DDT Residues on Sweet Corn

kernels and cob of corn treated with DDT remain practically free of residues but amounts on plant restrict use as fodder

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Technical DDT at the rate of 4.5 to 12 pounds an acre—depending upon the method and number of applications—is applied to most of California's commercial sweet corn acreage to control the corn earworm.

Residue analyses have repeatedly shown that there are either no residues or only insignificant amounts of DDT on the kernels and cob of fresh market corn. However, residues that range from 283 ppm—parts per million—to 7.1 ppm have been found on the husks, silks, leaves, and stalks of treated plants. Analyses of corn ensilage have shown DDT residues ranging from 290 ppm—in freshly chopped material—to 148 ppm in ensilage 165 days after preparation.

High DDT residues on sweet corn forage present a serious problem to dairymen because cows on a diet containing DDT secrete this substance in their milk, and—according to both State and Federal law—no DDT is allowable in milk. If DDT is detected in milk, the dairyman is subject to action by the State Bureau of Dairy Service which could result in seizure of the milk and other penalties. Furthermore, it is a violation of State law to sell forage that contains more than 7 ppm of DDT.

The problem of feeding forage contaminated with DDT to nonlactating animals or to meat animals has not been resolved, but forage containing over 7 ppm DDT should not be fed to animals being fattened for slaughter.

One of the most effective and widely used methods of controlling the corn earworm is to apply a 5% DDT dust to the silks of individual ears with a stencil brush. A less effective but still widely used method is aircraft dust applications. Ground spray and dust applications are sometimes used and occasionally DDT is applied as an oil solution which is injected into the tips of the ears with an oil can.

The amount of DDT residue varies with the method and number of applications.

In one experiment in Riverside, over 300 samples of sweet corn—that had received three applications of 5% DDT dust by the brush method—were analyzed. Residues on kernels and cob ranged from 0.99 to 1.40 ppm and averaged 1.18 ppm. Residues on husks and silks ranged from 229 to 283 ppm and averaged 254 ppm.

In another experiment, at San Jose, three applications of 0.75% DDT emulsion spray with a power sprayer at the rate of 50 gallons per acre per application resulted in from 0.19 to 0.53 ppm of DDT on kernels and cob and from 19.8 to 28.2 ppm of DDT on husks and silks.

Analyses of ears treated by the injection method—0.5 cubic centimeter of a 1% DDT-mineral oil solution—revealed DDT residues of from 0 to 2.7 ppm on kernels and cobs and from 18 to 38 ppm on husks and silks.

Smallest residues on husks and silks result from broadcast dust applications. Depending upon the concentration of dust used and the number of applications, residues of from 7.1 to 12.0 ppm have been found.

DDT Residues on Sweet Corn Fodder Resulting from Various Treatments. Kern County, 1951

Method of application	DDT % concentration	Applications: Rate	Applications: No.	DDT residue ppm on: Leaves and stalks	DDT residue ppm on: Unhusked ears
Brush dust	5.0	30 P/A	3	120.9	119.3
Individual ear spray	0.75	1.5-2cc/ear	3	32.2	31.0
Fixed nozzle boom spray	0.75	50GPA	3	129.9	51.1
Airplane dust	10.0	40 P/A	2	40.1	5.8

On Leaves and Stalks

It is impossible to confine DDT to the corn ears alone—with the exception of the oil injection method—because even when using the utmost care in brush dusting, large quantities of dust are dropped on the foliage where it may lodge between the ears and stalks and at points where leaves join the stalk.

General applications of sprays and dusts by air or by ground equipment contaminate all portions of the plant above ground.

Data obtained in Kern County indicated that the largest DDT residues on leaves and stalks occurred when individual ear brush dusting and fixed nozzle boom spray applications were used. Smallest residues resulted from individual ear spray treatments and airplane dust applications. Unfortunately, from the residue standpoint, best control of the corn earworm is obtained by brush dusting and poorest control results from airplane applications. In the Kern County tests, the least amount of residue on leaves and stalks was 32.2 ppm of DDT—considerably in excess of the 7 ppm tolerance allowed by law if the forage is to be sold for feed.

Residues on Ensilage

A study was conducted in Kern County to determine the rate of breakdown of DDT in sweet corn ensilage stored in a pit silo.

The field from which the ensilage was obtained had received six applications of a 10% DDT dust at 30 pounds per acre per application by air and two individual ear brush dust applications of 5% DDT at 30 pounds per acre per application. The marketable ears had been harvested. Ears remaining on the stalks were fairly numerous and consisted of sucker ears and poorly filled ears that were not of marketable quality. Most of these had received the brush applications.

Perhaps the field represented an extreme in numbers of insecticide applications. A more normal situation would probably be one or two airplane applications and three or possibly four brush dust treatments.

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DDT Residues on Sweet Corn Ensilage Samples at Approximately Monthly Intervals from Initial Preparation to Final Feeding[2, 3]. Kern County, 1951–52

Days after initial preparation of ensilage	DDT residue ppm: Wet wt.	DDT residue ppm: Dry wt.
0[1]	290	...
47	96	...
73	288	870
106	168	672
134	168	710
165	148	617

[1] Green freshly chopped material going into the silo.

[2] Each sample consisted of 10 pounds of material taken from approximately one foot below the top surface of the ensilage.

[3] The field received six applications of 10% DDT dust at 30 pounds per acre per application by air and two applications of 5% DDT dust applied to the silks with a stencil brush at the rate of 30 pounds per acre per application.

CORN

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Residue analyses were made from samples of approximately 10 pounds taken—from the same location in the silo on each sampling date—about 1′ below the surface of the ensilage.

The first sample—from fresh ensilage being put into the silo—analyzed 290 ppm of DDT. The second sample taken after 47 days in the silo analyzed 96 ppm of DDT. In view of the analyses of later samples, it is apparent that this sample was abnormally low. Samples taken 73 days after storage and subsequent samples were divided and analyzed both on the basis of their wet weight and on the basis of air dry weight. The differences in residues point out the importance of moisture content in such analyses. With a given amount of insecticide, the dryer the sample the greater is the rate of DDT to total weight of the sample. The data clearly indicate that DDT residues do not break down rapidly on sweet corn ensilage. In one sample of ensilage, 148 ppm of DDT were present—expressed in terms of wet weight—165 days after preparation. This represents approximately a 50% reduction under the initial residues.

DDT Residues on Sweet Corn Ensilage at Various Depths from Approximately One Foot Below the Surface to the Bottom of the Silo. Kern County, 1952.

Depth below surface of ensilage in feet	DDT residue ppm	
	Wet wt.	Dry wt.
1	125	500
2	68	325
4	98	394
6	70	308
8	88	337
10	83	314

Because first series of samples were taken from approximately 1′ below the surface of the ensilage, additional samples were taken at greater depths. On the last sampling date—165 days after initial preparation of the ensilage—samples were taken at approximately 2′ intervals from the top to the bottom of the pit. The sample nearest the surface—approximately 1′—contained 125 ppm of DDT on a wet weight basis which was higher than any of the rest. Probably this was because the temperatures near the surface were lower than those at greater depths in the silo. At lower temperatures DDT is broken down more slowly. There was relatively little difference in residues on samples taken below the 1′ level, indicating a rather uniform distribution of DDT throughout the ensilage.

Some of the sweet corn analyzed in these experiments was being fed to beef cattle, but none to dairy animals, so no studies were conducted to determine DDT residues in milk resulting from the feeding of treated sweet corn. However, work by other investigators has shown that even when very low residue is on cattle feed, appreciable DDT will appear in the milk. In one extensive series of experiments, seven cows were fed alfalfa hay with a DDT residue averaging 7 ppm and 8 ppm. After the first few days, the amount of DDT in the milk remained steady at about 2.3 to 3.0 ppm. Butter made from this milk was found to contain 65 ppm of DDT.

In other studies, five cows receiving pea silage containing about 100 ppm DDT for approximately four months had 15.6 ppm DDT in their milk.

Because there is no practical method of eliminating DDT residues from sweet corn once the insecticide has been applied, it is apparent that treated corn forage fed to dairy cattle could result in appreciable quantities of DDT in milk. Consequently, sweet corn fodder that has been treated with DDT should never be fed to dairy animals and it should not be fed to meat animals being fattened for slaughter.

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Determinations of DDT residue on corn were made at Riverside by L. D. Anderson, Entomologist, and F. A. Gunther, Associate Insect Toxicologist, University of California.

The investigations with DDT on alfalfa hay were conducted by Ray F. Smith, Associate Professor of Entomology, and W. M. Hoskins, Professor of Entomology, University of California, Berkeley; and O. H. Fullmer, formerly Research Assistant, University of California, Berkeley.

The studies with pea vine silage were made by H. F. Wilson, Professor of Economic Entomology; N. N. Allen, Professor of Dairy Husbandry; G. Bohstedt, Professor of Animal Husbandry; J. Betheil, Graduate Assistant in Biochemistry; and H. A. Lardy, Assistant Professor in Bacteriology, University of Wisconsin.

MITES

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was actually killed. The plot sprayed with dormant oil alone also required retreatment in June. This seems to be typical of the results obtained in past seasons with dormant oil. Even with a carefully hand sprayed plot, the mites build up to damaging populations by early June, and when air carrier equipment is used, the results have been even less satisfactory.

Genite-923 and Mitox held the mites in check until July, and if two-spotted mite had not become a problem in the orchard at that time—necessitating treatment with an acaricide to prevent foliage damage—seasonal control might have been obtained. There was little difference between the plot sprayed with Genite-923 alone and the plot which received dormant oil followed by Genite-923, although some differences might have been observed if it had been possible to continue the experiment for a longer period of time.

Compound 1303 also showed considerable promise. The mites did not build up to significant numbers until July, at which time the plot required retreatment. This has been the first phosphate compound—in tests made over the past several years—which has shown an ability to kill the overwintering eggs of European red mite.

Of the materials which were effective in the experiment, only Genite-923 is available for use by growers at the present time. The other materials are, as yet, experimental and will be further tested in the coming season.

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RUSSET

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during April 1955 was 6F below normal and the temperature in a shelter near the orchard dipped to 28F on the morning of April 2. Frost injury was evident by blackened centers in 80% to 95% of the flowers and small fruits. It is also possible under these low temperature conditions that a spray may cause more russet than a dust.

Bentonite dust, used as the carrier for streptomycin in the 1953 and 1954 trials, appeared to have some russet-reducing properties again in 1955. In the earlier experiments, fruit from trees dusted with streptomycin-bentonite had less russet than that from trees given no blight control treatment.

In the 1955 studies, three applications of a 200-mesh bentonite dust were superimposed on a portion of the check, the copper, and certain of the streptomycin plots in the three test orchards. The bentonite was applied at 10- to 12-day intervals during the blight control period.

In the Sacramento Valley orchard, fruit from trees in the copper-lime plot which were dusted three times with bentonite had less russet than fruit dusted only with copper-lime. This was the orchard where fruit subjected to either the copper-lime or streptomycin applications developed more russet than that from the check trees receiving no blight control treatment. However, the bentonite did not reduce the amount of fruit russet in the check plot. Out of seven other comparisons with and without ben-

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