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1980 PESTICIDE USE ON FIELD CORN
IN THE NORTHERN PLAINS

by

Michael Hanthorn, Craig Osteen,
Robert McDowell, and Larry Roberson

February 1982

ERS Staff Report No. AGES820204

Key words:

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1980 PESTICIDE USE ON FIELD CORN IN THE NORTHERN PLAINS. By Michael Hanthorn, Craig Osteen, Robert McDowell, and Larry Roberson; Natural Resource Economics Division, Economic Research Service, U.S. Department of Agriculture, Washington, D.C. 20250; February 1982.

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ABSTRACT

Farmers reported that 33.3 million pounds (a.i.) of pesticides were applied to field corn in the Northern Plains during 1980. This consisted of 23.7 million pounds (a.i.) of herbicides and 9.6 million pounds (a.i.) of insecticides. Pesticide acre-treatments totaled 23.1 million and consisted of 9 million with single material herbicides, 3.6 million with herbicide mixes, and 10.5 million with insecticides. The primary herbicides were alachlor, atrazine, and 2,4-D. The major insecticides were carbofuran, dimethoate, fonofos, parathion, and terbufos. Herbicides were applied primarily to control cocklebur, foxtail, and pigweed infestations, while insecticides were mainly used for Banks grass mite, corn borer, and corn rootworm larvae control. Coefficients of variation were computed for acres of field corn treated with specific pesticides.

Key words: Pesticides, herbicides, insecticides, active ingredient, acres treated, acre-treatments, application rates, primary target pests, field corn, and Northern Plains.

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* U.S. Department of Agriculture. *
* *

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PREFACE

This report presents data for pesticides applied to field corn in the Northern Plains during 1980. Pesticide use data for the major producing States not included in the Northern Plains and for all major producing regions are available in the following ERS Staff Reports:

- "1980 Pesticide Use on Field Corn in the Corn Belt"
- "1980 Pesticide Use on Field Corn in the Lake States"
- "1980 Pesticide Use on Field Corn in the Major Producing States".

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INTRODUCTION

This report presents pesticide use data for field corn grown in the Northern Plains during 1980. The data include usage patterns and quantities of specific herbicides and insecticides applied to field corn. This information should be useful to policymakers, academic institutions, government agencies, and private and commercial entities in evaluating the impacts of regulatory actions on specific pesticides, conducting economic analyses of pesticide use, developing more effective pest management programs, and conducting pesticide market analyses.

METHODOLOGY AND TERMINOLOGY

The Economics and Statistics Service collected pesticide use data as part of the 1980 Corn Objective Yield Survey. A total of 2,870 farmers, of which 560 were located in the Northern Plains, were personally interviewed by enumerators in the 16 major field corn producing States. The sample size by State was as follows: Kansas, 186; Nebraska, 234; and South Dakota, 140.

Sample fields for each State were randomly selected from farmers who reported through the June Enumerative Survey that they had planted or intended to plant field corn in 1980. Each field corn acre in a State had an equal probability of being selected. Consequently, the probability of a field being chosen was directly correlated to its size.

Several terms pertinent to this report are defined as follows. An "active ingredient" (a.i.) is that portion of a pesticide material that provides the control activity. "Acres treated" are the number of acres receiving one or more applications of a specific pesticide during the growing season. Acres treated with different pesticide materials cannot be summed because more than one material may have been applied on a given acre during the growing season.

Therefore, the addition of these numbers would result in multiple counting. "Acre-treatments" are the number of acres treated with a pesticide material multiplied by the number of applications made during the growing season. Acre-treatments are summed for each product at the State and regional level. "Pesticide mixes" are two or more pesticide materials that are premixed during formulation or tank-mixed at the time of application.

Pesticide application rates vary as a result of weather conditions, soil type, weed spectrum, and insect species. Also, the method of application influences the amount of a material used per acre. Herbicide and foliar insecticide application rates are generally expressed as broadcast rates. The amount of a material applied on an acre in either a band, in-furrow, or spot application is generally one-fourth to one-third the amount applied in a broadcast application. The application rate listed for each material in this report is an aggregation of band, broadcast, in-furrow, and spot applications.

RELIABILITY OF ESTIMATES

Estimates based upon sample surveys have varying degrees of statistical reliability. Confidence in data depends upon sample size, sampling methods, and the variability of the responses. To provide the user of the data with some indication of the reliability of the estimates, coefficients of variation (CV's) are presented in Appendix Table 1. The CV is a measure of relative variation (expressed in percentage terms) and can be used to indicate the degree of confidence a user can place in the estimate. The smaller the CV, the more reliable the estimate.

In simplest terms, it can be said there is 95 percent confidence that the sample represents the true population and that the true value for the population lies within an interval defined as the estimated value \pm 2 CV's times the

estimated value. For example, with a CV of 10 percent and an estimate of 40, the interval would be 32 to 48. However, there is a 5 percent chance that the true value does not fall within the interval as defined above because the sample is not representative of the population.

CV's were calculated only for acres treated with specific pesticides. The estimates of acres treated are expected to have greater variation than other data reported. Consequently, for most other information included in this report, the level of reliability should be equal to or greater than reported for acres treated.

NORTHERN PLAINS

Description

The Northern Plains include Kansas, Nebraska, and South Dakota (Figure 1). In 1980, 16 percent of the U.S. field corn acreage (13.1 million acres) was planted in these States, from which 13 percent of the corn for grain (843 million bushels) and 14 percent of the corn silage (16 million tons) were produced (Table 1). The farm value of corn for grain grown in this region during 1980 was \$2.7 billion.

Trends in Pesticide Use

Total acres planted to field corn increased 2.5 million (24 percent) between 1972 and 1980, while the number of planted acres treated with herbicides and insecticides more than doubled (Table 2). In 1980, the percentage of planted acres treated with herbicides and insecticides was greatest in Kansas and decreased northward through South Dakota. The largest percentage increase in herbicide treated acreage occurred in Nebraska and the largest percentage increase in insecticide treated acreage occurred in Kansas. The absolute number of acres treated with pesticides was greatest in Nebraska in 1980, while the

Table 1. Field corn acreage planted and harvested, production, and value in the Northern Plains, 1980

States	: <u>Total acres a/</u> :			: <u>Total production a/</u> :		Value of grain b/
	: Planted	: <u>Harvested</u>	: Silage	: Bushels of grain	: Tons of silage	
	----- <u>Million</u> -----					<u>Million dollars</u>
Kansas	1.8	1.2	0.4	117	3.8	396
Nebraska	7.8	7.1	.6	604	6.8	1,961
South Dakota	3.5	2.3	1.0	122	5.4	32
Region	13.1	10.6	2.0	843	16	2,729
U.S. total	84.1	73.1	9.3	6,648	111	21,687
Percent of U.S. total	16	15	22	13	14	13

a/ "Crop Production-1980 Annual Summary", USDA, ESS, Crop Reporting Board, CrPr 2-1(81), January 14, 1981.

b/ "Field Crops-Production, Disposition, Value 1979-80", USDA, ESS, Crop Reporting Board, CrPr 1(81), April 1981.

Table 2. Field corn acreage planted and treated for weed and insect control in the Northern Plains States, 1972 and 1980

State	Planted acres		Treated acres				Percent of planted acres treated			
	: 1972 a/ : 1980 b/		: Weeds c/ : Insects d/		: Weeds e/ : Insects f/		: 1972:1980 g/ : 1972:1980 h/			
	1972	1980	1972	1980	1972	1980	1972	1980		
	<u>Million</u>		<u>Million</u>		<u>Percent</u>		<u>Percent</u>			
Kansas	1.6	1.8	0.9	1.7	0.5	1.4	60	92	34	77
Nebraska	5.7	7.8	2.8	6.8	2.0	5.0	50	87	35	65
South Dakota	3.3	3.5	1.3	2.1	.6	.9	39	60	17	26
Region	10.6	13.1	5.0	10.6	3.1	7.3	48	81	29	56

a/ "Agricultural Statistics, 1974", U.S. Department of Agriculture.

b/ "Crop Production-1980 Annual Summary", USDA, ESS, Crop Reporting Board, CrPr 2-1(81), January 14, 1981.

c/ Herman W. Delvo, "1972 Corn Objective Yield Survey", USDA, ERS, Farm Production Economics Division, 1972, (unpublished).

d/ "1980 Corn Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

number of acres treated in Kansas and South Dakota was approximately the same.

Pesticide Use

The primary field corn weed and insect pests, as reported by farmers in the Northern Plains, are listed in Tables 3 and 4. Although several pests may have been present at any given time and caused varying degrees of damage, farmers were asked to report what they perceived to be the primary target pest for each pesticide material applied to field corn. In 1980 farmers reported that cocklebur, foxtail, and pigweed were the primary target pests for 53 percent of the herbicide acre-treatments (Table 3). Corn borer and corn rootworm larvae were the major target pests for 24 and 51 percent of the insecticide acre-treatments, respectively (Table 4).

About 33.3 million pounds (a.i.) of pesticides were applied to field corn in 1980 (Table 5). This amount consisted of 14.6 million pounds (a.i.) of single material herbicides, 9 million pounds (a.i.) of herbicide mixes, and 9.6 million pounds (a.i.) of insecticides. Application rates for herbicides, applied alone and in mixes, averaged 1.6 and 2.5 pounds (a.i.) per acre-treatment, respectively. Insecticide applications averaged 0.9 pound (a.i.) per acre-treatment.

Pesticide acre-treatments totaled 23.1 million, consisting of 9 million with single material herbicides, 3.6 million with herbicide mixes, and 10.5 million with insecticides.

Atrazine acre-treatments amounted to 3.5 million (38 percent) of those made with single material herbicides. Alachlor and 2,4-D acre-treatments totaled 2.1 and 1.3 million, respectively, and represented approximately the same proportion of acre-treatments as atrazine. Atrazine plus alachlor totaled 1.1 million (30 percent) of the herbicide mix acre-treatments. Atrazine was also combined in separate mixes with butylate⁺, cyanazine, and propachlor. These

Table 3. Percentage of field corn herbicide acre-treatments by primary weeds controlled as reported by farmers in the Northern Plains, 1980 a/

Weeds	:	:	:	:
	:	:	:	:
	: Kansas	: Nebraska	: South Dakota	: Region
	<u>Percent</u>			
<u>Grasses</u>				
Barnyardgrass	1	3	-	2
Broadleaf signalgrass	1	3	1	2
Crabgrass	8	4	-	4
Foxtail	1	30	66	32
Johnsongrass	2	4	-	3
Shattercane	27	2	-	6
Other	10	13	6	12
<u>Broadleaves</u>				
Cocklebur	8	7	18	9
Pigweed	31	11	-	12
Ragweed	1	1	-	1
Smartweed	-	5	-	3
Velvetleaf	-	8	-	5
Other	10	9	9	9

- None reported.

a/ "1980 Corn Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

Table 4. Percentage of field corn insecticide acre-treatments by primary insects controlled as reported by farmers in the Northern Plains, 1980 a/

Insects	: Kansas	: Nebraska	: South Dakota	: Region
	----- <u>Percent</u> -----			
Armyworm	-	2	-	1
Banks grass mite	24	12	-	14
Beetles	7	1	-	2
Corn borer <u>b/</u>	33	23	4	24
Corn rootworm larvae	30	54	91	51
Corn rootworm beetle	5	2	4	3
Cutworm	-	1	-	1
Grasshopper	-	4	1	3
Other	1	1	-	1

- None reported.

a/ "1980 Corn Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ Includes European and Southwestern corn borer in Kansas and European corn borer in Nebraska and South Dakota.

Table 5. Usage patterns and quantities of specific pesticides applied to field corn in the Northern Plains, 1980 a/

Pesticides	: Acres <u>b/</u> :		Acre- <u>c/</u> :		Pounds of active ingredient	
	treated	treatments	Total	:	Total	Per treatment
	----- <u>Thousand</u> -----					
HERBICIDES						
<u>Single materials</u>						
Alachlor	2,053	2,053	3,049	:	14,630	1.5
Atrazine	3,286	3,464	5,708	:	14,630	1.6
Butylate ⁺	567	567	2,199	:	14,630	3.9
EPTC ⁺	423	423	1,659	:	14,630	3.9
2,4-D	1,226	1,308	596	:	14,630	.5
Other	-	1,211	1,419	:	14,630	1.2
Total	-	9,026	14,630	:	14,630	1.6
<u>Tank-mix materials</u>						
Atrazine + alachlor	1,088	1,088	1,190+1,676	:	14,630	1.1+1.5
Atrazine + butylate ⁺	306	306	384+964	:	14,630	1.3+3.2
Atrazine + cyanazine	387	387	323+343	:	14,630	.8+ .9
Atrazine + propachlor	390	390	244+471	:	14,630	.6+1.2
Atrazine + other <u>d/</u>	-	624	681+1,184	:	14,630	1.1+1.9
Cyanazine + other <u>e/</u>	-	357	413+720	:	14,630	1.2+2.0
Dicamba + 2,4-D	405	405	187+197	:	14,630	.5+ .5
Other	-	41	72	:	14,630	1.8
Total	-	3,598	9,049	:	14,630	2.5
Total herbicides	-	12,624	23,679	:	14,630	1.9
INSECTICIDES						
Carbofuran	2,297	2,424	1,992	:	14,630	.8
Dimethoate	855	1,061	535	:	14,630	.5
Fonofos	1,713	1,759	2,120	:	14,630	1.2
Parathion	851	1,202	597	:	14,630	.5
Phorate	751	751	825	:	14,630	1.1
Terbufos	1,591	1,591	1,818	:	14,630	1.1
Other	-	1,660	1,710	:	14,630	1.0
Total	-	10,448	9,597	:	14,630	.9
TOTAL PESTICIDES	-	23,072	33,276	:	14,630	1.4

a/ "1980 Corn Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ Data in this column for "other" and "total" were not reported because two or more materials may have been used on the same acre resulting in multiple counting.

c/ Most farmers applied herbicides and insecticides one time during the growing season. The average number of applications per season for each material can be determined by dividing acre-treatments (column 2) by acres treated (column 1).

d/ Other includes bentazon, fonofos, EPTC⁺, linuron, metolachlor, pendimethalin, simazine, and 2,4-D.

e/ Other includes alachlor, butylate⁺, and metolachlor.

mixes comprised 1.1 million (30 percent) of the herbicide mix acre-treatments. All of the butylate⁺ included in this report contained an additive to protect the corn seed from possible damage and was sold as Sutan⁺. Foxtail was the primary target pest for two-thirds of the alachlor acre-treatments (Appendix Table 2). Atrazine acre-treatments made for foxtail and pigweed control totaled 29 and 23 percent, respectively (Appendix Tables 2 and 3). Cocklebur control accounted for 46 percent of the 2,4-D acre-treatments and velvetleaf control accounted for 13 percent.

Three-fourths (8 million) of the insecticide acre-treatments were made with either carbofuran, dimethoate, fonofos, parathion, or terbufos (Table 5). About 95 percent of the fonofos, 97 percent of the terbufos, and 42 percent of the carbofuran acre-treatments were made for corn rootworm larvae control (Appendix Table 4). Corn borer control accounted for 49 percent of the carbofuran acre-treatments and 55 percent of the parathion acre-treatments. About 82 percent of the dimethoate acre-treatments were made to suppress Banks grass mite infestations and 22 percent of the parathion acre-treatments were made for grasshopper control.

KANSAS

In 1980, Kansas farmers planted 1.8 million acres of field corn and treated 1.7 million acres with herbicides and 1.4 million acres with insecticides (Table 2). About 6.9 million pounds (a.i.) of pesticides were applied to field corn, of which 3.6 million pounds were single material herbicides, 1.2 million pounds were herbicide mixes, and 2.2 million pounds were insecticides (Table 6). Application rates for herbicides, applied alone and in mixes, averaged 2 and 2.8 pounds (a.i.) per acre-treatment, respectively. Insecticide application rates averaged 0.9 pound (a.i.) per acre-treatment.

Table 6. Usage patterns and quantities of specific pesticides applied to field corn in Kansas, 1980 a/

Pesticides	: Acres <u>b/</u> : : treated :	Acre- <u>c/</u> : : treatments :	: Pounds of active ingredient : Total :	: Per treatment
	----- <u>Thousand</u> -----			
HERBICIDES				
<u>Single materials</u>				
Alachlor	204	204	365	1.8
Atrazine	674	674	828	1.2
Butylate ⁺	197	197	690	3.5
Cyanazine	185	185	224	1.2
EPTC ⁺	347	347	1,327	3.8
Other	-	181	124	.7
Total	-	1,788	3,558	2.0
<u>Tank-mix materials</u>				
Atrazine + cyanazine	122	122	91+139	.7+1.1
Atrazine + EPTC ⁺	86	86	43+300	.5+3.5
Atrazine + propachlor	79	79	101+143	1.3+1.8
Atrazine + other <u>d/</u>	-	109	76+128	.7+1.2
Other	-	24	141	5.9
Total	-	420	1,162	2.8
Total herbicides	-	2,208	4,720	2.1
INSECTICIDES				
Carbofuran	797	924	740	.8
Dimethoate	499	499	233	.5
Fonofos	317	317	406	1.3
Terbufos	300	300	370	1.2
Other	-	513	479	.9
Total	-	2,553	2,228	.9
TOTAL PESTICIDES	-	4,761	6,948	1.5

a/ "1980 Corn Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ Data in this column for "other" and "total" were not reported because two or more materials may have been used on the same acre resulting in multiple counting.

c/ Most farmers applied herbicides and insecticides one time during the growing season. The average number of applications per season for each material can be determined by dividing acre-treatments (column 2) by acres treated (column 1).

d/ Other includes alachlor, metolachlor, and simazine.

Total pesticide acre-treatments were estimated to be 4.8 million, comprised of 1.8 million with single material herbicides, 420,000 with herbicide mixes, and 2.6 million with insecticides.

Atrazine acre-treatments totaled 674,000 (38 percent) of those made with single material herbicides and EPTC⁺ accounted for 347,000 (19 percent). All of the EPTC⁺ included in this report contained an additive to protect the corn seed from possible damage and was sold as Eradicane. Alachlor, butylate⁺, and cyanazine acre-treatments totaled 586,000 (33 percent) of those made with single material herbicides. Atrazine was combined in separate mixes with cyanazine, EPTC⁺, and propachlor. In total, these three mixes comprised two-thirds (287,000) of the herbicide mix acre-treatments. Pigweed and shattercane control accounted for a greater proportion and foxtail control a smaller proportion of the herbicide acre-treatments in Kansas than in the other Northern Plains States (Table 3). Shattercane control accounted for 39 percent of the alachlor acre-treatments, while crabgrass and cocklebur control amounted to 18 and 15 percent, respectively (Appendix Tables 2 and 3). Atrazine acre-treatments for pigweed control totaled 57 percent.

About 924,000 (36 percent) of the insecticide acre-treatments were made with carbofuran and 1.1 million (44 percent) were made with either dimethoate, fonofos, or terbufos (Table 6). Carbofuran acre-treatments for corn borer and corn rootworm larvae control totaled 60 and 16 percent, respectively (Appendix Table 4). About 61 percent of the dimethoate acre-treatments were made for Banks grass mite control and 36 percent were made to control corn rootworm beetle infestations. Fonofos and terbufos were used exclusively for corn rootworm larvae control. Parathion was applied solely to suppress Banks grass mite infestations.

NEBRASKA

During the 1980 growing season, 7.8 million acres of field corn were planted in Nebraska, of which 6.8 million were treated with herbicides and 5 million were treated with insecticides (Table 2). A total of 21.4 million pounds (a.i.) of pesticides were applied to field corn, consisting of 7.4 million pounds of single material herbicides, 7.5 million pounds of herbicide mixes, and 6.6 million pounds of insecticides (Table 7). Application rates for herbicides, applied alone and in mixes, averaged 1.5 and 2.5 pounds (a.i.) per acre-treatment, respectively. Insecticides were applied at an average rate of 0.9 pound (a.i.) per acre-treatment.

Pesticide acre-treatments totaled 15.1 million, comprised of 5 million with single material herbicides, 3 million with herbicide mixes, and 7.1 million with insecticides.

Atrazine acre-treatments amounted to 2.4 million, or one-half of those made with single material herbicides. Also, alachlor and 2,4-D acre-treatments totaled 2 million (39 percent). One-third (1 million) of the herbicide mix acre-treatments were atrazine plus alachlor. About 61 percent of the alachlor and 29 percent of the atrazine acre-treatments were made to control foxtail infestations (Appendix Table 2). Also, pigweed control accounted for 17 percent of the atrazine acre-treatments (Appendix Table 3). Cocklebur and velvetleaf control constituted 37 and 19 percent, respectively, of the 2,4-D acre-treatments.

Approximately the same number of acre-treatments were made with carbofuran, fonofos, parathion, and terbufos (Table 7). In total, these four insecticides constituted 4.8 million (68 percent) of the insecticide acre-treatments. The proportion of carbofuran, fonofos, and terbufos acre-treatments for corn rootworm larvae control totaled 54, 93, and 96 percent, respectively (Appendix Table 4). European corn borer control accounted for 46 percent of the carbofuran and 56

Table 7. Usage patterns and quantities of specific pesticides applied to field corn in Nebraska, 1980 a/

Pesticides	: Acres <u>b/</u> :		Acre- <u>c/</u> :		Pounds of active ingredient	
	treated	treatments	Total	:	Total	Per treatment
	----- <u>Thousand</u> -----					
HERBICIDES						
<u>Single materials</u>						
Alachlor	1,019	1,019	1,493			1.5
Atrazine	2,241	2,419	4,155			1.7
2,4-D	857	939	392			.4
Other	-	584	1,318			2.3
Total	-	4,961	7,358			1.5
<u>Tank-mix materials</u>						
Alachlor + cyanazine	210	210	383+229			1.8+1.1
Atrazine + alachlor	1,016	1,016	1,137+1,555			1.1+1.5
Atrazine + butylate ⁺	306	306	384+964			1.3+3.2
Atrazine + cyanazine	265	265	233+205			.9+ .8
Atrazine + propachlor	311	311	143+328			.5+1.1
Atrazine + other <u>d/</u>	-	438	568+740			1.3+1.7
Dicamba + 2,4-D	311	311	155+171			.5+ .5
Other	-	132	327			2.5
Total	-	2,989	7,522			2.5
Total herbicides	-	7,950	14,880			1.9
INSECTICIDES						
Carbofuran	1,370	1,370	1,157			.8
Dimethoate	356	562	302			.5
Fonofos	1,135	1,180	1,409			1.2
Parathion	826	1,178	574			.5
Phorate	438	438	469			1.1
Terbufos	1,116	1,116	1,291			1.2
Other	-	1,259	1,366			1.1
Total	-	7,103	6,568			.9
TOTAL PESTICIDES	-	15,053	21,448			1.4

a/ "1980 Corn Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ Data in this column for "other" and "total" were not reported because two or more materials may have been used on the same acre resulting in multiple counting.

c/ Most farmers applied herbicides and insecticides one time during the growing season. The average number of applications per season for each material can be determined by dividing acre-treatments (column 2) by acres treated (column 1).

d/ Other includes bentazon, EPTC⁺, linuron, metolachlor, and 2,4-D.

percent of the parathion acre-treatments. Nearly one-fourth of the parathion acre-treatments were made to suppress grasshopper infestations. All of the dimethoate was used to control Banks grass mite infestations.

SOUTH DAKOTA

Farmers planted 3.5 million acres of field corn in South Dakota during the 1980 growing season and treated 2.1 million acres with herbicides and 900,000 acres with insecticides (Table 2). Approximately 4.9 million pounds (a.i.) of pesticides were applied to field corn, of which 3.7 million were single material herbicides, 356,000 were herbicide mixes, and 801,000 were insecticides (Table 8). Application rates for herbicides, applied alone and in mixes, averaged 1.6 and 1.9 pounds (a.i.) per acre-treatment, respectively. Insecticides were applied at an average rate of 1 pound (a.i.) per acre-treatment.

Pesticide acre-treatments totaled 3.3 million and were comprised of 2.3 million with single material herbicides, 188,000 with herbicide mixes, and 794,000 with insecticides.

Alachlor acre-treatments totaled 830,000 (36 percent) of those made with single material herbicides. Atrazine, butylate⁺, propachlor and 2,4-D acre-treatments constituted 1.2 million (55 percent) of the same total. One-half (94,000) of the herbicide mix acre-treatments were dicamba plus 2,4-D. Herbicide acre-treatments for foxtail control totaled 66 percent in South Dakota, compared with 32 percent for the region (Table 3). About 86 percent of the alachlor acre-treatments and 79 percent of the atrazine acre-treatments were made to control foxtail infestations (Appendix Table 2). Also, three-fourths of the 2,4-D acre-treatments were made for cocklebur control (Appendix Table 3).

One-third (262,000) of the insecticide acre-treatments were made with fonofos (Table 8). Carbofuran, phorate, and terbufos acre-treatments accounted

Table 8. Usage patterns and quantities of specific pesticides applied to field corn in South Dakota, 1980 a/

Pesticides	: Acres <u>b/</u> :		Acre- <u>c/</u> : Pounds of active ingredient	
	treated	: treatments	: Total	: Per treatment
----- <u>Thousand</u> -----				
HERBICIDES				
<u>Single materials</u>				
Alachlor	830	830	1,191	1.4
Atrazine	371	371	725	2.0
Butylate ⁺	284	284	1,149	4.1
Propachlor	219	251	339	1.4
2,4-D	337	337	187	.6
Other	-	206	135	.7
Total	-	2,279	3,726	1.6
<u>Tank-mix materials</u>				
Atrazine + other <u>d/</u>	-	63	47+125	.7+2.0
Dicamba + 2,4-D	94	94	31+27	.3+ .3
Other	-	31	63+63	2.0+2.0
Total	-	188	356	1.9
Total herbicides	-	2,467	4,082	1.7
INSECTICIDES				
Carbofuran	131	131	95	.7
Fonofos	262	262	305	1.2
Phorate	186	186	199	1.1
Terbufos	176	176	157	.9
Other	-	39	45	1.2
Total	-	794	801	1.0
TOTAL PESTICIDES	-	3,261	4,883	1.5

a/ "1980 Corn Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ Data in this column for "other" and "total" were not reported because two or more materials may have been used on the same acre resulting in multiple counting.

c/ Most farmers applied herbicides and insecticides one time during the growing season. The average number of applications per season for each material can be determined by dividing acre-treatments (column 2) by acres treated (column 1).

d/ Other includes alachlor and pendimethalin.

for 493,000 (62 percent) of the insecticide acre-treatments. About 91 percent of the insecticide acre-treatments were made to control corn rootworm larvae in South Dakota, compared with 51 percent for the region (Table 4). Also, fewer insecticide acre-treatments were made to control corn borer infestations. Corn rootworm larvae were the primary target pest for all of the carbofuran, fonofos, and terbufos acre-treatments (Appendix Table 4).

REFERENCES

1. Delvo, Herman W., "1972 Corn Objective Yield Survey", USDA, ERS, Farm Production Economics Division, 1972, (unpublished).
2. U.S. Department of Agriculture, "Agricultural Statistics, 1974".
3. USDA, ESS, Crop Reporting Board, "Crop Production-1980 Annual Summary", CrPr 2-1(81), January 14, 1981.
4. USDA, ESS, Crop Reporting Board, "Field Crops-Production, Disposition, Value 1979-80", CrPr 1(81), April 1981.

Appendix Table 1. Coefficients of variation for acres of field corn treated with specific pesticides in the Northern Plains, 1980 a/ b/

Pesticides	:	:	:	:	
	:	Kansas	Nebraska	South Dakota	Region
	----- Percent -----				
HERBICIDES					
<u>Single materials</u>					
Alachlor	25	19	17	12	
Atrazine	12	11	27	9	
Butylate ⁺	25	71	31	21	
EPTC ⁺	18	67	-	19	
2,4-D	70	19	29	16	
<u>Tank-mix materials</u>					
Atrazine + alachlor	58	19	<u>c/</u>	19	
Atrazine + butylate ⁺	-	37	-	37	
Atrazine + cyanazine	30	40	-	29	
Atrazine + propachlor	43	37	-	31	
Dicamba + 2,4-D	-	37	57	31	
INSECTICIDES					
Carbofuran	10	16	46	11	
Dimethoate	14	31	-	16	
Fonofos	19	18	32	13	
Parathion	70	20	-	19	
Phorate	30	31	40	21	
Terbufos	19	18	40	14	

- None reported.

a/ "1980 Corn Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ A coefficient of variation is the standard error of the estimate divided by acres treated times 100. A coefficient of variation describes the relative variation of the estimate. The lower the value of the coefficient, the more reliable the estimate.

c/ Use of this material at the State level was not significant and was reported in the "other" category.

Appendix Table 2. Percentage of field corn herbicide acre-treatments by primary grasses controlled as reported by farmers in the Northern Plains, 1980 a/

Herbicides, grasses	:	:	:	:
	: Kansas	: Nebraska	: South Dakota	: Region
	----- Percent -----			
<u>Alachlor</u>				
Broadleaf signalgrass	-	4	-	2
Crabgrass	18	-	-	2
Foxtail	12	61	86	66
Shattercane	39	-	-	4
Other	8	18	10	14
<u>Atrazine</u>				
Barnyardgrass	-	4	-	3
Broadleaf signalgrass	-	2	-	1
Crabgrass	2	9	-	7
Foxtail	-	29	79	29
Johnsongrass	-	8	-	5
Shattercane	13	-	-	3
Quackgrass	-	-	8	1
Other	13	12	-	10
<u>2,4-D</u>				
Broadleaf signalgrass	-	4	-	3

- None reported.

a/ "1980 Corn Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

Appendix Table 3. Percentage of field corn herbicide acre-treatments by primary broadleaf weeds controlled as reported by farmers in the Northern Plains, 1980 a/

Herbicides, broadleaf weeds	:	:	:	:
		Kansas	Nebraska	South Dakota
		<u>Percent</u>		
				Region
<u>Alachlor</u>				
Cocklebur	15	-	4	3
Pigweed	8	4	-	3
Smartweed	-	4	-	2
Velvetleaf	-	9	-	4
<u>Atrazine</u>				
Cocklebur	8	-	8	3
Pigweed	57	17	-	23
Ragweed	-	2	-	1
Smartweed	-	3	-	2
Velvetleaf	-	7	-	5
Other	7	7	5	7
<u>2,4-D</u>				
Canada thistle	-	-	9	2
Cocklebur	-	37	74	46
Pigweed	-	4	-	3
Smartweed	-	9	-	6
Velvetleaf	-	19	-	13
Other	100	27	17	27

- None reported.

a/ "1980 Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

Appendix Table 4. Percentage of field corn insecticide acre-treatments by primary insects controlled as reported by farmers in the Northern Plains, 1980 a/

Insecticides, insects	: Kansas	: Nebraska	: South Dakota	: Region
	----- <u>Percent</u> -----			
<u>Carbofuran</u>				
Corn borer <u>b/</u>	60	46	-	49
Corn rootworm larvae	16	54	100	42
Corn rootworm beetle	3	-	-	1
Other	21	-	-	8
<u>Dimethoate</u>				
Banks grass mite	61	100	-	82
Corn rootworm beetle	36	-	-	17
Other	3	-	-	1
<u>Fonofos</u>				
Corn rootworm larvae	100	93	100	95
European corn borer	-	7	-	5
<u>Parathion</u>				
Banks grass mite	100	12	-	13
Corn rootworm beetle	-	2	-	2
European corn borer	-	56	-	55
Grasshopper	-	23	-	22
Other	-	7	-	8
<u>Terbufos</u>				
Corn rootworm larvae	100	96	100	97
Other	-	4	-	3

- None reported.

a/ "1980 Corn Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ Includes European and Southwestern corn borer in Kansas and European corn borer in Nebraska.



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