

# Corn Pesticide Performance in Missouri 1984



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Abstract

Corn herbicide and soil insecticide failures have become an increasing concern to the agricultural industry in recent years. A corn pesticide performance survey was conducted in 1984 in Missouri. The primary objective was to obtain information on the extent and distribution of poor corn pesticide performance. Questionnaires were mailed to 3,000 farmers in 1984. The response was approximately 19 percent and represented 2.1 percent of all corn acres planted. All crop reporting districts reported a range in performances of pesticides for control of corn pests.

### Introduction

The herbicides and insecticides used in today's agriculture are, in general, non-persistent. This characteristic is important in that there is little or no "carry over" in the soil that may adversely affect the environment or the crop planted in the same or subsequent seasons.

In recent years, performance failures of some herbicides and insecticides have raised questions about the fates of pesticides in soil. Additionally, these failures raise concern for the future utilization of certain classes of agricultural chemicals.

Many factors influence the fate of pesticides in soil. They include: adsorption; leaching; volatilization; uptake by soil organisms and plants; movement with runoff water and eroded soil; microbial degradation; chemical degradation; and photolysis. The chemical nature of the pesticide, the soil type, and environmental conditions are of primary significance in determining the relative importance of these factors.

Biodegradation is a natural and expected process by which soil-applied pesticides are broken down by microorganisms and removed from the environment. The primary microorganisms found in the soil are algae, fungi, actinomycetes, and bacteria. These microorganisms are dependent on organic compounds for energy and growth. When a pesticide is added to the soil and is in solution, it is susceptible to attack as an energy source. If a microorganism can adopt the pesticide as an energy source, it will rapidly metabolize the pesticide. Conditions that encourage the growth of degrading organisms will enhance the transformation and disappearance of the original pesticide compound.

Felsot et al. reported in 1981 that Furadan (carbofuran) was rapidly lost from soils with a three year history of carbofuran use. Poor pest control in such soils was attributed to unavailability of insecticides following rapid degradation by soil microbes. In 1983, Amaze (isofenphos), a soil insecticide, was reported (Illinois Natural History Survey Bulletin #899) to provide poor or no control of corn rootworm in parts of southern Wisconsin and northern Illinois. McNevin and Harvey (1982) reported difficulty in controlling proso millet in Wisconsin soils because of shortened activity of thiocarbamate herbicides. Skipper et al. (1985) associated soil microbes with the rapid degradation of the commonly used Eradicane (EPTC) and Sutan (butylate).

Human error also contributes to pesticide failure in some instances. The most common errors are related to application, calibration, and placement.

This survey was undertaken because of the increasing awareness of pesticide failures in Missouri. No attempt was made to associate the causes of poor pesticide performance with any of the numerous factors known to contribute to performance failure. The information recorded here serves as an indicator and data base for performance of two major groups of farm chemicals for 1984 and preceding years.

## Methods

This survey was a cooperative effort between the University of Missouri-Columbia Departments of Entomology and Agronomy and USDA-ARS. The design, compilation, and tabulation of the questionnaires were a joint venture of the Entomology and Agronomy departments.

A questionnaire was sent to corn producers in all crop districts throughout Missouri in October 1984 to examine the distribution and performance of corn herbicides and insecticides. The 3000 producers receiving the questionnaire were selected from a list of respondents participating in surveys conducted by the Missouri Crop and Livestock Reporting Service. Responses were grouped according to state crop reporting districts (Fig. 1).

There were six sections to the questionnaire. The first section dealt with herbicide performance in 1984 and prior years. A list of brand name products including Atrazine, Bladex, Dual, Eradicane, Lasso, Lorox, Paraquat, and Sutant was presented, as was an "Other" category. Performance of the product was based on a scale of 1-4. A rating of 1 was excellent, 2 was good, 3 was fair, and 4 was poor. The second section examined insecticide performance in 1984 and prior years. A list of brand name products including Furadan, Counter, Amaze, Dyfonate, Thimet, Mocap, Lorsban, and "Other" was presented. Performance was based on the same scale as herbicides. The third section dealt with tillage practices used on the majority of production fields in 1982, 1983, and 1984. The choices included No-till, Minimum Tillage, and Regular Tillage. Regular tillage is defined as that tillage including moldboard plowing, discing/harrowing, and planting in the conventional manner. Section four requested information on crop rotation(s) used on the majority of acreage planted in 1982, 1983, and 1984. Choices were Corn following Corn; Corn following Soybeans; and Corn following "Other." Section five asked if manure had been applied to acreages in corn. A response of yes or no was indicated. The last section asked the grower if failures or poor performance of pesticides had occurred previously. Again, a response of yes or no was indicated. A copy of the questionnaire is included in the appendix.

## Results

Response to the survey was excellent. Questionnaires were mailed to 3,000 corn producers and approximately 19 percent responded. That represented 2.1 percent of all corn acres planted. Nonusable returns accounted for less than 0.1 percent of the total responses. All results of the survey are listed in the order in which they appeared on the questionnaire. The results of sections one through four are presented by region. Results in sections five and six reflect the entire state.

### Herbicide Performance (Tables 1 and 2)

Atrazine was probably the most popular corn herbicide in Missouri, and its performance was rated as good to excellent by most of the growers sampled. Atrazine apparently did not perform as expected in Districts 7 and 9 in 1984.

Bladex performance was generally rated as good throughout the state. District 7 growers rated Bladex very high. Exceptions to the general trend were a good to fair performance in Districts 4 and 8 in 1984 and Districts 1, 4, and 8 in prior years.

Dual performed as well as Atrazine, but grower response was lacking. Districts 4 and 5 had more responses of "fair" than other districts.

Eradicane was a strong performer throughout the state. The number of growers rating Eradicane as poor and fair dropped in 1984. Overall, Eradicane was rated as good.

Lasso rivalled Atrazine in popularity and gave good to excellent performance in most districts. Districts 7, 8, and 9 tended to rate Lasso as good to fair. Overall, the performance of Lasso was rated good to excellent.

Lorox was a typical "middle of the road" herbicide. Districts 7 and 8 had no growers responding to Lorox usage.

Paraquat was not as consistent in performance as were the other herbicides. Much variation in performance can be seen between Districts 1 and 2. The use of Paraquat is somewhat limited to minimum and no-tillage systems.

Sutant was generally rated as good, although some growers in District 5 rated its performance as poor. The ratings for Sutant in District 3 are very high. District 7 had no growers responding to Sutant use in 1984.

The category of "Other" herbicides included compounds not specifically listed in the questionnaire. The overall performance of "Other" herbicides in Missouri was good to excellent.

#### Insecticide Performance (Tables 3 and 4)

Insecticides were used in corn primarily for controlling corn rootworms and black cutworm.

Furadan is one of the more popular insecticides in Missouri and was generally rated as good.

Counter performance was generally rated as good throughout the state. The use of Counter was heaviest in Districts 1, 2, and 5. Districts 7, 8, and 9 had no response to Counter use.

Amaze was limited in use, but an overall performance of fair to excellent was indicated. None of the reporting districts had responses of poor. Districts 2, 6, 7, 8, and 9 had no growers responding to Amaze use.

Dyfonate was rated as good to fair. Ratings for Dyfonate were greatest where use was greatest, and in these areas of high use, ratings were good. Districts 7, 8, and 9 had no response to Dyfonate use.

The response to Thimet was limited. Thimet was given a rating of fair to good in districts 1, 4, and 5.

Mocap was generally rated as good to excellent in Districts 1 through 6. There was almost no response to Mocap use in Districts 7, 8, and 9.

Lorsban was one of the more popular soil insecticides in Missouri, and the performance of this compound was rated as good to excellent. District 8 had minimal Lorsban use.

Only Districts 3 and 9 responded to the "Other" insecticide category. Ratings of good to excellent were indicated.

In general, grower response to herbicide performance in Missouri remained unchanged. Insecticide performance in Missouri declined in 1984 when compared to ratings for prior years.

### Tillage Practices

Tillage practices (Table 5) have shown some dynamic changes in recent years. No-tillage is increasing. A 50 percent gain in no-till was indicated for 1983, and a 73 percent increase was realized in 1984. Minimum tillage is increasing but not at the rate of no-till. The use of minimum tillage increased 18.6 percent in 1983 and 1.2 percent in 1984. Reduction in regular tillage occurred, although not as dramatically as the growth of no-till or minimum tillage. Regular tillage in 1983 dropped 8.6 percent, and further declined 7.2 percent in 1984.

Pesticide use is expected to increase because farmers will rely more heavily on pesticides to control the greater numbers of weeds and insects associated with minimum and no-tillage practices. Performance of pesticides in minimum and no-tillage may be more variable because of altered environmental conditions and changing pest populations.

### Crop Rotation

Rotation practices in Missouri for the survey years show much variation (Table 6). Corn-Soybeans was the preferred crop rotation in Districts 1, 2, 3, 4, and 9. In these districts, Corn-Corn was generally the second most common rotation. In Districts 5 and 8, Corn-Corn rotation was preferred, followed by Corn-Soybeans. In District 6, Corn-Other was the number one choice, followed by Corn-Corn and Corn-Soybeans. In District 7, Corn-Corn was preferred, followed closely by Corn-Soybeans and Corn-Other.

Farmers in Missouri apparently favor corn-soybean rotation, followed by corn-corn. The impact of crop rotation on pesticide use and performance is not clear. However, insect pests such as corn rootworm and black cutworm may be affected. For example, corn-corn rotation favors continued build-up of corn rootworm populations, but rotations of corn-soybeans decreases rootworm populations. Rotations of corn-soybeans, primarily soybeans to corn, favor potentially heavy black cutworm damage in first-year corn. Herbicides may show a similar relationship. For example, fields with corn-corn rotations may have heavy infestations of foxtail, pigweed, and shattercane. However, because of the change in the use of herbicides in corn-soybean rotations, velvetleaf, volunteer corn, and cocklebur infestations may be favored. Pesticide performance as indicated by the survey is fairly consistent with respect to corn-soybean rotations.

### Manure Application

The survey indicated an interesting trend between manure application and pesticide failure (Tables 7 and 8). This trend may suggest that manure adversely affects the performance of soil-applied pesticides.

### Pesticide Failures

Corn producers throughout Missouri expressed concern for pesticide failure problems. Twenty-one percent of the farmers responded as having previous experience with pesticide failures. Table 8 shows the percent by district of growers reporting pesticide failures.

### Summary

Corn producers throughout Missouri expressed concern for pesticide failure problems. More than 20 percent of corn producers indicated a previous experience with pesticide failure, and nearly 30 percent rated pesticide performance for 1984 and prior years as poor to fair.

Atrazine was apparently the most popular corn herbicide in Missouri. Furadan and Lorsban appeared to be the most widely used insecticides.

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TABLE 1. MEAN HERBICIDE PERFORMANCE RATINGS BASED ON GROWER RETURNS, 1984.

District	Atrazine	Bladex	Dual	Eradicane	Lasso	Lorox	Paraquat	Sutant+	Others
PERFORMANCE RATING <sup>1</sup>									
1	1.8	2.0	1.8	2.0	1.8	2.8	2.7	1.8	1.9
2	1.6	2.0	1.1	2.0	1.7	2.0	1.0	1.8	1.4
3	1.6	1.6	1.5	2.3	1.7	1.9	1.8	1.4	1.3
4	2.0	2.4	2.3	2.1	1.9	2.0	1.6	1.8	1.8
5	1.7	2.1	1.5	2.3	1.9	1.8	2.6	2.3	2.1
6	1.7	1.8	1.6	2.6	1.8	1.7	1.9	1.4	1.3
7	2.3	1.0	2.0	-	2.5	-	-	-	2.0
8	2.0	3.0	-	2.0	2.0	-	-	-	-
9	2.3	2.0	1.7	1.8	2.2	1.0	2.0	1.2	1.8

<sup>1</sup> 1=Excellent, 2=Good, 3=Fair, 4=Poor

TABLE 2. MEAN HERBICIDE PERFORMANCE RATINGS BASED ON GROWER RETURNS, YEARS PRIOR TO 1984.

District	Atrazine	Bladex	Dual	Eradicane	Lasso	Lorox	Paraquat	Sutant+	Others
PERFORMANCE RATING <sup>1</sup>									
1	1.8	2.4	1.8	2.0	2.0	2.8	3.3	2.2	1.8
2	1.8	2.0	1.5	2.4	1.9	2.6	1.3	1.8	1.7
3	1.7	2.2	1.7	1.8	2.2	2.0	2.0	1.3	1.6
4	1.8	2.6	2.1	1.6	1.8	1.8	1.5	1.8	2.0
5	1.7	2.1	2.0	2.6	1.8	1.8	2.5	2.5	1.7
6	1.6	2.1	1.8	2.3	1.8	2.0	1.8	2.0	2.2
7	1.8	1.0	-	-	2.4	-	-	-	2.0
8	1.8	2.3	-	2.0	2.0	-	-	2.0	1.0
9	1.9	2.0	2.5	2.4	2.1	2.0	2.0	1.6	2.0

<sup>1</sup> 1=Excellent, 2=Good, 3=Fair, 4=Poor

TABLE 3. MEAN INSECTICIDE PERFORMANCE RATINGS BASED ON GROWER RETURNS, 1984.

District	Furadan	Counter	Amaze	Dyfonate	Thimet	Mocap	Lorsban	Other
PERFORMANCE RATING <sup>1</sup>								
1	2.1	2.3	-	2.2	3.0	2.2	1.8	-
2	1.6	2.0	-	2.0	-	1.7	1.8	-
3	2.0	2.0	1.0	2.0	-	2.2	1.8	1.5
4	1.6	3.0	3.0	-	2.5	1.9	1.8	-
5	2.1	1.9	-	2.2	-	1.0	1.8	-
6	1.7	2.0	-	2.5	-	-	1.8	-
7	2.2	-	-	-	-	-	-	-
8	2.0	-	-	-	-	-	-	-
9	2.4	-	-	-	-	-	2.0	1.0

<sup>1</sup> 1=Excellent, 2=Good, 3=Fair, 4=Poor

TABLE 4. MEAN INSECTICIDE PERFORMANCE RATINGS BASED ON GROWER RETURNS, YEARS PRIOR TO 1984

District	Furadan	Counter	Amaze	Dyfonate	Thimet	Mocap	Lorsban	Other
PERFORMANCE RATING <sup>1</sup>								
1	2.2	2.2	1.0	2.1	1.8	2.1	2.0	-
2	2.4	2.2	-	1.5	-	1.6	1.8	-
3	2.3	2.4	2.5	2.8	-	2.5	1.8	2.0
4	2.0	1.5	2.0	3.0	3.0	2.6	2.1	-
5	2.0	2.4	2.0	2.2	2.0	2.6	1.9	-
6	2.6	1.5	-	2.8	-	1.0	1.9	-
7	2.2	-	-	-	-	-	2.0	-
8	1.6	-	-	-	-	-	-	-
9	2.1	-	-	-	-	4.0	2.0	1.0

<sup>1</sup> 1=Excellent, 2=Good, 3=Fair, 4=Poor

TABLE 5. TILLAGE SYSTEMS USED ON THE MAJORITY OF ACRES IN CORN PRODUCTION IN MISSOURI, BASED ON GROWER RETURNS.

District	Tillage System								
	No-till			Minimum			Regular		
	1982	1983	1984	1982	1983	1984	1982	1983	1984
	%								
1	0	2	6	37	48	47	63	50	47
2	5	5	7	35	39	41	60	56	52
3	4	4	8	46	50	51	49	46	41
4	0	0	0	52	56	53	48	44	47
5	3	3	3	31	43	50	66	55	47
6	2	5	7	25	33	31	73	61	61
7	0	0	0	29	29	25	71	71	75
8	0	0	0	50	40	40	50	60	60
9	0	3	3	17	19	19	83	77	77

TABLE 6. CROP ROTATIONS USED ON THE MAJORITY OF ACRES IN CORN PRODUCTION IN MISSOURI, BASED ON GROWER RETURNS.

District	Crop Rotation								
	Corn-Corn			Corn-Soybeans			Corn-Other		
	1982	1983	1984	1982	1983	1984	1982	1983	1984
	%								
1	11	12	12	81	81	78	8	6	10
2	11	15	14	78	77	78	11	8	8
3	8	9	16	78	79	66	14	12	19
4	12	11	15	78	76	69	10	13	16
5	45	38	41	34	37	38	21	25	21
6	35	30	31	24	29	27	41	41	42
7	43	29	25	29	43	38	29	29	38
8	20	50	80	20	25	20	60	25	-
9	10	13	18	87	84	74	3	3	9

TABLE 7. MISSOURI GROWERS APPLYING MANURE TO CORNFIELDS, 1984.

	Crop Reporting District								
	1	2	3	4	5	6	7	8	9
	%								
Growers applying manure	17	23	34	31	34	45	38	-	25

TABLE 8. PESTICIDE FAILURE IN MISSOURI, 1984.

	Crop Reporting District								
	1	2	3	4	5	6	7	8	9
	%								
Growers Reporting Failure	17	21	23	24	25	27	-	20	15

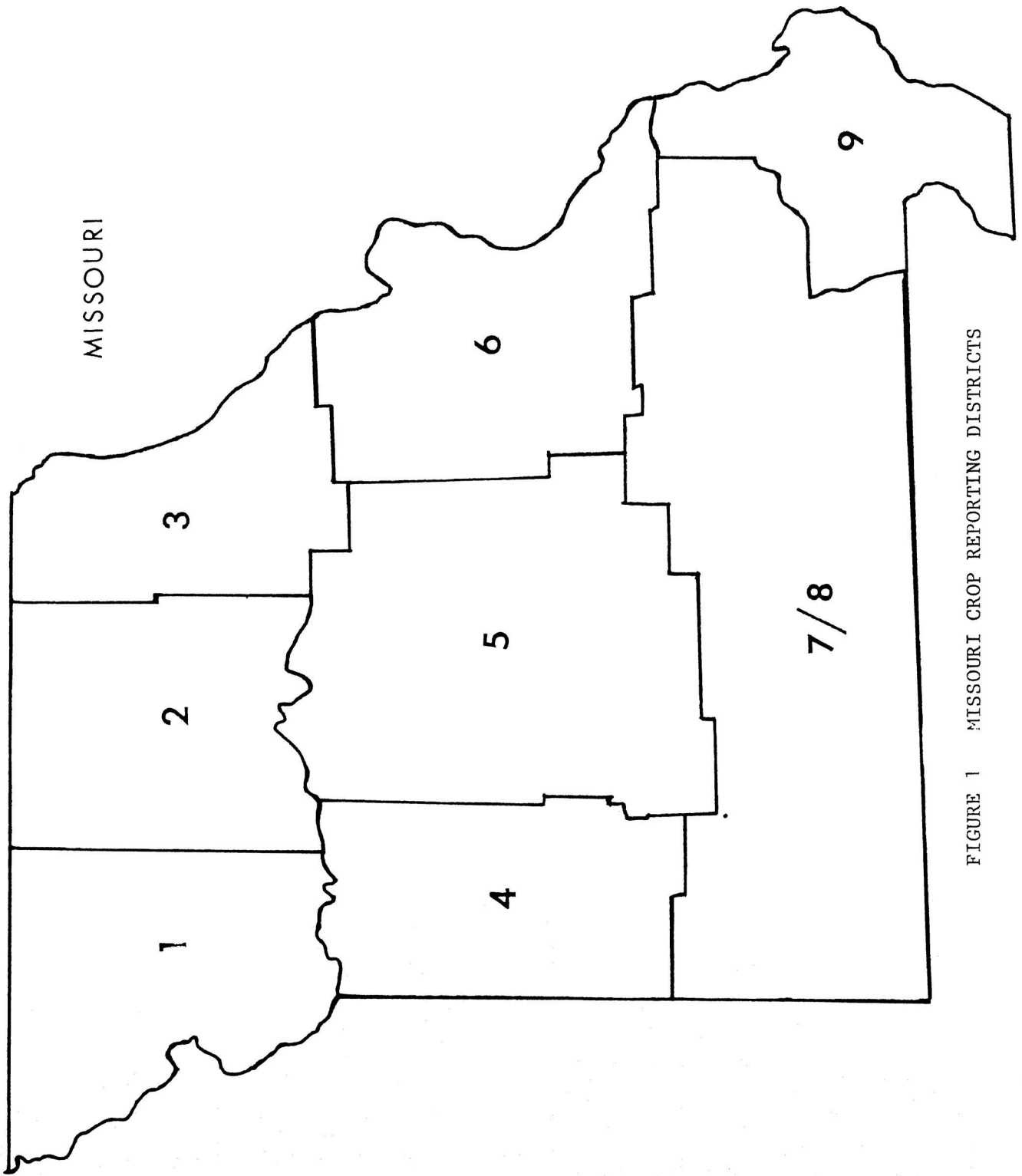


FIGURE 1 MISSOURI CROP REPORTING DISTRICTS

APPENDIX

1984 MISSOURI PESTICIDE PERFORMANCE SURVEY

Dear Corn Producer:

Corn insecticide and herbicide failures have become more of a concern in the last few years. This survey is being conducted by the University of Missouri Departments of Entomology and Agronomy to determine if such failures in corn production systems are real and how extensive failures may be throughout Missouri. A stamped return envelope is enclosed for your use.

Please read each question carefully and if you have records please refer to them when answering. Indicate your answer by checking the product and rating its performance.

I. HERBICIDE PERFORMANCE ON CORN:(Use the following rating scale: 1=excellent; 2=good; 3=fair; 4=poor.)

A. Please rate the performance of herbicide(s) that you used on corn.

Brand Name	A. Performance in 1984 (check below)				B. Performance in prior years (check below)			
	1	2	3	4	1	2	3	4
Atrazine								
Bladex								
Dual								
Eradicane								
Lasso								
Lorox								
Paraquat								
Sutan +								
Other _____								

II. INSECTICIDE USAGE ON CORN:(Use the following rating scale: 1=excellent; 2=good; 3=fair; 4=poor.)

A. Please rate the performance of soil insecticide(s) you used on corn.

Brand Name	A. Performance in 1984 (check below)				B. Performance in prior years (check below)			
	1	2	3	4	1	2	3	4
Furadan								
Counter								
Amaze								
Dyfonate								
Thimet								
Mocap								
Lorsban								
Other _____								

III. What type of tillage did you use on the majority of your corn acreage: (Please check)

IV. What type of crop rotation did you use in: (Please check)

	1982	1983	1984
No-till			
Minimum tillage			
Regular tillage			

(Majority of Acreage)	1982	1983	1984
Corn following corn			
Corn following soybeans			
Corn following ( )			

V. Do you routinely apply livestock manure to any of your fields which also receive herbicides and insecticides? YES ( ) NO ( )

VI. Have you had any pesticide failures before? YES ( ) NO ( )  
If yes, please put name, address and phone number in space below.





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