



# **Pesticide Use and Pest Management Practices for Major Crops in North Dakota 1992**

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## INTRODUCTION

This is the fourth major account of pesticide usage in North Dakota and describes pesticide usage on agricultural land in 1992. The information is derived from a comprehensive survey of North Dakota farm operators. The first three comprehensive surveys to assess pesticide usage on major crops in North Dakota were conducted on 1978<sup>1</sup>, 1984<sup>2</sup>, and 1989<sup>3</sup>, pesticide applications.

Total acres treated with herbicides, insecticides and fungicides was 16,081,700 in 1978, 20,600,300 in 1984, 19,527,400 in 1989, and 19,034,200 in 1992. Changes in pesticide treated acres may be due to changes in pest populations, changes in tillage practices, substitution of non-chemical for chemical methods, shifts of acreage of major crops, or new developments in pest control technology.

The survey of 1992 pesticide usage in North Dakota was conducted because regular assessment of pesticide usage is an important indicator of changes in farming practices and farmer attitudes toward pesticide as well as an indicator of the relative severity of various pests in the state. Specific questions were added to the 1992 survey regarding the use of non-chemical methods of pest control and the level of concern for several pesticide issues.

The specific objectives of the survey were: 1) identify acreage of crops treated with each pesticide group, and identify specific pesticides used; 2) determine pesticide usage by state districts; 3) determine the percentage of pesticides applied by farm operator or custom applicator by air or ground equipment; 4) estimate the relative importance of several non-chemical pest control methods; and 5) estimate farmer attitudes toward the importance of several pesticide issues.

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**NOTE: This report gives the information on the pesticide usage as reported by the farmers surveyed. The data do not imply endorsement of any particular product or practice. Also, some survey respondents may have accidentally mis-reported use of pesticides, or products may have been applied before planting or after harvest.**

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<sup>1</sup>Nalewaja, J.D., A.G. Dexter, J. Buchli, W. Hamlin, and G. Kimmet. 1980. Pesticide Usage in Major North Dakota Crops. North Dakota State University in cooperation with North Dakota Crop and Livestock Reporting Service, Agronomy Report 1. 33p.

<sup>2</sup>McMullen, M.P., A.G. Dexter, J.D. Nalewaja, W. Hamlin, and K. Davison. 1985. Pesticide Use on Major Crops in North Dakota, 1984. North Dakota State University in cooperation with North Dakota Crop and Livestock Reporting Service, Agronomy Report 3. 31p.

<sup>3</sup>McMullen, M.P., A.G. Dexter, J.D. Nalewaja, and G. Dahl. 1989. Pesticide Use on Major Crops in North Dakota, 1989. North Dakota State University in cooperation with North Dakota Crop and Livestock Reporting Service, Extension Report 1. 50p.

## METHODOLOGY

The North Dakota Agricultural Statistics Service participated in the design of the survey and was in charge of printing and mailing the survey, telephone follow-up of non-respondents, and summarization and analysis of the survey results. North Dakota State University participated in the design of the survey and prepared the documentation of the survey results.

### The Questionnaire

The questionnaire was designed to collect pesticide data for wheat, barley, oats, flax, corn, sunflower, dry beans, potatoes, sugarbeets, alfalfa hay, other hay, CRP, summer-fallow, and pasture in North Dakota for the 1992 crop year. The questionnaire was very similar to the one used for the 1989 survey, except for the additional questions on non-chemical methods of pest control and pesticide related concerns.

Information on total acres seeded, acres seeded with any treated seed and acres seeded with farm-treated seed, by individual crops was obtained. Acres treated by crop, for the general pesticide categories of herbicides, insecticides, fungicides and desiccants were also collected.

In addition, information was requested for on-farm treated seed, which included the specific chemicals used, acres seeded with farm-treated seed and method used for seed treatment. The methods used for the on farm-treated seed treatment was queried only for wheat, barley, oats, flax, soybeans and potatoes.

For other pesticide usage, the chemicals used, acres treated, number of applications, type of applicator and method of application were asked separately for each major crops or land uses included in Section 1 of the questionnaire. The type of applicator meant the chemical was self-applied by the farm operator or custom applied. The method of application refers to aerial or ground applications.

For non-chemical methods of pest control, respondents were asked to indicate their usage of eleven common farming practices. Respondants were asked if a procedure was used, and if the practice was used for pest control. Respondents were also asked to indicate their concern, on an increasing scale of one through five, relative to eight pesticide topics.

### The Sample

A sample of 10,000 farm operators was selected at random from the North Dakota Agricultural Statistics Service (NDASS) list of farm operators. Extra samples were selected for potato, dry bean and sugarbeet growers, to improve coverage for these three important, but limited acreage crops.

## Data Collection and Editing

Questionnaires were mailed in mid December 1992. A random sample of non-respondents to the mailing were surveyed by telephone during a thirty-day period, from about mid-January to mid-February 1993. As a result of these efforts, about 3,000 usable reports were obtained.

Of the farmers surveyed in 1992, 82% grew wheat, 53% barley, 31% oats, 6% flax, 26% corn, 19% sunflower, 12% soybeans, 10% dry beans, 6% sugarbeets and 2% potatoes. Thirty-six percent reported having alfalfa hay, 38% other hay 28% CRP, 72% reported having summerfallow and 54% pastureland. Also, 59% of the farmers reported using at least some treated seed, and 28% used on-farm treated seed. Seventy-nine percent used herbicides, 14% used insecticides, 6% used fungicides and 2% used desiccants.

The edit process looked at completeness and reasonableness of data within each section of the questionnaire and across sections. For example, the acreage treated with herbicides reported in the first section of the questionnaire was compared to the total herbicide treated acreage reported in Section 3 for each crop. Phone follow-up was used to clear up questions about reports.

## THE SUMMARY

All State level percents shown in the summary tables are weighted averages of the districts. Data were summarized by obtaining a percent of total acres treated for the general pesticide category, as well as for specific chemicals, by crop, by crop reporting districts. These percents of total acres treated were multiplied by the NDASS estimate of total acres planted to each crop in the district. State acres were obtained by the addition of these data with State percents derived to obtain the weighted figures.

All results from the questionnaire were included in the summary tables except for farm-treatment of seed for crops not specified in Section 2. The percentage of a crop treated with a pesticide was given a zero when less than 0.1%. However, acreage treated values were given. Also, these values which indicate only one or two thousand acres, may represent only one response, as reported values were interpolated to represent the total State acreage.

## RESULTS

### Total Acres Treated with Pesticides

The reported pesticide treated acres in Tables 1A, 2 and 3 indicate acres that received one or more applications of a pesticide. The treated acres in Tables 4 through 20 include multiple applications to the same acreage as separate values in the total, and pesticides applied as a tank mixture were totaled separately unless a commercial premix was used. Thus, acres treated in Tables 4 through 20 can exceed 100% of the planted acres.

Herbicides, insecticides, and fungicides were applied one or more times to 17.6, 0.9, and 0.6 million acres, respectively, in 1992 (Table 1A). Herbicides, insecticides, and fungicides were applied to 17.4, 1.8, and 0.4 million acres, respectively, in 1989 (Table 1B) and 17.5, 2.5, and 0.5 million acres, respectively, in 1984 (Table 1C). Herbicides were applied to approximately 43.1% of all crop, pasture, hay, CRP, and summerfallow land in 1992, insecticides to 2.1%, and fungicides to 1.4%.

The survey indicated that 24.1% of the total agricultural land was planted with treated seed and over half was on-farm treated (Table 1A). These values are similar to those from the 1989 survey. Treated seed was planted on 51.7% or 9,787,589 acres of the small grain and row crops. Forty seven percent of the wheat and 57% of the barley acreage was seeded with treated seed, and the majority of this was on-farm treated. Approximately three-fourths of the potato acreage was planted with treated seed pieces, and almost all was on-farm treated. All sugarbeet seed was treated as obtained from the supplier. The great majority of corn, sunflower and dry bean acreage was planted with treated seed, but treatment was not on-farm.

Total acres treated at least once with herbicides was 17,539,800 in 1984, 17,368,600 in 1989, and 17,573,200 in 1992 (Tables 1A, 1B, and 1C) indicating that acres treated at least once with herbicides has remained relatively stable over the past nine years. However, when multiple herbicide applications were totaled as multiple acres, herbicide treated acres increased from 24,819,300 in 1984, to 27,674,700 in 1989 to 28,777,400 in 1992 (Tables 21A, 21B, and 21C). The percentage of acres treated at least once with herbicides in 1992 was over 85% for wheat, barley, sunflower, soybean, dry bean, and sugarbeet (Table 1A). Acres treated was less than 3% for alfalfa hay, other hay, pasture, and CRP. Percentage of acres treated for individual crops has remained relatively constant across years (Tables 1A, 1B, and 1C). Two notable changes were a 17% decline in treated oat acres and a 8% increase in treated summer fallow acreage from 1989 to 1992.

Total acreage treated with fungicide, exclusive of seed treatment, increased slightly in 1992 compared to 1989, from 1.0% to 1.4% of total cropland treated at least once.

Insecticides were used on 0.9 million fewer acres in 1992 than in 1989. Grasshopper and sunflower insect infestations were lower in 1992 than in 1989 and this may account for much of the reduced insecticide use. Insecticides were applied to 95.6, 71.3, 27.1, 8.2, 1.5, and 1.1 percent of the acreage for potato, sugarbeet, sunflower, corn, flax, and dry bean, respectively, in 1992 (Table 1A). Insecticides were applied to less than one percent of the acreage of wheat, barley, oats, dry bean, alfalfa hay, other hay, pasture, summer fallow, and CRP in 1992.

## Acres Treated According to Agricultural Statistics Districts

North Dakota has nine agricultural statistics districts (Appendix B). Summaries of pesticide usage by district are given in Table 2. The largest percentages of acreage planted to treated seed and treated with herbicides, insecticides and fungicides were in the Northeast and East Central districts. These two districts also have some of the largest acreage planted to wheat, barley, sunflower, soybean, dry bean, potato and sugarbeet crops (Table 3).

Summaries of pesticide usage per crop by district are given in Table 3. Herbicide usage on wheat ranged from 67.4% of the acreage in the South Central to 97.3% in the East Central district. Acres treated with herbicides was over 90% in six of the nine districts. Insecticide usage on wheat ranged from less than 0.1% in the South Central district to 1.9% in the East Central district. Fungicide usage on wheat ranged from less than 0.1% in the Northwest, West Central, Southwest and South Central districts, to 10.7% of wheat acreage treated in the Northeast district.

Herbicide usage on barley ranged from 53.7% of the acreage in the West Central to 97.1% in the East Central district. Acres treated with herbicides was over 80% in seven of the nine districts. Insecticide usage on barley ranged from less than 0.1% in the Southwest, South Central, and Southeast districts to 1.5% in the North Central district. Fungicide usage on barley ranged from less than 0.1% in the Northwest, West Central, Southwest and South Central districts, to 8.8% of acreage treated in the Northeast district.

Herbicide usage on oats was less than on wheat and barley in all districts. Usage ranged from 21.6% of the acreage in the West Central and South Central to 82.7% in the East Central district. Herbicide usage on flax varied greatly from less than 0.1% in the Southwest to 90% in the East Central district. Insecticide usage on oats was less than 1.6% in any district. Insecticides were used on 7.2% and 2.9% of the flax acreage in the Northwest and Central districts, respectively.

Herbicide usage on corn ranged from 88.2 to 98.1% of the acreage in the three east districts, from 32.5 to 64.1% in the three west districts. The use of insecticides on corn was greatest in the Southeast district where insecticide was applied to 15.1% of the corn acreage, followed by the East Central district to 9.1% of the corn acreage.

More than 75% of the sunflower acres were treated with herbicides in all districts. The majority of the sunflowers were planted in the Central, Southeast, East Central, and Northeast districts, where insecticides were applied to 37.4, 25.1, 26.0, and 18.2% of the acreage, respectively.

More than 95% of the soybean acres were treated with herbicides in all districts that had a significant soybean acreage. Insecticides were applied to 1.8% of the soybean acreage in the East Central district and 0.5% in the Southeast district.

More than 90% of the dry bean acres were treated with herbicide in all districts that had a significant dry bean acreage. Insecticides were reported to be applied to 0.5% of the dry bean acreage in the Southeast district. Fungicides were used on dry bean, with 8.0%, 8.2% and 9.2% of the acreage treated in the Northeast, West Central and Southeast districts, respectively.

Herbicides were used on 26.1% of the potato acreage in the Northeast district, on 54.5% in the East Central, and on 100% in the Southeast. The majority of the potato acreage is in the Northeast district where insecticides were applied to 95.6% of the potato acreage. Potatoes were treated with fungicides in all districts. The Northeast had the greatest number of acres planted and 90.4% of these acres were treated with fungicides.

Herbicide usage was 73.8% of the sugarbeet acres in the West Central district and over 95% in all other districts where sugarbeet was produced. Insecticide usage on sugarbeets in the districts where sugarbeets are planted ranged from 48.0% in the Southeast district to 83.1% in the East Central district. Insecticides were applied to 71.7% of the sugarbeet acreage in the Northeast district where the greatest acreage is located. The East Central and Southeast districts had the greatest percentages of sugarbeet acres treated with fungicides, 47.7% and 55.3%, respectively.

Herbicide use on alfalfa and other hay was very small, from zero to 3.3% of the acreage among the districts. Insecticides were applied to 4.7% of the alfalfa in the North Central district. Insecticides were applied to less than 1% of the alfalfa acreage in the remaining districts. Insecticides for grasshopper control were applied to 6.0% of the hayland in the Northeast district. Grasshopper populations were higher in the Northeast district than in the other districts because conditions were drier in the Northeast than in other districts in 1992. Insecticides were applied to less than 1% of the hayland in the remaining districts.

## Pesticide Usage on Crops, Pasture, Summer Fallow and CRP in North Dakota, 1992

Herbicide usage on pasture ranged from 0.4% in the West Central district to 6.1% in the east Central district. Usage was less than 1% in four districts. Insecticides for grasshopper control were applied to 5.5% of the pastureland in the Northeast district. Grasshopper populations were higher in the Northeast district than in the other districts because moisture conditions were drier in the Northeast than in other districts in 1992. Insecticides were applied to less than 1% of the pastureland in the remaining districts.

Herbicides were applied to 8.7% of the summer fallow acreage in the Northeast and to 32.9% in the Northwest, with other districts in between. The Northwest had the greatest acreage of summer fallow as well as the greatest herbicide usage. Very little usage of insecticides or fungicides was reported on summer fallow in any district.

Herbicides were used on less than 1% of the CRP acreage in seven of the nine districts. Herbicides were applied to 2.4% of the CRP in the North Central district and to 2.6% of the East Central district. Insecticides were used on 2.6 and 2.4% of the CRP acreage in the East and North Central districts. Insecticides were used on less than 1% of the CRP acreage in the remaining districts.

### On-Farm Seed Treatment, by Crop

Total acres of on-farm seed treatment for wheat is greater in Table 4 than Table 1A because in Table 4 applications of products or mixtures applied to the same acreage were totaled as separate values, whereas the acreage in Table 1A represents the acres seeded with treated seed regardless of the number of products or mixtures used. Maneb + lindane was the most frequently used seed treatment product on wheat, with 16.5% of the acreage and carboxin + thiram was second most used, with 8.1% of wheat acreage. The grain auger method was used to treat 72.8% of on-farm seed treated of wheat.

Maneb + lindane was the most frequently used seed treatment product on barley, with 16.1% of acreage (Table 4). Carboxin and carboxin + thiram were used to treat seed for 9.7% and 9.8% of the barley acreage, respectively. The grain auger was the most used seed treatment method.

Oats, flax or soybeans on-farm treated seed was used on 5.1, 1.6, and 2.8% of the acreage, respectively (Table 4). On-farm seed treatment of potato was 74.1% and mancozeb was most widely used on 42.7% of the acres. Thiophanate methyl was used on 15.3% and maneb + streptomycin + bark on 9.6% of the potato acres.

Maneb + lindane was used for on farm seed treatment on 2,377,300 acres, when totaled over wheat, barley, oats, flax, soybean and potato acres (Table 5). Carboxin containing seed treatment products were used on a total of 3,050,700 acres of these crops.

Acres treated values in Tables 6 through 20 often exceed the acres treated in Table 1A because multiple applications to the same acreage were totaled as separate values and pesticides applied as a tank mixture were totaled separately unless a commercial mix was used. Acres treated in Table 1A were acres that received one or more applications of pesticide. Percent acres treated are presented as an aid to compare among years and crops. Tables 6 through 20 contain data on individual pesticides used, number of applications, and application methods in major crops, pasture land, summer fallow and CRP for 1992. Pesticides are listed by common name only. Common and trade names of individual pesticides are presented in Appendix C.

**WHEAT** 2,4-D was applied to 51.6% of the wheat acreage in 1992 (Table 6), compared to 55.1% in 1989<sup>3</sup>, and 63.6% in 1984<sup>2</sup>. MCPA was applied to 19.2% of the acres in 1992 and to 28.0% in 1989<sup>3</sup>. However, Banvel was applied to 26.2% of the acres in 1992 compared to 22% in 1989<sup>3</sup>. Trifluralin was applied to 11.8% of the wheat acreage in 1992 compared to 18.2% in 1989<sup>3</sup> and 16.4% in 1984<sup>2</sup>. Wheat acreage treated with sulfonylurea type herbicides (metsulfuron, thifensulfuron, triasulfuron, and tribenuron) was 21.4% in 1992, the same as in 1989<sup>3</sup>. Postemergence grass control herbicides were applied to 13.7% of the wheat acreage. Premix products containing fenoxaprop were used on 8.6% of the acreage. The farm operator applied 89.8% of the herbicides to wheat and 93.6% was applied by ground equipment.

Insecticides were applied to 0.9% of the wheat acreage in 1992 (Table 6) compared to 3.5% in 1989<sup>3</sup>. Eleven insecticides were reported used on wheat in 1992. Carbofuran was the most frequently used insecticide. Most of the insecticide applied to wheat was applied aerially. Propiconazole was the most commonly applied foliar fungicide to wheat, on 1.5% of the acres, followed by mancozeb on 1.2% of the acres. The majority of fungicides were applied once to wheat and aerially.

<sup>2</sup>McMullen, M.P., A.G. Dexter, J.D. Nalewaja, W. Hamlin, and K. Davison. 1985. Pesticide Use on Major Crops in North Dakota, 1984. North Dakota State University in cooperation with North Dakota Crop and Livestock Reporting Service, Agronomy Report 3. 31p.

<sup>3</sup>McMullen, M.P., A.G. Dexter, J.D. Nalewaja, and G. Dahl. 1989. Pesticide Use on Major Crops in North Dakota, 1989. North Dakota State University in cooperation with North Dakota Crop and Livestock Reporting Service, Extension Report 1. 50p.



**BARLEY** 2,4-D was applied to 50.4% of the barley acreage in 1992 (Table 7), which is an increase from 42.7% in 1989<sup>3</sup>. MCPA was applied to 22.5% of the barley acreage in 1992 compared to 33.2% in 1989<sup>3</sup>. Sulfonylurea herbicides were applied to 22% of the barley acreage and trifluralin to 12.0%. Over 92% of herbicides on barley were applied by the farm operator with ground equipment.

Insecticides were applied to 0.7% of the barley acreage in 1992 (Table 7) compared to 4.2% in 1989<sup>3</sup>. Eight insecticides were reported used on barley. Carbofuran was the most frequently used insecticide. Aerial application made up 42% of the total insecticide application to barley. Propiconazole was applied to 1.9% and mancozeb to 0.9% of the barley acres. The majority of fungicides applied to barley were applied once and aerially.

**OATS** MCPA was applied to 15.9% of the oat acreage and 2,4-D to 14.1% (Table 8). Dicamba was applied to 6.1% of the oat acreage. Total herbicide use on oat acreage declined from 60.9% in 1989<sup>3</sup> to 39.6% in 1992. The majority of herbicides on oats were applied once by the farmer with ground equipment.

Insecticides were applied to 0.3% of the oats acreage in 1992 (Table 8). The only insecticides reported used on oats were carbaryl and malathion. Fungicides were not reported used on oats in 1992.

**FLAX** MCPA was applied to 37.0% of the flax acreage and trifluralin to 27.6% (Table 9). About 95% of the applications were made by the farm operator with ground equipment. Insecticides were applied to 1.5% of the flax acreage in 1992 (Table 9). Carbaryl was used on 1% of the flax acres and esfenvalerate on 0.5%.

**CORN** Nicosulfuron was applied to 25.0% of the corn acres in 1992, more than any other herbicide (Table 10). EPTC was applied to 23.7% of corn acreage in 1992, dicamba to 21.0% and bromoxynil and cyanazine each to just over 11% of corn acreage. Atrazine use declined from 10.2% of corn acreage in 1989<sup>3</sup> to 2.9% in 1992. Most corn herbicides were applied once by the farm operator with ground equipment.

Eight insecticides were used in corn in 1992 (Table 10). Corn acreage treated with insecticides was less in 1992 than in 1989<sup>3</sup> or 1984<sup>2</sup>. Insecticides were applied to 8.2% of the corn acreage in 1992 compared to 10.2% in 1989<sup>3</sup> and 18.9% in 1984<sup>2</sup>. The most commonly used insecticide on corn in 1992 was tefluthrin which was first marketed in 1990. Tefluthrin was reported used on 4.1% of the corn acreage.

Terbufos was used on 7.2% of the corn acreage in 1989<sup>3</sup>, but only on 2.3% of the corn acreage in 1992. Tefluthrin replaced much of the terbufos use on corn because the herbicide, nicosulfuron, can be applied safely to corn treated with tefluthrin. Nicosulfuron severely injured corn previously treated with terbufos.

**SUNFLOWER** Trifluralin was applied to 46.2% of the sunflower acres while ethalfluralin was applied to 40.7%, compared to 65.0% and 24.7%, respectively in 1989<sup>3</sup>, and 79.2% and 1.2% in 1984<sup>2</sup> (Table 11). Over 88% of the herbicides were applied by the farm operator and over 96% by ground equipment.

Insecticides were applied to 29.7% of the sunflower acreage in 1992 (Table 11) compared to 59.1% in 1989<sup>3</sup> and 64.8% in 1984<sup>2</sup>. Sunflower seed-weevil populations in 1992 were lower than populations in previous years and fewer fields required treatment. Esfenvalerate, ethyl parathion, and methyl parathion were applied to 10.3, 9.2, and 6.3% of the sunflower acreage, respectively, in 1992. Most of the insecticide was applied by commercial aerial application in 1992. Insecticides were applied twice 10.1% of the time.

**SOYBEAN** Trifluralin and ethalfluralin were applied to 45.6% and 28.3% of the soybean acreage, respectively (Table 12). Bentazon was applied to 43.1% and sethoxydim to 10.1% of the soybean acreage. Over 87% of the herbicides were applied by the farm operator and over 93% by ground equipment.

Insecticides were applied to 1.1% of the soybean acreage in 1992 (Table 12). Grasshoppers were not as severe in 1992 as in 1989<sup>3</sup> when 34.3% of the soybean acreage was treated with insecticide. Three insecticides were used in 1992 compared with 11 insecticides used in 1989<sup>3</sup>.

**DRY BEAN** Ethalfluralin, trifluralin, and bentazon were applied to 54.9%, 27.8%, and 32.6% of the dry bean acreage, respectively, in 1992 (Table 13). Trifluralin was applied to 49.8%, ethalfluralin to 34.1%, and bentazon to 31.2% of the dry bean acreage in 1989<sup>3</sup>.

Insecticides were reported to be applied to approximately 200 acres of dry bean in 1992 (Table 13), compared to 53,500 acres or 10.7% of the dry bean acreage in 1989<sup>3</sup>. Dimethoate was the only insecticide reported used in 1992 compared to eight insecticides reported used in 1989<sup>3</sup>.

<sup>2</sup>McMullen, M.P., A.G. Dexter, J.D. Nalewaja, W. Hamlin, and K. Davison. 1985. Pesticide Use on Major Crops in North Dakota, 1984. North Dakota State University in cooperation with North Dakota Crop and Livestock Reporting Service, Agronomy Report 3. 31p.

<sup>3</sup>McMullen, M.P., A.G. Dexter, J.D. Nalewaja, and G. Dahl. 1989. Pesticide Use on Major Crops in North Dakota, 1989. North Dakota State University in cooperation with North Dakota Crop and Livestock Reporting Service, Extension Report 1. 50p.



Maneb + zinc was applied to 2.1% of the dry bean acres, followed by thiophanate methyl on 1.2% and chlorothalonil on 1.1% of the dry bean acres. Wet weather and white mold infection contributed to the increase in fungicide use from 1.1% of acreage treated in 1989<sup>3</sup> to 5.5% in 1992.

Sodium chlorate desiccant was applied to 1.0% of the dry bean acreage in 1992 (Table 13), compared to 0.3% in 1989<sup>3</sup>, and 1.2% in 1984<sup>2</sup>. Paraquat was applied as a desiccant to 0.6% of the dry bean acreage.

**POTATO** Trifluralin, pendimethalin, and metolachlor were applied to 11.4%, 9.2%, and 7.0% of the potato acreage in 1992, respectively (Table 14). EPTC was applied to 2.1% of the potato acreage in 1992 as compared to 7.5% in 1989<sup>3</sup>.

Insecticides were applied to 241% of the planted potato acreage in 1992 (Table 14) because much of the acreage was treated more than once. Insecticides were applied once, twice or three times to 42.7, 43.4, and 10.3% of the potato acreage, respectively. Fifteen insecticides were reported used on potato acreage in 1992 compared to 10 insecticides reported used in 1989<sup>3</sup>. Carbofuran was applied to 115.6% of the potato acreage. Carbofuran was applied once, twice and three times to 24.2, 62.2, and 13.6% of the potato acreage, respectively. Endosulfan, methamidophos, esfenvalerate, azinphos-methyl, and phorate were applied to 42.2, 20.3, 15.2, 12.3, and 11% of the potato acreage, respectively. Insecticides were applied by the farm operator 76.4% of the time in 1992 compared to 91.7% of the time in 1989<sup>3</sup>.

Mancozeb was applied to 131.6% of the potato acreage, followed by chlorothalonil on 54.5% and triphenyltin hydroxide on 34.3% of the acreage. Metalaxyl containing fungicides were applied to 15% of the acreage. Fungicides were applied up to four times and the majority by ground application. Cool, wet weather contributed to an outbreak of late blight disease and accounted for widespread use of foliar fungicides on potatoes in 1992.

**SUGARBEETS** Desmedipham + phenmedipham and desmedipham alone was applied to 105.1% and 78.9% of the sugarbeet acreage in 1992, respectively (Table 15), which is similar to use in 1989<sup>3</sup>. Sethoxydim and clopyralid were applied to 78.3% and 21.3% of the sugarbeet acreage, respectively.

Insecticide use on sugarbeets increased to 95.9% in 1992 (Table 15) from 67.6% of the acreage in 1989 because of high sugarbeet maggot populations. Many farm operators in the areas with high sugarbeet maggot populations applied an insecticide at planting time plus a postemergence insecticide. Terbufos was applied to 53.0% of the sugarbeet acreage in 1992. Chlorpyrifos was applied to 39.9% of the sugarbeet acreage. Terbufos was applied once. Chlorpyrifos was applied once, twice, and three times to 76.2, 11.4, and 12.4% of the sugarbeet acreage, respectively.

Triphenyltin hydroxide was used on 42.8% of the sugarbeet acreage. Other fungicides were used on much fewer acres. The majority of fungicide application was mostly by air.

**ALFALFA** Only 0.6% of the alfalfa acreage was treated with herbicides in 1992; picloram was applied to 0.2% of the acreage (Table 16).

Insecticides were applied to 0.7% of the alfalfa acreage in 1992 (Table 16). Five insecticides were used in alfalfa. Carbaryl was the most used insecticide with application to 0.5% of the alfalfa acreage.

**OTHER HAY** Herbicides were applied to 1.9% of the hay land in 1992 and 2,4-D was the most applied product (Table 17). Insecticides were applied to 0.4% of the hayland acreage in 1992. Carbaryl was used on 0.3% of the hayland acreage.

**PASTURE** Two percent of all pastureland was treated with herbicide in 1992 (Table 18). The most used herbicide was 2,4-D followed by picloram. Insecticides were applied to 0.1% of the pastureland acreage in 1992. Carbaryl was the product applied to nearly all the treated acreage.

**SUMMER FALLOW** Products containing glyphosate were applied to 17.5% of the summer fallow acreage in 1992 (Table 19), as compared to 6.5% treated in 1989<sup>3</sup>. 2,4-D was applied to 13.1% and dicamba to 11.1% of the summer fallow acreage.

**CRP** Herbicides were applied to 4.5% of the CRP acreage in 1992 (Table 20), while 12.8% of the CRP was treated in 1989<sup>3</sup>. 2,4-D was applied to 2.3% and dicamba to 1.2% of the CRP land. Insecticides were applied to 0.7% of the CRP acreage in 1992. Carbaryl was the most used insecticide of the seven insecticides reported used in CRP.

<sup>2</sup>McMullen, M.P., A.G. Dexter, J.D. Nalewaja, W. Hamlin, and K. Davison. 1985. Pesticide Use on Major Crops in North Dakota, 1984. North Dakota State University in cooperation with North Dakota Crop and Livestock Reporting Service, Agronomy Report 3. 31p.

<sup>3</sup>McMullen, M.P., A.G. Dexter, J.D. Nalewaja, and G. Dahl. 1989. Pesticide Use on Major Crops in North Dakota, 1989. North Dakota State University in cooperation with North Dakota Crop and Livestock Reporting Service, Extension Report 1. 50p.

# PESTICIDE SUMMARIES

Total cumulative acres treated with each pesticide in North Dakota in 1992 are given in Tables 21A through 24A. Results from the survey of pesticide use in 1989, 1984, and 1978 are given in Tables 21B through 24B, 21C through 24C, and 21D through 24D, respectively. Acres reported treated in Tables 21 through 24 may exceed the acres treated in Table 1 because Tables 21 through 24 include multiple applications to the same acreage totaled as separate values and pesticides applied as a tank mixture were totaled separately unless a commercial mixture was used. Acres treated in Table 1 received one or more applications of pesticide. Percent acres treated are presented to aid in comparing among years and crops.

Seventy formulations of herbicides were applied to 28.8 million acres in 1992, equivalent to 73.2% of the agricultural acreage (Table 21A). In 1989, 69 formulations of herbicides were applied to 27.7 million acres or 70.4% of the agricultural acreage (Table 21B), in 1984, 57 herbicide formulations to 24.8 million acres or 60.6% of the agricultural acreage (Table 21C), and in 1978, 40 herbicide formulations to 16.9 million acres or 52.4% of the agricultural acreage (Table 21D).

2,4-D was applied to 8.2 million acres or 20.8% of the agricultural acreage in 1992 (Table 21A), compared to 8.1 million acres or 20.6% of the acreage in 1989 (Table 21B), 8.6 million acres or 20.9% of the acreage in 1984 (Table 21C), and 9.3 million acres or 28.9% of the acreage in 1978 (Table 21D). Trifluralin was applied to 2.9 million acres or 7.3% of the agricultural acreage in 1992, compared to applications to 4.1 million acres or 10.4% of the acreage in 1989, 4.5 million acres or 11.1% of the acreage in 1984, and 2.0 million acres or 6.3% of the acreage in 1978.

MCPA was applied to 3.0 million acres or 7.8% of the agricultural acreage in 1992 (Table 21A), compared to 4.4 million acres or 11.3% of the acreage in 1989 (Table 21B), 2.8 million acres or 6.8% of the acreage in 1984 (Table 21C), and 2.4 million acres or 5.9% of the acreage in 1978 (Table 21D). Dicamba was applied to 3.8 million acres in 1992 compared to 3 million acres in 1989, 1.4 million acres in 1984, and 170,000 acres in 1978. Of the sulfonylurea herbicides, tribenuron was applied to 1.4 million acres, more than any other. Thifensulfuron + tribenuron was applied to 1.1 million acres. Other products that increased in use in 1992 compared to 1989 include bentazon, bromoxynil, clopyralid, desmedipham, desmedipham + phenmedipham, ethalfluralin, all fenoxaprop products (not available in 1989), all glyphosate products, imazamethabenz, imazethapyr (not available in 1989), lactofen, metolachlor, nicosulfuron (not available in 1989), picloram, sethoxydim, all thifensulfuron/tribenuron products. The acreage treated with atrazine, barban, cyanazine, diclofop, difenzoquat, EPTC, metribuzin, metsulfuron, paraquat, pendimethalin, and triallate products were less in 1992 compared to 1989.

As in 1978, 1984, and 1989, nearly all the herbicides applied in 1992 were applied once, by the farm operator with ground equipment (Tables 21A-24D).

Insecticides were used on 1.2 million acres in 1992 compared to 2.2 and 2.9 and 0.4 million acres in 1989, 1984, and 1978, respectively (Tables 22A-22D). Twenty-three insecticides were used in 1992 compared to 24 in 1989, 27 in 1984, and 21 in 1978.

Nineteen insecticides were applied to less acres in 1992 than in 1989. Ten insecticides were applied to more acres in 1992 than in 1989. Carbofuran, ethyl parathion, methyl parathion, and esfenvalerate, were applied to 0.25, 0.13, 0.10, and 0.16 million acres, respectively in 1992, compared to 0.53, 0.35, 0.21, and 0.26 million acres, respectively, in 1989. Grasshopper and sunflower insect populations were lower in 1992 than in 1989 and fewer insecticide applications were necessary in 1992.

Terbufos was applied to 0.3 million acres both in 1992 and in 1989. Turbufos usage was similar in 1992 as 1989 because usage increased in sugarbeet and decreased proportionally in corn from 1989 to 1992.

Tefluthrin was first marketed in 1990, so it was not available in 1989. Greater chlorpyrifos use in 1992 than 1989 was due to the increased use in sugarbeets for sugarbeet root maggot control. Azinphos-methyl, endosulfan, and methamidophos use was greater in 1992 compared to 1989 because of increased use in potato for control of Colorado potato beetle and other insect pests.

Fungicides were applied to 0.93 million acres in 1992 compared to 0.58 million in 1989 and 0.5 million in 1984, and 0.1 million in 1978 (Tables 23A-23D). Increase in fungicide use primarily was due to wet weather and an increase in fungal leaf diseases in all crops. Mancozeb was applied to 0.36 million acres in 1992, compared to 0.16 million and 0.18 million in 1989 and 1984, respectively. Propiconazole was used on 0.23 million acres in 1992, compared to 0.16 million acres in 1989. Custom and aerial application was used slightly more than farm operator and ground application in 1992 for all fungicides combined.

## Summary of Other On Farm Procedures and Methods

Pesticide use is a topic of public interest. There is concern about the real and perceived potential risks from pesticides. Several organizations advocate reduced pesticide use by adopting more integrated pest management practices and sustainable agricultural methods. Farm operators are using alternative procedures and methods to control pests. Alternative procedures and methods have not been included in previous surveys of pesticide use in North Dakota. The alternative procedures and methods were included in the 1992 pesticide use survey to determine the extent that alternative pest control procedures and methods are being used in North Dakota.

Farm operators were asked to indicate their usage of various alternative procedures and methods and if used for pest control. Some procedures or methods could serve functions other than pest control. For example: Summer fallow could be used for moisture conservation.

There were 1911 farm operators that reported usage of alternative procedures and methods for crop production. Percentage of respondents using alternative practices were: crop rotation 89%, summer fallow 81%, field monitoring 69%, resistant varieties 63%, row crop cultivation 50%, moldboard plow 40%, harrow/ rotary hoe 37%, hand weeding 19%, no-till 10%, stubble burning 5%, other procedures and methods 5%, and beneficial insects/diseases 3% (Table 25).

**Crop rotation** was the most widely used alternative practice reported by farm operators. Eighty-nine percent of the farm operators reported using crop rotation (Table 25). Seventy-one percent of the farm operators used crop rotation for pest control. Crop rotation was used most widely in the East Central, Southeast and Northeast districts, with 96, 93, and 92% usage, respectively. Crop rotation was used least in the Southwest district at 82%.

**Summer fallow** was used by 81% of the farm operators in North Dakota (Table 25). Fifty-nine percent used summer fallow for pest control. The greatest usage of summer fallow was in the Northwest district, at 93%. The lowest usage of summerfallow was 72% in the Southeast district.

**Moldboard plowing** was used by 40% of the farm operators in North Dakota (Table 25). Sixty-six percent of these operators reported using the moldboard plow for pest control. The greatest usage of the moldboard plow was 57% in the South Central and 55% in the Southeast districts. The lowest usage was 18% in the Southwest and 19% in the Northwest districts.

**Row crop cultivation** was used by 50% of the farm operators, statewide (Table 25). Seventy-eight percent of row crop cultivation was for pest control. Row crop cultivation was used most in the East Central, Southeast, and Northeast districts where usage was by 73, 68, and 68% of the farm operators, respectively. Only 12% of the farm operators in the Northwest district and 17% in the Southwest district reported using row crop cultivation.

**Harrow or rotary hoe** was used by 37% of the North Dakota farm operators (Table 25). Sixty-nine percent of harrow and/or a rotary hoe usage was for pest control. The greatest number of farm operators that reported using a harrow and/or rotary hoe was in the Northeast district, at 56%. In the Northwest and Southwest districts, harrow and/or rotary hoe usage was only 16 and 18%, respectively.

**No-till** was used by 10% of the farm operators in North Dakota (Table 25) and 35% of the no-till usage was for pest control. The percentage of farmers that reported using no-till ranged from 5% in the Northeast district to 18% in the Southwest district.

**Resistant varieties** were used by 63% of the North Dakota farm operators (Table 25). Eighty-five percent of the farm operators used resistant varieties for pest control. The percentage of farm operators that reported using resistant varieties ranged from 49% in the South Central district to 82% in the East Central district.

**Hand weeding or hoeing** was used by 19% of the farm operators, statewide (Table 25). Eighty-four percent of the hand weeding was used for pest control. The percentage of farm operators in the East Central, Northeast, Southeast, and West Central districts that reported using hand weeding was 40, 35, 30 and 10%, respectively. Sugarbeet production is based in these districts and hand hoeing is a common procedure in sugarbeet production. The percentage of farm operators that reported using hand weeding in the remaining districts ranged from 5 to 9%.

**Stubble burning** was used by 5% of the farm operators, statewide (Table 25). Fifty-nine percent of the stubble burning was used for pest control. Twelve percent of the farm operators in the North Central district, 11% in the Northeast district used stubble burning, and 2 to 5% in the remaining districts used stubble burning.

**Beneficial insects or diseases** were used by 3% of the North Dakota farm operators in their farm operations (Table 25). Many of these farm operators indicated in the comments section of the survey that they were using flea beetles to control leafy spurge. The percentage of farm operators using insects and/or diseases ranged from 1% in the Northwest district to 7% in the South Central district.

**Field monitoring** was used by 69% of the farm operators in their farming operation (Table 25). Ninety percent of the field monitoring was for pest control. The percentage of farm operators using field monitoring ranged from 57% in the Northwest district to 80% in the East Central district.

**Other procedures or methods** were used by 5% of the farm operators, statewide (Table 25). Sixty-four percent of the farm operators used non-chemical procedures and methods for pest control. The percentage of farm operators using other procedures or methods ranged from 3% in the North Central district to 7% in the Northwest and South Central districts. More farm operators used tillage equipment for minimum tilling, chisel plowing, undercutting, disking, ridge tilling, and strip tilling than for any other type of procedure or method. Other procedures or methods used were using certified seed or clean seed, cleaning equipment between fields, using cover crops, adjusting planting dates, continuous cropping, strip cropping, and straw spreading.

## Summary of Concern for Pesticide Issues

Farm operators were asked to express their level of concern about certain pesticide related issues. The farm operators were asked to indicate a numerical value for their concern on a scale of 1 to 5 where 1 indicated no concern and 5 indicated a very high level of concern. A high average level of concern was indicated by North Dakota farm operators for all of the issues listed (Table 26). The various topics and the average level of concern in decreasing order of concern was applicator safety 4.32, effective pest control 4.24, food safety 4.22, environmental protection 4.12, continued product availability 4.10, resistance to pesticides 3.91, regulations 3.87, and need to develop new products 3.76.

**Applicator safety** was the greatest concern to North Dakota farm operators. The average level of concern that was indicated was 4.32 on a scale of 1 to 5 (Table 26). Eighty-one percent of the North Dakota farm operators indicated that they were highly concerned (rating of 4 or more) about pesticide applicator safety. Only 3.7% of the farm operators indicated that they were not concerned about applicator safety. The average level of concern was greater in the Northeast, Southeast, and East Central districts than in the remaining districts (Table 26).

**Food safety** was an issue that highly concerned (rating of 4 or more) 78% of the farm operators (Table 26). Only 5.4% of the farm operators reported that they were not concerned. The district with the highest average level of concern was the southeast district where 85% of the farm operators were highly concerned. Many of the farm operators commented that pesticides were used only when necessary and many others commented that they were organic crop producers.

**Environmental protection** was an issue that highly concerned (rating of 4 or more) 75% of the farm operators (Table 26). Only 4.6% of the farm operators were not concerned, but, the average environmental concern was higher in the Southeast, East Central, Northeast, and West Central districts than in the remaining districts.

**Regulation of pesticides** was an issue that highly concerned 64% of farm operators (Table 26). Only 5.9% of the farm operators were not concerned about pesticide regulation.

**Continued availability of pesticides** was an issue that highly concerned 74% of the farm operators in North Dakota. Only 6% of the farm operators were not concerned (Table 26). The average concern for availability of pesticides was greater in the Northeast, East Central, North Central and Southeast districts than in the remaining districts.

**Effective pest control** was an issue that highly concerned 79% of the North Dakota farm operators (Table 26). Only 4.5% of the farm operators were not concerned. The concern for effective pest control was greater in Southeast, East Central, Northeast, and North Central districts was more than in the remaining districts.

**Need for new products** was an issue that highly concerned 62% of the farm operators (Table 26). Nine percent of the farm operators were not concerned. Farm operators from the Northeast, North Central, East Central and Southeast districts had higher average concern than farm operators from the remaining districts.

**Resistance to pesticides** was an issue that highly concerned 69% of the farm operators in North Dakota (Table 26). Only 6.5% of the farm operators were not concerned. The most concern was in the East Central district and Northeast districts. These districts are where potatoes are grown and Colorado potato beetle is a pest and where sugarbeets are grown and where wild oat populations have developed resistance to herbicides with the ACC-ase inhibitor mode of action (Hoelon, Poast, etc).

## SUMMARY AND CONCLUSIONS

Pesticides remain an integral part of North Dakota agricultural production. Most agricultural producers used pesticides on major crops, but limited pesticide use occurred on alfalfa, hay, pasture, or CRP (Tables 6-20). For example, of the acreage in alfalfa, hay, pasture, fallow or CRP in 1992, 9.3% was treated with herbicide and 0.2% treated with insecticide, and in 1989, 7.2% and 0.5%, respectively. In contrast, of the acreage in wheat, barley, corn, sunflower, soybean, dry bean, potato, and sugarbeet, herbicides were applied an average of 1.55 times per acre, 6.2% of the acres were insecticide treated and 5.2% were fungicide treated in 1992 compared to 1.47 times, 12.3%, and 3.2%, respectively in 1989.

Environment continues to impact pesticide use. Weather was cooler and wetter in 1992 which reduced grasshopper infestations and insecticide use. However, the moist conditions increased late and early blight in potatoes and fungicide use.

The number of herbicide formulations used on agricultural land was similar in 1989 and 1992 (Tables 21A, 21B). Several new herbicides were released during this period, but due to the cost of herbicide reregistration many older herbicides were canceled. The number of insecticide formulations also remained similar from 1989 to 1992 (Tables 22A, 22B). However, the number of fungicides used increased from 10 to 12 from 1989 to 1992 (Tables 23A, 23B).

More acres were treated with herbicides than with other pesticides in 1992, approximately 20 times more than insecticides and 30 times more than fungicides (Table 1A). As in 1989, wheat was grown on the most acreage and accounted for the greatest herbicide use. Sunflower had the most acreage treated with insecticides and wheat continued to have the largest acreage treated with fungicide.

Seed treatment is commonly used by North Dakota producers (Table 1A). Of the major crops, flax and soybeans seed were least frequently treated, while most all the corn, sunflower and sugarbeet seed was treated, but not on farm. Of the total crop acreage planted with treated seed 59.8% was on-farm treated.

Small grain, dry bean, potato and sugarbeet production and use of pesticides on these crops was greatest in the Northeast district (Table 3). The Central and Southeast district had the greatest concentration and use of herbicides on sunflower and corn, respectively. The East Central and Southeast districts had the greatest concentration and greatest use of pesticides on soybean.

Pesticides are mostly applied once and by the farm operator using ground equipment (Tables 21A-23D).

Most North Dakota farm operators were highly concerned about present pesticide issues, including health, safety and environmental protection issues. Further more, farm operators were highly concerned about effective pest control, continued availability of pesticides, future pest resistance, pesticide regulation, and need for new products.

Table 1A. Acreage planted, acreage treated and percentage of planted acreage treated with pesticides in crops. North Dakota, 1992.

Crop	Pesticide treated acres <sup>2</sup>												
	Acres planted <sup>1</sup>	On-Farm						On-farm					
		Treated seed	treated seed	Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants	Treated seed	treated seed	Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants
(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(%)	(%)	(%)	(%)	(%)	(%)	
Wheat	11600.0	5446.6	4409.0	10454.9	100.9	291.9	1.2	47.0	38.0	90.1	0.9	2.5	0.0
Barley	2700.0	1538.5	1199.2	2386.5	19.4	79.4	.	57.0	44.4	88.4	0.7	2.9	.
Oat	780.0	55.0	35.1	254.7	2.0	0.0	0.5	7.0	4.5	32.7	0.3	0.0	0.1
Flax	145.0	10.7	2.3	95.2	2.2	.	.	7.3	1.6	65.7	1.5	.	.
Corn	1000.0	986.3	56.5	797.4	82.4	0.0	.	98.6	5.7	79.7	8.2	0.0	.
Sunflower	1225.0	988.5	51.8	1096.4	332.0	1.3	.	80.7	4.2	89.5	27.1	0.1	.
Soybean	700.0	100.4	19.9	687.2	7.5	.	.	14.3	2.8	98.2	1.1	.	.
Dry Bean	440.0	359.4	0.7	404.6	0.2	23.6	7.4	81.7	0.2	92.0	0.0	5.4	1.7
Potato	146.0	107.6	103.3	45.4	139.6	129.5	55.1	73.7	70.8	31.1	95.6	88.7	37.7
Sugarbeet	195.5	195.5	.	188.8	139.4	61.7	.	100.0	.	96.6	71.3	31.6	.
Alfalfa Hay	1300.0	16.4	.	3.9	7.2	.	.	1.3	.	0.3	0.6	.	.
Other Hay	1600.0	2.6	.	23.8	6.2	.	.	0.2	.	1.5	0.4	.	.
Pasture	11938.2	1.3	.	152.7	15.4	.	.	0.0	.	1.3	0.1	.	.
Summer Fallow	4100.0	10.2	0.0	896.6	0.2	0.7	0.2	0.2	0.0	21.9	0.0	0.0	0.0
CRP <sup>3</sup>	2898.7	10.1	.	85.0	18.2	.	.	0.3	.	2.9	0.6	.	.
Total	40768.4	9828.9	5877.8	17573.2	872.9	588.1	64.3	24.1	14.4	43.1	2.1	1.4	0.2

<sup>1</sup>Preliminary estimates by the North Dakota Agricultural Statistics Service.

<sup>2</sup>Multiple applications to the same acreage were totaled as one application. Seed treatment not included, except where specified.

<sup>3</sup>CRP represents acres in the Conservation Reserve Program.

Table 1B. Acreage planted, acreage treated and percentage of planted acreage treated with pesticides in crops. North Dakota, 1989.

Crop	Pesticide treated acres <sup>2</sup>												
	Acres planted <sup>1</sup>	On-Farm						On-farm					
		Treated seed	treated seed	Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants	Treated seed	treated seed	Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants
(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(%)	(%)	(%)	(%)	(%)	(%)	
Wheat	10800.0	5133.3	4179.9	10036.8	349.8	171.5	.	47.5	38.7	92.9	3.2	1.6	.
Barley	2800.0	1505.4	1193.1	2526.1	104.5	37.1	.	53.8	42.6	90.2	3.7	1.3	.
Oat	1150.0	149.6	126.3	573.8	8.6	.	.	13.0	11.0	49.9	0.7	.	.
Flax	170.0	19.2	7.4	100.3	4.7	.	.	11.3	4.3	59.0	2.7	.	.
Corn	880.0	880.0	47.6	638.0	90.8	.	.	100.0	5.4	72.5	10.3	.	.
Sunflower	1320.0	979.1	87.6	1197.4	674.9	30.0	3.1	74.2	6.6	90.7	51.1	2.3	0.2
Soybean	640.0	76.7	34.3	586.5	147.1	.	.	12.0	5.7	91.6	23.0	.	.
Dry Bean	500.0	391.6	4.2	461.1	45.7	5.4	1.5	78.3	0.8	92.2	9.1	1.1	0.3
Potato	140.0	106.7	102.1	51.9	132.2	108.6	14.4	76.2	72.9	37.1	94.4	77.6	10.3
Sugarbeet	180.2	180.2	6.6	161.0	113.7	44.1	.	100.0	3.6	89.4	63.1	24.5	.
Alfalfa Hay	1500.0	12.7	0.2	4.3	19.4	.	.	0.8	0.0	0.3	1.3	.	.
Other Hay	1900.0	7.8	.	10.4	1.1	.	.	0.4	.	0.5	0.1	.	.
Pasture	10206.2	4.6	4.0	128.5	7.2	.	.	0.0	0.0	1.3	0.1	.	.
Summer Fallow	4200.0	3.8	1.2	637.7	6.2	.	.	0.1	0.0	15.2	0.1	.	.
CRP <sup>3</sup>	2948.5	11.3	.	254.8	56.2	.	.	0.4	0.0	8.6	1.9	.	.
<b>Total</b>	<b>39334.9</b>	<b>9462.0</b>	<b>5794.5</b>	<b>17368.6</b>	<b>1762.1</b>	<b>396.7</b>	<b>19.0</b>	<b>24.1</b>	<b>14.7</b>	<b>44.2</b>	<b>4.5</b>	<b>1.0</b>	<b>0.0</b>

<sup>1</sup>Preliminary estimates by the North Dakota Agricultural Statistics Service.

<sup>2</sup>Multiple applications to the same acreage were totaled as one application. Seed treatment not included, except where specified.

<sup>3</sup>CRP represents acres in the Conservation Reserve Program.



Table 1C. Acreage planted, acreage treated, and percentage of planted acreage treated with pesticides in crops. North Dakota, 1984<sup>1</sup>.

Crop	Pesticide treated acres <sup>3</sup>								
	Acres planted <sup>2</sup> (1000)	Herbi- cide (1000)	Insecti- cide (1000)	Fungi- cide (1000)	Other <sup>4</sup> (1000)	Herbi- cide (%)	Insecti- cide (%)	Fungi- cide (%)	Other <sup>3</sup> (%)
Wheat	8820.0	8018.2	206.1	183.5	0.0	90.9	2.3	2.1	0.0
Barley	2950.0	2581.7	65.9	44.0	0.0	87.5	2.2	1.5	0.0
Oat	1150.0	492.6	13.9	0.0	0.0	42.8	1.2	0.0	0.0
Flax	400.0	265.2	11.4	0.0	0.0	66.3	2.9	0.0	0.0
Corn	970.0	735.3	13.8	2.2	0.0	75.8	17.9	0.2	0.0
Sunflower	2850.0	2521.4	1846.9	0.5	5.6	88.5	64.8	0.0	0.2
Soybean	750.0	722.4	15.7	2.7	0.4	96.3	2.1	0.4	0.0
Dry Bean	205.0	191.7	0.7	38.9	3.5	93.5	0.4	19.0	1.7
Potato	136.0	41.6	131.8	91.9	54.5	30.6	96.9	67.6	40.1
Sugarbeet	139.8	135.0	69.3	108.5	0.0	96.5	49.5	77.6	0.0
Alfalfa hay	1550.0	13.4	14.5	0.5	0.0	0.9	0.9	0.0	0.0
Other hay	1350.0	9.1	3.8	0.0	0.1	0.7	0.3	0.0	0.0
Pasture & range <sup>5</sup>	9754.7	116.0	27.7	0.0	0.0	1.2	0.3	0.0	0.0
Summer Fallow + PIK + ARP <sup>6</sup>	9908.0	1696.4	6.2	0.0	0.0	17.1	0.1	0.0	0.0
Other Crops <sup>7</sup>	-	-	-	-	-	52.9	8.5	0.0	0.0
<b>Total</b>	<b>40933.5</b>	<b>17539.8</b>	<b>2587.8</b>	<b>472.7</b>	<b>64.1</b>	<b>42.8</b>	<b>6.3</b>	<b>1.2</b>	<b>0.2</b>

<sup>1</sup>McMullen, M. P., A. G. Dexter, J. D. Nalewaja, W. Hamlin and K. Davison. 1985. Pesticide Use on Major Crops in North Dakota, 1984. North Dakota State University in cooperation with North Dakota Crop and Livestock Reporting Service, Agronomy Report 3. 31p.

<sup>2</sup>Preliminary estimates by the North Dakota Crop and Livestock Reporting Service. Exception: Pasture and range which are U.S. Census figures.

<sup>3</sup>Multiple applications to the same acreage were totaled as one application. Seed treatments not included.

<sup>4</sup>See Table 21 for other chemical usage in North Dakota. Desiccants were the main chemicals in the other category.

<sup>5</sup>Pasture and rangeland other than crop and woodland pastured.

<sup>6</sup>PIK and ARP are acres for the Payment in Kind and Acreage Reserve Program.

<sup>7</sup>Main crops in other category are rapeseed, mustard, millet, buckwheat, safflower.

Table 2. Acreage planted, acreage treated, and percentage of planted acreage treated with pesticides in agricultural statistics districts. North Dakota, 1992.

District	Pesticide treated acres <sup>2</sup>												
	Acres planted <sup>1</sup>	On-Farm						On-farm					
		Treated seed	treated seed	Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants	Treated seed	treated seed	Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants
(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(%)	(%)	(%)	(%)	(%)	(%)	
Northwest	5305.9	1068.9	846.9	2376.2	37.4	0.9	.	20.1	16.0	44.8	0.7	0.0	.
North Central	3902.0	1178.4	898.7	1840.2	76.7	8.1	.	30.2	23.0	47.2	2.0	0.2	.
Northeast	4925.4	2476.4	1673.6	3605.3	280.2	460.9	55.0	50.3	34.0	73.2	5.7	9.4	1.1
West Central	4686.2	520.0	371.2	941.8	14.7	3.3	0.2	11.1	7.9	20.1	0.3	0.1	0.0
Central	4182.8	900.3	495.2	1855.2	128.2	3.0	.	21.5	11.8	44.4	3.1	0.1	.
East Central	3279.6	1756.6	787.8	2664.8	169.6	77.9	4.6	53.6	24.0	81.3	5.2	2.4	0.1
Southwest	5256.7	541.2	390.4	1075.1	6.7	.	.	10.3	7.4	20.5	0.1	.	.
South Central	4886.7	297.3	117.2	764.0	3.6	.	.	6.1	2.4	15.6	0.1	.	.
Southeast	4338.5	1088.7	297.0	2448.5	151.3	33.1	4.3	25.1	6.8	56.4	3.5	0.8	0.1
Other (Potato)	4.6	1.0	0.0	2.1	4.5	1.0	0.3	22.8	0.0	44.8	98.9	22.8	5.5

<sup>1</sup>Preliminary estimates by the North Dakota Agricultural Statistics Service.

<sup>2</sup>Multiple applications to the same acreage were totaled as one application.

Table 3. Acreage planted, acreage treated, and percentage of planted acreage treated with pesticides in crop reporting districts of North Dakota, 1992.

District	Acres planted <sup>1</sup>	Pesticide treated acres <sup>2</sup>											
		On-Farm						On-farm					
		Treated seed	treated seed	Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants	Treated seed	treated seed	Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants
(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(%)	(%)	(%)	(%)	(%)	(%)
<b>Wheat</b>													
Northwest	1782.0	821.5	682.2	1616.0	21.5	.	.	46.1	38.3	90.7	1.2	.	.
North Central	1250.0	716.5	650.8	1159.8	15.3	6.7	.	57.3	52.1	92.8	1.2	0.5	.
Northeast	2282.0	1419.0	1178.3	2218.2	24.1	243.7	.	62.2	51.6	97.2	1.1	10.7	.
West Central	872.0	358.8	309.1	647.1	2.0	.	.	41.1	35.5	74.2	0.2	.	.
Central	1223.0	455.4	385.1	1122.5	10.9	2.1	.	37.2	31.5	91.8	0.9	0.2	.
East Central	1341.0	839.5	565.0	1305.1	25.1	31.0	1.2	62.6	42.1	97.3	1.9	2.3	0.1
Southwest	921.0	416.5	330.3	766.7	1.6	.	.	45.2	35.9	83.2	0.2	.	.
South Central	741.0	142.2	92.0	499.3	.	.	.	19.2	12.4	67.4	.	.	.
Southeast	1188.0	277.1	216.2	1120.4	0.4	8.4	.	23.3	18.2	94.3	0.0	0.7	.
<b>Total</b>	<b>11600.0</b>	<b>5446.6</b>	<b>4409.0</b>	<b>10454.9</b>	<b>100.9</b>	<b>291.9</b>	<b>1.2</b>	<b>47.0</b>	<b>38.0</b>	<b>90.1</b>	<b>0.9</b>	<b>2.5</b>	<b>0.0</b>
<b>Barley</b>													
Northwest	290.0	171.3	154.4	243.5	2.6	.	.	59.1	53.3	84.0	0.9	.	.
North Central	400.0	272.9	224.0	355.2	6.2	0.7	.	68.2	56.0	88.8	1.5	0.2	.
Northeast	720.0	468.4	380.2	696.8	3.4	63.7	.	65.1	52.8	96.8	0.5	8.8	.
West Central	140.0	64.2	58.6	75.2	0.7	.	.	45.9	41.9	53.7	0.5	.	.
Central	220.0	97.8	93.5	198.5	0.9	0.9	.	44.4	42.5	90.2	0.4	0.4	.
East Central	450.0	302.5	176.2	436.9	5.6	12.3	.	67.2	39.1	97.1	1.3	2.7	.
Southwest	150.0	77.1	57.4	120.8	.	.	.	51.4	38.3	80.5	.	.	.
South Central	130.0	28.4	18.6	81.7	.	.	.	21.8	14.3	62.9	.	.	.
Southeast	200.0	55.9	36.2	177.8	.	1.8	.	27.9	18.1	88.9	.	0.9	.
<b>Total</b>	<b>2700.0</b>	<b>1538.5</b>	<b>1199.2</b>	<b>2386.5</b>	<b>19.4</b>	<b>79.4</b>	<b>.</b>	<b>57.0</b>	<b>44.4</b>	<b>88.4</b>	<b>0.7</b>	<b>2.9</b>	<b>.</b>
<b>Oat</b>													
Northwest	75.0	7.7	4.0	26.0	0.3	.	.	10.3	5.4	34.6	0.4	.	.
North Central	70.0	14.6	11.0	21.5	0.3	.	.	20.9	15.7	30.8	0.4	.	.
Northeast	25.0	2.8	2.4	15.3	.	.	.	11.2	9.7	61.4	.	.	.
West Central	140.0	5.4	3.4	30.2	0.1	.	.	3.9	2.4	21.6	0.1	.	.
Central	80.0	7.1	5.2	30.0	1.3	.	.	8.9	6.5	37.5	1.6	.	.
East Central	20.0	4.6	3.0	16.5	.	0.0	0.5	23.1	14.9	82.7	.	0.0	2.5
Southwest	110.0	6.4	2.7	33.6	.	.	.	5.8	2.5	30.5	.	.	.
South Central	180.0	5.3	3.0	38.9	.	.	.	3.0	1.6	21.6	.	.	.
Southeast	80.0	0.9	0.4	42.6	.	.	.	1.2	0.4	53.3	.	.	.
<b>Total</b>	<b>780.0</b>	<b>55.0</b>	<b>35.1</b>	<b>254.7</b>	<b>2.0</b>	<b>0.0</b>	<b>0.5</b>	<b>7.0</b>	<b>4.5</b>	<b>32.7</b>	<b>0.3</b>	<b>0.0</b>	<b>0.1</b>
<b>Flax</b>													
Northwest	21.0	1.5	1.1	17.0	1.5	.	.	7.2	5.4	81.0	7.2	.	.
North Central	27.0	1.3	.	13.5	.	.	.	4.9	.	50.0	.	.	.
Northeast	35.0	1.6	0.4	23.6	.	.	.	4.6	1.0	67.4	.	.	.
West Central	11.0	2.7	.	7.1	.	.	.	24.7	.	64.7	.	.	.
Central	23.0	.	.	16.8	0.7	.	.	.	.	72.9	2.9	.	.
East Central	8.5	0.4	.	7.6	.	.	.	4.5	.	90.0	.	.	.
Southwest	1.0	.	.	.	.	.	.	.	.	.	.	.	.
South Central	5.5	0.8	0.8	1.5	.	.	.	13.8	13.8	26.9	.	.	.
Southeast	13.0	2.3	.	8.1	.	.	.	18.0	.	62.3	.	.	.
<b>Total</b>	<b>145.0</b>	<b>10.7</b>	<b>2.3</b>	<b>95.2</b>	<b>2.2</b>	<b>.</b>	<b>.</b>	<b>7.3</b>	<b>1.6</b>	<b>65.7</b>	<b>1.5</b>	<b>.</b>	<b>.</b>

<sup>1</sup>Preliminary estimates by the North Dakota Agricultural Statistics Service.

<sup>2</sup>Multiple applications to the same acreage were totaled as one application.