | 191 | 192 | 637 | 8 | 98.8 |

[a] Insecticides applied by air on Sept. 4, 1958. Sprays applied at rate of 10 gal/acre and the dust at 25 lbs. per acre.

**Residues on Grain Sorghum Heads and Seeds Following DDT Spray and Dust Applications. Glenn County, 1958.[a]**

| Variety | Days after treatment | ppm DDT: Check | Dust[b] | Spray[c] |
|---|---|---|---|---|
| RS610 Seed Heads | 4 | < 0.5 | 5.4 | 22.0 |
| | 11 | < 0.5 | 2.6 | 7.0 |
| | 18 | 0.8 | 0.7 | 2.5 |
| | 25 | < 0.5 | 6.2 | 13.3 |
| RS610 Threshed Seeds | 25 | 0.5 | 0.8 | 3.2 |
| | 32 | < 0.5 | 0.8 | 2.0 |
| | 39 | 0.6 | 0.5 | 2.7 |
| Double Dwarf 38 Seed Heads | 4 | < 0.5 | 7.0 | .. |
| | 11 | < 0.5 | 3.5 | .. |
| | 18 | 0.8 | 1.3 | .. |
| Double Dwarf 38 Threshed Seeds | 18 | 0.8 | 0.6 | .. |
| | 25 | 0.5 | 0.2 | .. |

[a] Analyses by Toxicology laboratory at U. C., Berkeley.
[b] 2.5 lbs. toxicant per acre.
[c] 2.0 lbs. toxicant per acre.

tions occurred in all treatments including the check but the differences between the treatments did not appear significant.

The heads of Double Dwarf 38 are characteristically tight and compact. In the test field many heads were covered by the dense foliage, which made it almost impossible to apply liquid insecticides thoroughly to the heads. Furthermore, most of the larvae in the field were mature or nearly mature at the time of treating. Many of the larvae were leaving the plants to pupate. This factor alone undoubtedly accounted for much of the difference in numbers of larvae between the pre- and post-treatment counts of the check. The age of the larvae undoubtedly influenced the degree of control, because mature larvae are more tolerant of certain insecticides than are the younger larvae.

Excellent control of the corn earworm was obtained in the RS610 variety with DDT spray and dust—each 98.8%—followed closely by Phosdrin—97.1%—and Thiodan—95%. Guthion with 84.9% and Dylox with 89.1% gave the poorest control. The RS610 variety produces heads on stalks high above the foliage. The heads are loose and not as compact as those of Double Dwarf 38. While a much heavier infestation was in the RS610 field the larvae were mostly immature—first to third instars—at the time of treatment.

From these experiments it appears that DDT is highly effective in reducing numbers of corn earworm larvae in grain sorghum heads. However, spray applications of DDT result in significant residues on the grain at harvest. Although residues on threshed grain were extremely small in the dusted plots, Federal regulation prohibits any residue.

The results of these tests indicate that Phosdrin, Thiodan, and perhaps Dylox are materials that could be substituted for DDT. Dust formulations of these materials were not tested, but it is possible that dusts may prove to be superior to airplane spray applications in penetrating the grain sorghum heads.

To achieve maximum control, fields should be treated while the larvae are small and before extensive feeding damage has occurred in the heads. The presence of small larvae can be detected readily without removing the heads from the plant by jarring the heads over a pan.

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## LIME

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should be more friable and easy to cultivate. Power requirements for tillage should be reduced and seedbed preparation less difficult. No plant differences could be attributed to the changes in physical condition but greenhouse methods minimize the effect of physical condition on yield.

Samples of the same three soils—Colusa silty clay, Yolo silty clay loam, and Capay clay—were tested for hydraulic conductivity by the laboratory method of determining the flow of water through a column of soil to gain information on the permeability of soils. As was the case with modulus of rupture, some soils are affected more favorably than others by the addition of lime. The permeability of a soil is increased by the addition of lime, the first increment of 10 tons per acre being practically as effective as larger amounts. Hydraulic conductivity and modulus of rupture data indicate an improvement in the physical conditions of some soils.

Because the tomato plants showed an increase in growth, which could be attributed to the phosphate, the phosphorus content of 23 samples of sugar beet by-product lime—representing old and new production—was determined chemically.

Sugar beet lime may contain from 0.06% to 0.64% phosphorus or an average of 0.38% phosphorus. An application of 10 tons per acre of sugar beet lime may add to the soil some 12 to 128 pounds of phosphorus per acre or, expressed as phosphorus pentoxide, from 27.5 to 313 pounds per acre. Laboratory and greenhouse studies indicate that this phosphate is readily available.

It is evident that modulus of rupture and permeability of some soils can be improved by lime applications and other soils may be improved only slightly or show no change. At present, there is no test or measurement that can be readily utilized to determine which soils might be changed favorably by lime applications. While increased yields may not result from this improvement, cultivation and seedbed preparations may be somewhat easier. No adverse nutritional effects could be demonstrated.

Sugar beet by-product lime can not be considered a fertilizer and the response obtained in these studies might be nutritional rather than a result of physical improvement of the soil. The percentage of phosphate in sugar beet by-product lime varies—even from the same refinery—and there is no assurance that the lime will always contain a uniform concentration of phosphorus.

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## DISTRICTS

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ness of district agricultural production to one or more of the external economic conditions.

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*The foregoing is based on a research project financed in part by the Water Resources Center of the University of California.*

## ALFALFA

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At such locations growers applied phosphate fertilizers, and yield responses were observed. The survey indicated also alfalfa fields where phosphorus application was not needed. Strip tests with superphosphate were tried in many such fields and—in no case—was a response to fertilization obtained.

Plant analysis shows real promise as a means of evaluating the phosphorus status of alfalfa fields and as a guide for the development of improved fertilization practices.

Samples of alfalfa plants for tissue analysis must be collected at the one-tenth bloom stage—the ideal time for hay harvest—or when one out of 10 plants is in bloom. In spring or fall the plants are in a growth stage comparable to the one-tenth bloom period when the small regrowth shoots, growing up from the plant crown, are ¼″–½″ in length. The soluble phosphate concentration in the midstem tissue will be too high in alfalfa plants sampled before the one-tenth bloom stage and, at more mature stages of growth, the phosphorus readings will be too low. The critical values reported in this article apply only to alfalfa plants in the one-tenth bloom stage of growth.

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