



PESTICIDE USE ON MAJOR CROPS IN NORTH DAKOTA 1989

North Dakota State University in Cooperation with
North Dakota Agricultural Statistics Service

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INTRODUCTION

This is the third major account of pesticide usage in North Dakota and describes pesticide usage on agricultural land in 1989. The information is derived from a comprehensive survey of North Dakota farm operators. The first two comprehensive surveys to assess pesticide usage on major crops in North Dakota were conducted on 1978¹ and 1984² pesticide applications. The amount of acres treated with herbicides, insecticides and fungicides was greater in 1984 than in 1978. Increases in acres treated may have been due to changes in pest populations, changes in tillage practices, increases or shifts in acreages of major crops, and to new developments in pest control technology and pesticide chemistry.

Pesticide usage in North Dakota was assessed again in 1989 because of agricultural production changes since the last survey in 1984, such as increased Conservation Reserve Program (CRP) acreage. Other changes include increased interest in sustainable agriculture and organic farming, increased public concern about pesticides, increased activity and specificity of certain pesticides, and the availability of new pesticides. The objectives of this survey were: 1) to determine acreages of crops treated with each pesticide group and to identify the specific pesticides used; 2) to determine pesticide usage by state districts; 3) to determine the percentage of pesticides applied by farm operator or custom applicator and by air or ground equipment; and 4) to assess the use of seed treatment pesticides on major crops.

NOTE: This report gives the information on 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 misreported use of pesticides, or products may have been applied before planting or after harvest.

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 usage data for major crops, alfalfa hay, other hay, CRP, summerfallow and pasture in North Dakota (Appendix A).

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

The survey asked respondents to identify specific chemicals used for on-farm treated seed, acres seeded with farm-treated seed and the method of application. The methods queried for the farm-treated seed were drillbox, auger and other. Detailed information for farm-treated seed was obtained only for wheat, barley, oats, flax, soybeans and potatoes. Other crops, such as corn and sugarbeets, are usually pretreated prior to purchase.

Respondents were asked to provide information on non-seed treatment uses of herbicides, fungicides, insecticides and desiccants, acres treated, number of applications, type of application and method of application for each of the major crops or land uses. Type of application referred to either self-applied or custom applied; method referred to aerial or ground applications. A list of trade names of individual pesticides was provided with the questionnaire (Appendix C).

The Sample

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

¹Nalewaja, 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.

²McMullen, 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.

Data Collection and Editing

Questionnaires were mailed in late December 1989. A random sample of non-respondents to the mailing was surveyed by telephone during a 30-day period from mid-January to mid-February 1990. Approximately 3500 usable reports were obtained; 85 percent reported planting wheat in 1989, 57 percent reported planting barley, 42 percent planted oats, 8 percent planted flax, 25 percent corn, 19 percent sunflower, 9 percent soybeans, 4 percent dry beans, 2 percent sugarbeets and 1 percent potatoes. Forty-two percent reported having alfalfa hay, 41 percent reported other hay acreage and 22 percent had CRP. Seventy-three percent reported some summer fallow land, with 59 percent reporting pasture-land. Fifty-two percent reported using at least some treated seed, and 28 percent used on-farm treated seed. Eighty-two percent of the respondents used herbicides, 18 percent used insecticides, 3 percent used fungicides and less than 1 percent used desiccants or vine killers.

The edit process considered completeness and reasonableness of data within each section of the questionnaire and across sections. For example, the total acreage treated with herbicides was compared to the totals of acres treated with herbicides for each crop, for each individual questionnaire. Telephone follow-up was used to complete and correct questionnaires with missing or questionable information. **This report gives the information on pesticide usage as reported by the farmers surveyed. No attempt was made to remove non-registered pesticides from the data. Some survey respondents may have accidentally mis-reported use of pesticides, or products may have been applied before planting or after harvest.**

The Summary

Total state percentages shown in the summary are weighted averages of the districts. Data were summarized by obtaining a percentage of total acres treated for the general pesticides category, as well as for specific chemicals, by crop for each crop reporting district. These percentages were multiplied by the North Dakota Agricultural Statistics Service estimate of total acres planted to each crop in the district. State acres were obtained by the addition of these data with state percentages derived to obtain the weighted values.

All results reported in the questionnaire were included in the summary tables except for farm-treatment of seed for crops not specified in the questionnaire. Values in the tables which show an acreage but zero percent are the result of internal calculations which produced some acreage but where the percent of the total was less than one tenth of one percent. Also, these values may represent only one survey response, as reported values were interpolated to represent the total state acreage. Percentages were rounded to the nearest tenth of a percent.

RESULTS

Total Acres Treated with Pesticides

The reported treated acres in Tables 1 and 2 indicate acres that received one or more applications of a pesticide. The treated acres in Tables 3 through 23 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 3 through 23 can exceed 100% of the planted acres.

Herbicides, insecticides and fungicides were applied one or more times to 17.4, 1.8 and 0.4 million acres, respectively, in 1989 (Table 1A). This compares to one or more treatments to 17.5, 2.5, and 0.5 million acres with herbicides, insecticides and fungicides, respectively, in 1984 (Table 1B). Herbicides were applied to approximately 44.2% of all crop, pasture, hay, CRP and summer fallow land in 1989, insecticides to 4.5%, and fungicides to 1.0%. Desiccants were applied to only 0.02 percent of the crop, hay, pasture and CRP land in 1989, with usage primarily on potatoes.

The data indicate that 24.1% of the total agricultural land was planted with treated seed and over half of this was on-farm treated (Table 1A). Treated seed was planted on 50.7% or 9,421,800 acres of the land planted to crops. Over half the acreage planted to wheat and barley was planted with treated seed, and the majority of this was on-farm treated. Most of the potato acreage was planted with treated seed and this also was primarily with on-farm treated seed. The majority of corn, sunflower, dry bean and sugarbeet acreage also was planted with treated seed, but with these crops, the seed generally was treated by the seed supplier, *not* on the farm.

Total acres treated at least once with herbicides was 0.17 million fewer in 1989 than in 1984 (Tables 1A, 1B). Herbicides were applied to more than 90% of the wheat, barley, sunflower, soybean, and dry bean acreage (Table 1A). The percent of acreage treated with herbicides was more in 1989 than in 1984 for wheat, barley, oats, sunflower and potatoes (Tables 1A, 1B). The percent acreage treated with herbicides was less in 1989 than in 1984 for flax, corn, soybean, dry bean and sugarbeets. The insecticide use on soybeans increased to 23.0% in 1989 from 2.1% in 1984 and for sugarbeets to 63.1% in 1989 from 49.5% in 1984 (Tables 1A, 1B). Grasshopper occurrence in 1989 was the primary reason for increased insecticide use on soybeans and sugarbeets.

Insecticide use on sunflower decreased from 64.8% of acreage treated in 1984 to 51.1% in 1989. Overall, insecticide treatment decreased from usage on 6.3% of total acres in 1984 to 4.5% in 1989. Total fungicide use in 1989 was about equal to that of 1984.

Acres Treated According to Agricultural Statistics Districts

North Dakota has nine agricultural statistics districts (Appendix B). Summaries of pesticide usage in crops for agricultural statistics districts are given in Table 2. The Northeast district had the greatest acreage of wheat and of barley. Over 95% of the acres planted to wheat and barley were treated with herbicides in the Northeast district. The Northeast district also had the greatest use of fungicides on wheat and barley. Insecticide usage on wheat and barley was greatest in the East Central district, where grasshoppers infested many crops. Herbicides were used on only 29.4% of the oat acreage in the South Central district, although the oat acreage was the greatest in the South Central district.

The percentage of flax acreage treated with herbicides was highest in the Northeast district, which also had the greatest planted flax acreage (Table 2). Insecticides were used on 15% of the flax acreage in the North Central district, primarily to control grasshoppers. Insecticide was applied to 21% of the corn acreage in the Southeast district, the district with the greatest acreage of corn.

Sunflower acreage decreased from 2,850,000 acres in 1984 to 1,320,000 acres in 1989 (Tables 1A, 1B). The Central district had the greatest acreage of sunflowers in 1989 and 74% of this acreage was treated with insecticides (Table 2). Fungicides were applied to 12.2% of the sunflower acres in the Northeast district because of an outbreak of sunflower rust.

Soybean acreage was concentrated in the East Central and Southeast districts (Table 2). Insecticides, primarily for control of grasshoppers, were applied to 29.1% of the soybean acres in the East Central district and to 20.1% of the acres in the Southeast district.

Dry bean acreage was greatest in the Northeast and East Central districts, and insecticides were applied to the greatest number of acres in these two districts (Table 2). Fungicides were used on 2.3% of the dry bean acres in the Northeast, compared to 32.1% in 1984. Dry bean diseases such as rust and white mold were not common in 1989 because of dry conditions.

Potato acreage was greatest in the Northeast district (Table 2). Herbicides were applied to 38.3% of the acreage in the Northeast district, while insecticides were applied to 97.9% of the acres and fungicides to 80.3%. Insecticides were for the control of Colorado potato beetle, while fungicides were for prevention of early blight infection.

Sugarbeet acreage was highest in the Northeast district (Table 2). Herbicides and insecticides were applied to the most sugarbeet acres in the Northeast district, while fungicides were applied to the greatest acreage in the East Central district.

Pesticide use on alfalfa, other hay, and pasture was very low, generally with less than 1% of the acreage treated with any class of pesticide (Table 2). Herbicides were applied to 15.2% of the summer fallow and 8.6% of the CRP acreage. The Northwest district had the greatest useage of herbicide on summer fallow and CRP, with 23.7% and 18.2% of the acreage treated, respectively.

On Farm Seed Treatment, by Crop

Acreage planted to wheat with seed treated on-farm is greater in Table 3 than in Table 1A because Table 3 includes multiple applications to seed as separate values in the total, whereas acreage in Table 1A is acreage planted to seed treated with one or more applications of pesticide. Maneb + lindane was used to treat seed on 20% of the wheat acres and was the most frequently used product on wheat. Other seed treatments used included carboxin on 11.2% and carboxin + thiram on 5.5% of the acres. Seed treatment was by auger treatment for 74.6% of the treated seed.

Maneb + Lindane was the most frequently used barley seed treatment, on 19.9% of planted acres, followed by carboxin on 15.6% and carboxin + thiram on 6.0% (Table 3). Barley seed treatment primarily was by auger application.

The percentage of seed treated on-farm was less for oats, flax and soybean than for wheat or barley. Only 11.4% of oat acres and 4.3% of flax acres were planted with treated seed (Table 3). Maneb + lindane was the most commonly used product on these two crops. The auger treater was the primary method for treating oats, while most flax was treated in the drill box. Treated soybean seed was planted on 5.4% of the soybean acreage and carboxin + thiram was the most commonly used product. Method of application was almost evenly split between drill box and auger treater.

Seed treatment was common in potatoes with 75.6% of acres planted to treated seed (Table 3). Zineb + streptomycin + bark was the most widely used product, followed by mancozeb. The method primarily used for seed treatment was other than drill box or auger.

Other crops, such as corn and sunflower, were planted with treated seed, but treatment was not on-farm, and individual chemicals were not identified.

Maneb + lindane was the most commonly used seed treatment, followed by carboxin and carboxin plus thiram, when on-farm seed treatment was totaled over wheat, barley, oats, flax, soybean and potato (Table 4).

Pesticide Usage on Crops, Pasture, Summer Fallow and CRP in North Dakota, 1989

Acres treated in Tables 5 through 19 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 5 through 19 contain data on individual pesticides used, number of applications, and application methods in major crops, pasture land, summer fallow and CRP for 1989. 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 55.1% of the wheat acreage in 1989 (Table 5), compared to 63.6% of the wheat acreage in 1984². MCPA was applied to 28.0% of the wheat acreage in 1989, followed by dicamba to 22%. MCPA was applied to 16.5% and dicamba to 9.6% of the wheat acres in 1984². Trifluralin was applied to 18.2% of the wheat acreage in 1989 compared to 16.4% in 1984². Wheat acreage treated with low dosage sulfonylurea type herbicides increased from 2.1% with chlorsulfuron in 1984² to 21.0% with either chlorsulfuron, metsulfuron, or DPX-M6316 in 1989. The farm operator applied 88.4% of the herbicides to wheat and 91.1% was applied by ground equipment.

Insecticides were applied to 3.5% of the wheat acreage in 1989 (Table 5) compared to 2.1% in 1984². Carbofuran was the most frequently used insecticide in 1989. Insecticides were applied most frequently with custom and aerial application. Fungicides were applied to 1.7% of the wheat acres in 1989 and to 2.0% in 1984². Propiconazole was the most frequently applied fungicide, and it generally was applied by custom, aerial application.

BARLEY 2,4-D was applied to 42.7% of the barley acreage in 1989, followed by MCPA to 33.2% (Table 6). Trifluralin was applied to 14.8% of the barley acreage and DPX-M6316 on 11.3%. Over 90% of herbicides on barley were applied by the farm operator with ground equipment.

Insecticides were applied to 4.2% of the barley acres and carbofuran was the product most frequently used (Table 6). Insecticide use primarily was for grasshopper control. Foliar fungicides were applied to 1.4% of the barley acreage and propiconazole was the most frequently used product.

OATS MCPA was applied to 26.9% of the oat acreage and 2,4-D to 20.7% (Table 7). Dicamba was applied to 9.0% of the oat acreage. The majority of herbicides on oats were applied once by the farm operator with ground equipment.

Insecticides were applied to 1.1% of the oat acreage and the most commonly used product was fenvalerate (Table 7). Fungicides were not used on oats.

FLAX MCPA was applied to 34.3% of the flax acreage and trifluralin to 32.3% (Table 8). Over 90% of the applications were by the farm operator with ground equipment.

Carbofuran was the most commonly used insecticide on flax, but only 2.0% of the acres were treated (Table 8). Foliar fungicides were not used on flax.

CORN EPTC was applied to 33.4% of the corn acreage, and cyanazine to 21.9% (Table 9). Atrazine was applied to 10.2% of the corn acreage in 1989 compared to 22.5% in 1984². Most corn herbicides were applied once by the farm operator, with ground equipment.

Nine insecticides were reported used on corn in 1989; terbufos was the most frequently used product (Table 9). Insecticide use on corn declined from 18.9% in 1984² to 10.8% in 1989. Foliar fungicides were not applied to corn.

SUNFLOWER Trifluralin was applied to 65.0% of the sunflower acres while ethalfuralin was applied to 24.7%, compared to 79.2% and 1.2%, respectively, in 1984² (Table 10). Over 90% of the herbicides for sunflower were applied by the farm operator with ground equipment.

Insecticides were applied to 59.1% of the sunflower acreage in 1989 (Table 10) compared to 64.8% in 1984². Ethyl parathion was applied to 23% of the sunflower acres, followed by methyl parathion to 12.8% and fenvalerate to 11.3%. Fenvalerate had been applied to 44.8% of the acres in 1984². Insecticides were applied twice to 14.9% of the sunflower acres and were most often custom applied with aerial application equipment.

Fungicides were applied to 2.4% of the sunflower acreage, with mancozeb being the primary product (Table 10). Mancozeb received a special exemption for use in 1989 because of an outbreak of sunflower rust in some areas. Desiccants were applied to 0.2% of the sunflower acreage in 1989.

SOYBEAN Trifluralin and ethalfuralin were applied to 56.4% and 23.2% of the soybean acres, respectively (Table 11). Bentazon was applied to 39.7% and acifluorfen to 17.3% of the soybean acres. Over 90% of the soybean herbicides were applied by the farm operator with ground equipment.

Insecticides were applied to 34.3% of the soybean acreage in 1989 (Table 11), compared to 1.6% in 1984². Grasshoppers were a serious threat to the soybean crop in 1989 in the eastern part of the state. Esfenvalerate was applied to 16.1% of the soybean acreage, followed by carbofuran to 12.0%. Foliar fungicides were not used on soybeans.

DRY BEAN Ethalfuralin, trifluralin, and bentazon were applied to 49.8%, 34.1%, and 31.2% of the dry bean acreage, respectively, in 1989 (Table 12). Trifluralin was applied to 60.1%, ethalfuralin to 22%, and bentazon to 29.7% of the dry bean acreage in 1984².

²McMullen, 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.

Insecticides were applied to 10.7% of the dry bean acreage in 1989 (Table 12), up from 0.4% in 1984². Esfenvalerate was the most frequently used insecticide on dry bean. Aerial application was used for 54.5% of the acreage treated with insecticides.

Fungicides were applied to 1.1% of the dry bean acreage in 1989 (Table 12), compared to 19.3% of the acreage in 1984². Dry weather in 1989 limited infection by the white mold and rust fungi, and thus limited the need for fungicides.

Sodium chlorate desiccant was applied to 0.3% of the dry bean acreage in 1989 (Table 12), compared to 1.2% in 1984².

POTATO Trifluralin was applied to 19.0% of the potato acreage in 1989, while EPTC was applied to 7.5% and metolachlor to 7.2% (Table 13).

Potato acreage was frequently treated with insecticides, with carbofuran applied to 58.5% of the acreage, followed by fenvalerate to 52.4%, phosphamidon to 48.8%, and phorate to 47.6% (Table 13). Insecticides were applied more than once to 31.8% of the potato acreage, and 91.7% of the applications were by the farm operator primarily using ground equipment.

Fungicides also were used frequently on potato, with triphenyltin hydroxide applied to 85.5% of the acreage, followed by mancozeb to 69% (Table 13). Mancozeb was applied up to four times on potato, primarily to control early blight infections. Desiccants were applied to 13.3% of the potato acreage in 1989, compared to 54.8% in 1984². The reduction in desiccant usage may reflect the loss of dinoseb registration and the drought conditions in 1989. Diquat was the most commonly used desiccant with 9.2% of the potato acreage treated in 1989.

SUGARBEET Desmedipham + phenmedipham was applied to 110.8% of the sugarbeet acreage in 1989 (Table 14), approximately twice the use in 1984². Other herbicides used commonly on sugarbeet in 1989 were sethoxydim to 69.3% and desmedipham to 54.3% of the sugarbeet acreage. Diallate and EPTC were applied to 31.6% and 26.5% of the acreage, respectively, in 1984, and to only 0.8% and 1.3% of the acreage, respectively, in 1989.

Terbufos insecticide was applied to 37.8% of the sugarbeet acreage in 1989 (Table 14), while chlorpyrifos was applied to 15.4%. Over 90% of the insecticide application on sugarbeet was by the farm operator with ground equipment.

Fungicide use in 1989 on sugarbeets was about half that used in 1984² (Table 14). Disease pressure was reduced because of dry weather and because a *Cercospora* prediction system was established to reduce unnecessary treatments. The most frequently applied fungicide was triphenyltin hydroxide to 28.2% of the acres and it generally was applied once (Table 15).

ALFALFA Only 0.3% of the alfalfa acreage was treated with herbicides in 1989; trifluralin was applied to 0.1% of the acreage (Table 15). Insecticides were applied to 1.3% of the alfalfa acreage and carbofuran was the most commonly applied product. Carbofuran was applied up to three times. Fungicides were not reported used on alfalfa.

OTHER HAY Herbicides were applied to 0.8% of the hay land in 1989 and picloram was the most commonly applied product (Table 16). Four insecticides were reported used on hayland, but treatment was to less than 0.1% of the acres.

PASTURE Two percent of all pastureland was treated with herbicide in 1989 (Table 17). The most common herbicide treatment was 2,4-D, followed by picloram. Insecticides were applied to only 0.1% of the pastureland, with malathion the most frequently applied insecticide.

SUMMER FALLOW Products containing glyphosate were applied to 6.5% of the summer fallow acreage in 1989 (Table 18). 2,4-D was applied to 5.5% and trifluralin to 4.7% of summer fallow acreage. Carbofuran insecticide was applied to 0.1% of summer fallow.

CRP Herbicides were applied to 12.8% of the CRP acreage in 1989 (Table 19). 2,4-D was applied to 5.2% and dicamba to 2.3% of the CRP land. Insecticide use on CRP land was small in 1989, with carbofuran insecticide applied to 0.8% of these acres.

²McMullen, 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.

PESTICIDE SUMMARIES

Total cumulative acres treated with each individual pesticide in North Dakota in 1989 are given in Tables 20A-23A. Results from the surveys of pesticide use in 1984 and 1978 are given in Tables 20B-23B and Tables 20C-23C, respectively. Acres reported treated in Tables 20 through 23 often exceed the acres treated in Table 1 because Tables 20 through 23 include multiple applications to the same acreage totaled as separate values and pesticides applied as a tank mixture were totaled separately unless a commercial premix was used. Acres treated in Table 1 were acres that received one or more applications of pesticide. Percent acres treated are presented as an aid to compare among years and crops.

Sixty-nine formulations of herbicides were reported used in 1989 on 27.7 million acres, equivalent to 70.4% of the agricultural acreage (Table 20A). This compares to 57 formulations of herbicides reported used in 1984 on 24.8 million acres or 60.6% of the agricultural acreage (Table 20B), and 40 herbicide formulations in 1978 on 16.9 million acres or 52.4% of the agricultural acreage (Table 20C). 2,4-D was applied to 8.1 million acres or 20.6% of the agricultural acreage in 1989, compared to application to 8.6 million acres or 20.9% of the acreage in 1984 and to 9.3 million acres or 28.9% of the acreage in 1978. Trifluralin was applied to 4.1 million acres or 10.4% of the agricultural acreage in 1989, compared to 4.5 million acres or 11.1% of total agricultural land in 1984, and to 2.0 million acres or 6.3% of agricultural land in 1978.

MCPA was applied to 4.4 million acres or 11.3% of the agricultural acreage in 1989 (Table 20A), compared to 2.8 million acres or 6.8% in 1984 (Table 20B) and 2.4 million acres or 5.9% of agricultural land in 1978 (Table 20C). Dicamba was applied to 3 million acres in 1989 compared to 1.4 million acres in 1984 and 0.17 million acres in 1978. DPX-M6316 was applied to 1.3 million acres of small grains in 1989 and was not reported or available in 1984 or 1978. Other products that increased in use in 1989 compared to 1984 or 1978 include chloresulfuron (not available in 1978), clopyralid (not available in 1984 or 1978), desmedipham, ethalfluralin (not available in 1978) and fenoxaprop (not available in 1984 or 1978). The acreage treated with alachlor, atrazine, barban, and diallate was substantially less in 1989 compared to 1984 and 1978.

As in 1978 and 1984, nearly all the herbicides applied in 1989 were applied once, by the farm operator with ground equipment (Tables 20A-20C).

Insecticides were applied to a total of 2.2 million acres in 1989 (Table 21A) compared to 2.9 million acres in 1984 (Table 21B) and 0.36 million acres in 1978 (Table 21C). Twenty-four insecticides were reported used in 1989 compared to 27 in 1984 and 21 in 1978. Carbofuran was applied to 0.5 million acres in 1989 compared to 0.4 million in 1984 and 0.01 million in 1978. Fenvalerate was applied to 0.3 million acres in 1989 compared to 1.4 million acres in 1984.

Esfenvalerate was applied to 0.26 million acres in 1989. Fenvalerate was not available in 1978 and esfenvalerate was not available in 1978 or 1984. Grasshopper pressure was greater in 1989 than 1984 while sunflower insects were a greater threat in 1984 than in 1989. A slightly larger percentage of insecticides were applied twice in 1989 compared to 1984. In 1978, 83% of the insecticides were farm operator applied and 79% were ground applied, but in 1989, 41% were farm operator applied and 41% were ground applied rather than custom applied or aerial applied.

Fungicides were applied to 0.58 million acres in 1989 compared to 0.5 million in 1984 and 0.1 million in 1978 (Tables 22A-22C). Propiconazole was applied to 0.16 million acres of small grains in 1989, but was not available in 1984 or 1978. Triphenyltin hydroxides were applied to about 60,000 more acres in 1989 than 1984 and were not available in 1978. Acreage treated with mancozeb, maneb, or maneb + zinc totaled 0.21 million acres in 1989 compared to 3.6 million acres in 1984 and 0.06 million in 1978. Fungicides were most often applied once in 1989, while in 1984 were most often applied twice. Farm operator and ground application of fungicides was predominant in 1978, but in 1984 and 1989 custom and aerial application of fungicides was more common than farm operator or ground application.

Desiccants were applied to 0.02 million acres in 1989 compared to 0.07 million acres in 1984 and 0.11 million acres in 1978 (Tables 23A-23C). Diquat was the most commonly used desiccant in 1989, while dinoseb was most commonly used in 1984 and paraquat in 1978. The summer of 1989 was very dry and few acres needed a desiccant for dry-down. Most desiccants were applied in 1989 by a custom applicator.

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 (Table 5-19). For example, of the acreage in alfalfa, hay, pasture, fallow or CRP in 1989, only 7.2% was herbicide treated and 0.5% insecticide treated. In contrast, of the acreage in wheat, barley, corn, sunflower, soybean, dry bean, potato and sugarbeet, herbicides were applied an average of 1.47 times per acre, 12.3% of the acres were insecticide treated, and 3.2% were treated with foliar fungicides. The total percentage, including multiple treatments, of the acreage of agricultural land treated with pesticides (excluding seed treatment) was 77.5% in 1989 compared to 68.9% in 1984 and 53.9% in 1978 (Tables 20-23). Producers responded to pest outbreaks and used pesticides accordingly to protect their crops: i.e. in 1989 grasshoppers accounted for increased use of insecticides on

soybeans and sugarbeets, while lower insect pressure on sunflowers in 1989 resulted in decreased use of insecticides on sunflower.

The number of herbicide formulations used on agricultural land increased by 17 from 1978 to 1984 and by 12 from 1984 to 1989, indicating increased herbicide choices available to the farmer (Tables 20A-20C). The number of insecticides used by producers dropped from 27 to 24 from 1984 to 1989 (Tables 21A-21B), while the number of foliar fungicides used did not vary greatly from 1978 to 1989 (Tables 22A-22C).

More acres were treated with herbicides than with other pesticides in 1989, approximately ten times more than insecticides and 40 times more than fungicides (Table 1A). Wheat was grown on the most acreage and accounted for the greatest herbicide use. The sunflower crop had the most acreage treated with insecticides, while wheat had the largest

acreage treated with fungicides.

Seed treatment commonly is used by North Dakota producers (Table 1A). Of the major crops, flax and soybeans are least frequently seed treated, while almost all of the corn, sunflower, and sugarbeet seed is treated, but not on the farm. Of the total crop acreage planted to treated seed, 61.4% of this is on-farm treated.

Small grain production and use of pesticides on these crops was greatest in the Northeast district (Table 3). The Central district had the greatest concentration of sunflowers and the greatest use of herbicides and insecticides on sunflower. The Southeast district had the greatest acreage of corn and the greatest use of herbicides and insecticides on corn.

The majority of pesticides are applied once, by the farm operator using ground equipment (Tables 20A-23A).

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

CROP	Acres planted ¹	Pesticide treated acres ²											
		Treated seed		Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants	Treated seed		Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants
		Total	On-farm					Total	On-farm				
(1000)	(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	.
Oats	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 ³	2948.5	11.3	.	254.8	56.2	.	.	0.4	0.0	8.6	1.9	.	.
Total	39334.9	9462.0	5794.5	17368.6	1762.1	396.7	19.0	24.1	14.7	44.2	4.5	1.0	0.0

¹Preliminary estimates by the North Dakota Agricultural Statistics Service

²Multiple applications to the same acreage were totaled as one application. Seed treatments not included, except where specified.

³CRP 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, 1984¹.

Crop	Acres planted ²	Pesticide treated acres ³							
		Herbi- cide	Insecti- cide	Fungi- cide	Other ⁴	Herbi- cide	Insecti- cide	Fungi- cide	Other ³
	(1000)	(1000)	(1000)	(1000)	(1000)	(%)	(%)	(%)	(%)
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
Oats	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	173.8	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 Beans	205.0	191.7	0.7	38.9	3.5	93.5	0.4	19.0	1.7
Potatoes	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 ⁵	9754.7	116.0	27.7	0.0	0.0	1.2	0.3	0.0	0.0
Summer Fallow +PIK+ARP ⁶	9908.0	1696.4	6.2	0.0	0.0	17.1	0.1	0.0	0.0
Other Crops ⁷	-	-	-	-	-	52.9	8.5	0.0	0.0
Total	40933.5	17539.8	2587.8	472.7	64.1	42.8	6.3	1.2	0.2

¹McMullen, 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.

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

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

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

⁵Pasture and rangeland other than crop and woodland pastured.

⁶PIK and ARP are acres for the Payment in Kind and Acreage Reserve Program.

⁷Main 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 of North Dakota, 1989

District	Acres planted ¹	Pesticide treated acres ²											
		Treated seed		Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants	Treated seed		Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants
		Total	On-farm					Total	On-farm				
(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(%)	(%)	(%)	(%)	(%)	(%)	
Wheat													
Northwest	1667.5	710.7	616.4	1595.3	5.0	.	.	42.6	37.0	95.7	0.3	.	.
North Central	1164.5	650.5	500.8	1083.3	24.9	12.9	.	55.9	43.0	93.0	2.1	1.1	.
Northeast	2089.5	1371.6	1117.9	2035.2	72.6	97.6	.	65.6	53.5	97.4	3.5	4.7	.
West Central	800.8	359.3	292.4	656.3	5.5	.	.	44.9	36.5	82.0	0.7	.	.
Central	1122.0	486.3	445.0	1080.9	4.3	3.4	.	43.3	39.7	96.3	0.4	0.3	.
East Central	1201.0	764.4	572.5	1170.5	151.3	53.5	.	63.6	47.7	97.5	12.6	4.5	.
Southwest	874.5	362.8	279.9	768.8	0.8	.	.	41.5	32.0	87.9	0.1	.	.
South Central	684.2	100.4	84.5	517.9	.	.	.	14.7	12.3	75.7	.	.	.
Southeast	1196.0	327.2	270.3	1128.5	85.3	4.1	.	27.4	22.6	94.4	7.1	0.3	.
Total	10800.0	5133.3	4179.9	10036.8	349.7	171.5	.	47.5	38.7	92.9	3.2	1.6	.
Barley													
Northwest	280.0	128.4	111.0	251.7	0.3	.	.	45.9	39.7	89.9	0.1	.	.
North Central	350.0	194.6	154.0	323.1	9.1	.	.	55.6	44.0	92.3	2.6	.	.
Northeast	750.0	484.5	388.0	717.4	23.7	22.6	.	64.6	51.7	95.7	3.2	3.0	.
West Central	110.0	53.6	40.2	69.8	.	.	.	48.7	36.5	63.4	.	.	.
Central	200.0	90.6	85.3	181.7	.	0.2	.	45.3	42.6	90.9	.	0.1	.
East Central	580.0	359.8	258.1	573.0	61.9	13.0	.	62.0	44.5	98.8	10.7	2.2	.
Southwest	135.0	60.8	46.5	88.1	.	.	.	45.0	34.4	65.2	.	.	.
South Central	125.0	39.5	35.6	77.3	.	.	.	31.6	28.5	61.8	.	.	.
Southeast	270.0	93.6	74.5	244.1	9.5	1.3	.	34.7	27.6	90.4	3.5	0.5	.
Total	2800.0	1505.4	1193.1	2526.1	104.5	37.1	.	53.8	42.6	90.2	3.7	1.3	.
Oats													
Northwest	130.0	33.1	31.7	82.2	.	.	.	25.4	24.4	63.3	.	.	.
North Central	120.0	23.1	15.9	66.2	3.7	.	.	19.3	13.3	55.1	3.1	.	.
Northeast	50.0	8.9	8.0	35.7	0.1	.	.	17.8	15.9	71.4	0.2	.	.
West Central	180.0	25.2	20.2	53.6	.	.	.	14.0	11.2	29.8	.	.	.
Central	135.0	20.9	16.1	84.1	0.7	.	.	15.5	12.0	62.3	0.5	.	.
East Central	40.0	10.6	9.8	30.2	0.2	.	.	26.5	24.6	75.6	0.4	.	.
Southwest	145.0	6.1	4.5	66.5	.	.	.	4.2	3.1	45.8	.	.	.
South Central	210.0	12.9	11.4	61.7	.	.	.	6.2	5.4	29.4	.	.	.
Southeast	140.0	8.7	8.7	93.5	3.9	.	.	6.2	6.2	66.8	2.8	.	.
Total	1150.0	149.6	126.3	573.8	8.6	.	.	13.0	11.0	49.9	0.7	.	.
Flax													
Northwest	24.5	5.9	4.9	16.5	.	.	.	24.3	20.1	67.5	.	.	.
North Central	30.0	2.8	1.2	18.3	4.5	.	.	9.4	4.0	60.9	15.0	.	.
Northeast	39.0	2.3	0.1	29.6	0.1	.	.	5.9	0.3	75.9	0.4	.	.
West Central	11.5	1.1	0.5	6.9	.	.	.	9.7	4.3	59.8	.	.	.
Central	29.0	3.3	0.7	14.8	.	.	.	11.4	2.3	51.0	.	.	.
East Central	9.0	0.8	.	3.7	.	.	.	9.4	.	41.2	.	.	.
Southwest	1.5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
South Central	10.5	.	.	2.0	.	.	.	.	.	19.1	.	.	.
Southeast	15.0	2.9	.	8.5	.	.	.	19.2	.	56.6	.	.	.
Total	170.0	19.2	7.4	100.3	4.6	.	.	11.3	4.3	59.0	2.7	.	.

NR=The Southwest district had no reports for flax.

¹Preliminary estimates by the North Dakota Agricultural Statistics Service.

²Multiple applications to the same acreage were totaled as one application.

³Agricultural statistics districts not listed did not contain significant amounts of the crop.

Table 2. (continued)

District	Acres planted ¹	Pesticide treated acres ²											
		Treated seed		Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants	Treated seed		Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants
		Total	On-farm					Total	On-farm				
(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(%)	(%)	(%)	(%)	(%)	(%)	
Corn													
Northwest	9.0	9.0	1.3	6.3	.	.	100.0	14.3	69.5	.	.	.	.
North Central	33.0	33.0	2.6	16.4	3.2	.	100.0	8.0	49.5	9.6	.	.	.
Northeast	41.0	41.0	.	31.0	0.3	.	100.0	.	75.6	0.7	.	.	.
West Central	55.0	55.0	2.4	24.2	.	.	100.0	4.4	44.0	.	.	.	.
Central	77.0	77.0	4.4	53.4	.	.	100.0	5.7	69.3	.	.	.	.
East Central	125.0	125.0	10.4	112.8	7.1	.	100.0	8.3	90.3	5.7	.	.	.
Southwest	38.0	38.0	.	12.8	.	.	100.0	.	33.6	.	.	.	.
South Central	117.0	117.0	1.3	37.7	.	.	100.0	1.1	32.3	.	.	.	.
Southeast	385.0	385.0	25.3	343.6	80.3	.	100.0	6.6	89.2	20.9	.	.	.
Total	880.0	880.0	47.6	638.0	90.8	.	100.0	5.4	72.5	10.3	.	.	.
Sunflower													
Northwest	93.0	63.8	5.7	82.9	21.2	.	68.6	6.1	89.2	22.8	.	.	.
North Central	174.0	138.8	6.5	154.5	59.7	.	79.7	3.7	88.8	34.3	.	.	.
Northeast	200.0	165.9	18.8	184.0	107.1	24.3	82.9	9.4	92.0	53.5	12.2	.	.
West Central	74.5	62.4	12.2	66.2	28.2	.	83.8	16.3	88.9	37.8	.	.	.
Central	343.0	236.4	17.7	313.9	248.3	5.7	68.9	5.2	91.5	72.4	1.7	0.7	.
East Central	172.0	129.2	12.9	161.5	109.1	.	75.1	7.5	93.9	63.4	.	0.4	.
Southwest	25.8	14.1	1.8	19.9	3.1	.	54.8	6.8	77.0	12.2	.	.	.
South Central	44.7	32.7	1.3	42.7	.	.	73.2	2.9	95.5	.	.	.	.
Southeast	193.0	135.9	10.9	171.9	98.1	.	70.4	5.6	89.1	50.8	.	.	.
Total	1320.0	979.1	87.6	1197.4	674.9	30.0	74.2	6.6	90.7	51.1	2.3	0.2	.
Soybean³													
Northeast	60.0	20.8	6.2	54.2	5.5	.	34.7	10.3	90.3	.2	.	.	.
Central	9.5	2.2	.	9.0	.	.	23.6	.	95.2	.	.	.	.
East Central	310.0	44.1	24.1	288.8	90.3	.	14.2	7.8	93.2	29.1	.	.	.
Southeast	255.0	9.0	4.0	229.8	51.3	.	3.5	1.6	90.1	20.1	.	.	.
Other Counties	5.5	0.6	.	4.7	.	.	10.5	.	86.0	.	.	.	.
Total	640.0	76.7	34.3	586.5	147.1	.	12.0	5.4	91.6	23.0	.	.	.
Dry bean³													
Northeast	230.0	172.2	4.2	211.5	21.1	5.2	74.9	1.8	92.0	9.2	2.3	.	.
West Central	20.0	17.5	.	20.0	1.3	.	87.6	.	100.0	6.6	.	.	.
Central	30.0	28.7	.	30.0	3.1	.	95.8	.	100.0	10.2	.	.	.
East Central	160.0	131.9	.	151.0	12.9	1.0	82.5	.	94.4	8.0	.	0.6	.
Southeast	40.0	37.2	.	37.2	7.4	0.1	93.1	.	93.1	18.4	0.3	1.4	.
Other Counties	20.0	4.0	.	11.3	.	.	20.0	.	56.4	.	.	.	.
Total	500.0	391.6	4.2	461.1	45.7	5.4	78.3	0.8	92.2	9.1	1.1	0.3	.
Potato³													
Northeast	130.5	103.5	98.8	49.9	127.7	104.8	14.1	79.3	75.7	38.3	97.9	80.3	10.8
Other Counties	9.5	3.2	3.2	1.9	4.5	3.8	0.3	34.2	34.2	20.4	47.3	40.1	3.2
Total	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

¹Preliminary estimates by the North Dakota Agricultural Statistics Service.

²Multiple applications to the same acreage were totaled as one application.

³Agricultural statistics districts not listed did not contain significant amounts of the crop.

Table 2. (continued)

District	Acres planted ¹	Pesticide treated acres ²											
		Treated seed		Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants	Treated seed		Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants
		Total	On-farm					Total	On-farm				
(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(%)	(%)	(%)	(%)	(%)	(%)	
Sugarbeet³													
Northwest	4.2	4.2	.	2.4	0.2	.	100.0	.	58.3	4.7	.	.	
Northeast	91.6	91.6	.	76.6	63.6	10.8	100.0	.	83.6	69.4	11.8	.	
West Central	8.8	8.8	1.5	7.2	7.0	.	100.0	16.6	81.4	79.1	.	.	
East Central	52.3	52.3	5.1	52.3	23.8	22.9	100.0	9.8	100.0	45.5	43.9	.	
Southeast	23.3	23.3	.	22.5	19.2	10.4	100.0	.	96.6	82.4	44.5	.	
Total	180.2	180.2	6.6	161.0	113.7	44.1	100.0	3.6	89.4	63.1	24.5	.	
Alfalfa hay													
Northwest	120.0	1.2	.	1.2	0.8	.	1.0	.	1.0	0.7	.	.	
North Central	150.0	0.7	.	0.5	8.0	.	0.4	.	0.3	5.3	.	.	
Northeast	45.0	1.6	.	.	1.8	.	3.6	.	.	4.1	.	.	
West Central	200.0	2.6	.	0.4	3.2	.	1.3	.	0.2	1.6	.	.	
Central	190.0	2.2	.	0.9	1.2	.	1.1	.	0.5	0.6	.	.	
East Central	45.0	0.2	.	0.4	2.9	.	0.4	.	0.8	6.6	.	.	
Southwest	280.0	0.9	.	0.4	0.9	.	0.3	.	0.1	0.3	.	.	
South Central	300.0	3.0	.	0.2	.	.	1.0	.	0.1	.	.	.	
Southeast	170.0	0.4	0.2	0.4	0.5	.	0.3	0.1	0.2	0.3	.	.	
Total	1500.0	12.7	0.2	4.3	19.4	.	0.8	0.0	0.3	1.3	.	.	
Other hay													
Northwest	200.0	1.1	.	0.6	0.1	.	0.5	.	0.3	0.1	.	.	
North Central	270.0	0.8	.	5.1	.	.	0.3	.	1.9	.	.	.	
Northeast	100.0	.	.	.	.	.	.	.	.	.	.	.
West Central	250.0	0.3	.	0.5	.	.	0.1	.	0.2	.	.	.	
Central	280.0	2.9	.	1.2	.	.	1.0	.	0.4	.	.	.	
East Central	50.0	0.6	.	0.6	0.9	.	1.2	.	1.2	1.8	.	.	
Southwest	210.0	0.7	.	1.0	.	.	0.4	.	0.5	.	.	.	
South Central	330.0	1.1	.	0.2	.	.	0.3	.	0.1	.	.	.	
Southeast	210.0	0.3	.	1.2	.	.	0.1	.	0.6	.	.	.	
Total	1900.0	7.8	.	10.4	1.0	.	0.4	.	0.5	0.1	.	.	
Pasture													
Northwest	1051.2	.	.	7.1	0.6	.	.	.	0.7	0.1	.	.	
North Central	701.9	.	.	19.5	1.1	.	.	.	2.8	0.2	.	.	
Northeast	219.1	4.6	4.0	6.3	0.2	.	2.1	1.8	2.9	0.1	.	.	
West Central	1983.3	.	.	5.7	.	.	.	.	0.3	.	.	.
Central	876.7	.	.	31.4	0.3	.	.	.	3.6	0.0	.	.	
East Central	174.4	.	.	10.3	0.4	.	.	.	5.9	0.3	.	.	
Southwest	2174.6	.	.	14.4	4.5	.	.	.	0.7	0.2	.	.	
South Central	2226.0	.	.	16.5	.	.	.	.	0.7	.	.	.
Southeast	800.0	.	.	17.2	.	.	.	.	2.2	.	.	.
Total	10207.2	4.6	4.0	128.5	7.4	.	0.0	0.0	1.3	0.1	.	.	

¹Preliminary estimates by the North Dakota Agricultural Statistics Service.

²Multiple applications to the same acreage were totaled as one application.

³Agricultural statistics districts not listed did not contain significant amounts of the crop.

Table 2. (continued)

District	Acres planted ¹	Pesticide treated acres ²											
		Treated seed		Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants	Treated seed		Herbi- cide	Insecti- cide	Fungi- cide	Desic- cants
		Total	On-farm					Total	On-farm				
(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(1000)	(%)	(%)	(%)	(%)	(%)	(%)	
Summer fallow													
Northwest	1130.0	.	.	267.6	4.2	.	.	.	.	23.7	0.4	.	.
North Central	460.0	.	.	82.6	0.1	.	.	.	.	18.0	0.0	.	.
Northeast	520.0	1.4	1.2	61.5	0.2	.	.	0.3	0.2	11.8	0.0	.	.
West Central	510.0	.	.	75.4	.	.	.	.	.	14.8	.	.	.
Central	340.0	1.4	.	40.3	.	.	.	0.4	.	11.9	.	.	.
East Central	220.0	.	.	11.3	0.1	.	.	.	.	5.1	0.1	.	.
Southwest	510.0	0.2	.	44.4	.	.	.	0.0	.	8.7	.	.	.
South Central	250.0	0.8	.	30.3	.	.	.	0.3	.	12.1	.	.	.
Southeast	260.0	.	.	24.2	1.5	.	.	.	.	9.3	0.6	.	.
Total	4200.0	3.8	1.2	637.7	6.1	.	.	0.1	0.0	15.2	0.1	.	.
CRP													
Northwest	392.4	.	.	71.6	0.8	.	.	.	.	18.2	0.2	.	.
North Central	369.3	.	.	26.4	30.8	.	.	.	.	7.2	8.3	.	.
Northeast	340.6	.	.	44.6	21.9	.	.	.	.	13.1	6.4	.	.
West Central	194.7	1.0	.	20.7	0.5	.	.	0.5	.	10.6	0.3	.	.
Central	498.4	9.9	.	31.0	0.3	.	.	2.0	.	6.2	0.1	.	.
East Central	115.1	0.4	.	18.6	0.9	.	.	0.3	.	16.2	0.8	.	.
Southwest	417.1	.	.	32.4	.	.	.	.	.	7.8	.	.	.
South Central	295.4	.	.	5.9	0.1	.	.	.	.	2.0	0.0	.	.
Southeast	325.5	.	.	3.6	0.9	.	.	.	.	1.1	0.3	.	.
Total	2948.5	11.3	.	254.8	56.2	.	.	0.4	.	8.6	1.9	.	.

¹Preliminary estimates by the North Dakota Agricultural Statistics Service.

²Multiple applications to the same acreage were totaled as one application.

³Agricultural statistics districts not listed did not contain significant amounts of the crop.

TABLE 3. ON FARM SEED TREATMENT: Acres treated, percent of crop and method of application, North Dakota, 1989.

Treatment	Acres seeded ¹	Acres seeded	Method		
			Drill box	Auger	Other
	(1000)	(%)	(%)	(%)	(%)
Wheat					
Captan	1.6	0.0	100.0	.	.
Captan + diazinon + lindane	9.6	0.1	.	100.0	.
Captan + lindane	12.5	0.1	12.5	87.5	.
Captan + thiabendazole	25.7	0.2	37.6	62.4	.
Carboxin	1207.4	11.2	15.2	78.1	6.7
Carboxin + captan + lindane	3.8	0.0	100.0	.	.
Carboxin + maneb + lindane	188.2	1.7	16.1	76.4	7.5
Carboxin + thiram	593.1	5.5	16.2	78.0	5.8
Formaldehyde	22.8	0.2	28.0	70.6	1.4
Imazalil	160.8	1.5	12.3	73.7	14.0
Lindane	238.6	2.2	13.6	84.6	1.8
Mancozeb	11.7	0.1	6.3	93.7	.
Maneb	50.3	0.5	20.7	79.3	.
Maneb + lindane	2156.0	20.0	27.1	70.3	2.6
Maneb + thiabendazole	4.5	0.0	.	100.0	.
Maneb+ thiabendazole + lindane	26.9	0.2	9.6	90.4	.
TCMTB	3.2	0.0	.	100.0	.
Thiram + thiabendazole	18.6	0.2	25.0	75.0	.
Yield enhancing agent, chitin	8.3	0.1	35.1	64.9	.
Zineb	1.5	0.0	100.0	.	.
Zineb + douglas fir bark	2.3	0.0	100.0	.	.
Total	4747.4	44.0	21.0	74.6	4.5
Barley					
Captan + diazinon + lindane	0.7	0.0	.	100.0	.
Captan + lindane	0.2	0.0	100.0	.	.
Captan + thiabendazole	6.1	0.2	22.5	77.5	.
Carboxin	437.0	15.6	17.4	75.7	6.9
Carboxin + maneb + lindane	67.7	2.4	26.4	64.9	8.8
Carboxin + thiram	167.7	6.0	12.3	81.9	5.8
Formaldehyde	4.7	0.2	33.9	38.3	27.7
Imazalil	57.3	2.0	8.4	70.6	21.1
Lindane	44.0	1.6	24.9	75.1	.
Mancozeb	7.6	0.3	3.8	96.2	.
Maneb	7.6	0.3	57.6	42.4	.
Maneb + lindane	557.4	19.9	29.3	67.6	3.2
Maneb+ thiabendazole + lindane	6.2	0.2	5.7	94.3	.
TCMTB	0.2	0.0	.	100.0	.
Thiram + thiabendazole	12.3	0.4	35.6	64.4	.
Yield enhancing agent, chitin	3.6	0.1	.	100.0	.
Zineb + douglas fir bark	1.6	0.1	100.0	.	.
Total	1381.8	49.4	22.3	72.2	5.6

¹Acres reported seeded to treated seed include multiple applications to the same acreage totaled as separate values and seed treatment products applied as a tank mixture were totaled separately unless applied as a commercial premix.