DEPARTMENT OF AGRICULTURE

2016 Pesticide Usage on Soybeans and Wheat Grown in Minnesota

8/7/2020

For information regarding this report contact:
Denton Bruening
Minnesota Department of Agriculture
Pesticide and Fertilizer Management Division
651-201-6399

Table of Contents

Introduction

Acknowledgements

This survey was a cooperative effort between the Minnesota Department of Agriculture (MDA) and the United States Department of Agriculture: National Agricultural Statistics Service (NASS), Minnesota field office. The detailed pesticide use information could not have been collected without the cooperation of thousands of farmers who voluntarily responded to the survey in the midst of their normally busy lives, and for this we are extremely grateful. Similarly, the assistance of agricultural chemical dealers and co-operatives is much appreciated. Special thanks goes to Dan Lofthus, State Statistician within the USDA at the Minnesota field office and his respective staff, for assistance with sample design and data collection. The MDA is ultimately responsible for the representations of data provided in this report, and for the design of the survey mechanism used to collect that data.

2016 Pesticide Use Summary and Highlights

This report summarizes herbicide, insecticide and fungicide use information reported by approximately 2,200 farmers for the 2016 crop year. Excellent participation and good record keeping by Minnesota farmers and agricultural chemical dealerships played a vital part in providing complete and detailed pesticide information. This survey targeted two crops in Minnesota: soybean and wheat. Collectively these two crops accounted for approximately 45% of Minnesota's field crops harvested in 2016. This survey collected pesticide information from 670,000 acres of wheat and soybean cropland across the state in all Pesticide Management Regions (PMR) except for Lake, Cook, St. Louis, and Carlton counties in PMR 3 (Figure 1). The survey covered nearly 7% of the state's soybean acres and 9% of the wheat acres[i].

The report represents the eighth survey conducted on pesticide use in Minnesota by the MDA. The previous surveys collected information for the 2003, 2005, 2007, 2009, 2011, 2013, and 2015 crop years and included corn, soybeans, wheat, and hay. The MDA does not collect pesticide use data in the same year for the same crops as USDA NASS. In 2016, the MDA collected pesticide application information on soybeans and wheat. Due to USDA NASS collecting data for corn and hay for the 2016 crop year, the MDA did not survey farmers with those specific crops. The MDA surveys can be found at:

http://www.mda.state.mn.us/chemicals/pesticides/pesticideuse.aspx

The USDA NASS surveys can be found at:

https://www.nass.usda.gov/Statistics_by_State/Minnesota/Publications/Other_Press_Releases/index.php

Soybean Highlights: Herbicides, insecticides, and fungicides were applied to 98%, 25%, and 18%, respectively, of the surveyed soybean acres. For the 1,800 farms that reported soybean information on approximately 556,000 acres, the top five herbicide products (based on percent acres covered) were glyphosate[ii] (87%), fomesafen (24%), sulfentrazone (21%), cloransulam (18%) and flumioxazin (9%). Lambda-cyhalothrin (12%), chlorpyrifos (8%), and bifenthrin (4%) were the major soybean insecticides used in the survey. The major fungicide products were pyraclostrobin, fluxapyroxad, propiconazole, and tetraconazole, which were applied on 11%, 7%, 4%, and 4% of all soybean acres, respectively.

Wheat Highlights: Herbicides, insecticides, and fungicides were applied to 94%, 28%, and 69%, respectively, on 114,000 acres of wheat. Approximately 400 farms provided information on this crop. The top five herbicide products (based on percent acres covered) were bromoxynil (55%), pyrasulfotole (37%), MCPA (32%), fluroxypyr (28%), and triencarbazone-methyl (19%). Lambda-cyhalothrin (24%) and chlorpyroifos (3%) were the major wheat insecticides used in the survey. The major fungicide products were tebuconazole, propiconazole, prothioconazole, and pyraclostrobin applied on 32%, 27%, 25%, and 10% of all wheat acres, respectively.

Survey Design and Implementation

Figure 1 outlines the ten Pesticide Management Regions (PMRs) as defined by the MDA. Counties are clustered based on similarities in geology, soils and crops. The regions also define the boundaries of the monitoring areas used by the MDA water resource monitoring program. Pesticide management region pesticide use information is used to help design and implement specific water quality monitoring and pesticide educational programs.

Due to the low intensity of row crop agriculture in portions of northern Minnesota, PMR 3 was not included in the survey. Not all the participating PMRs were included for soybean acres and not all the participating PMRs were included for wheat acres, also due to the low intensity of the crops within the individual PMRs.

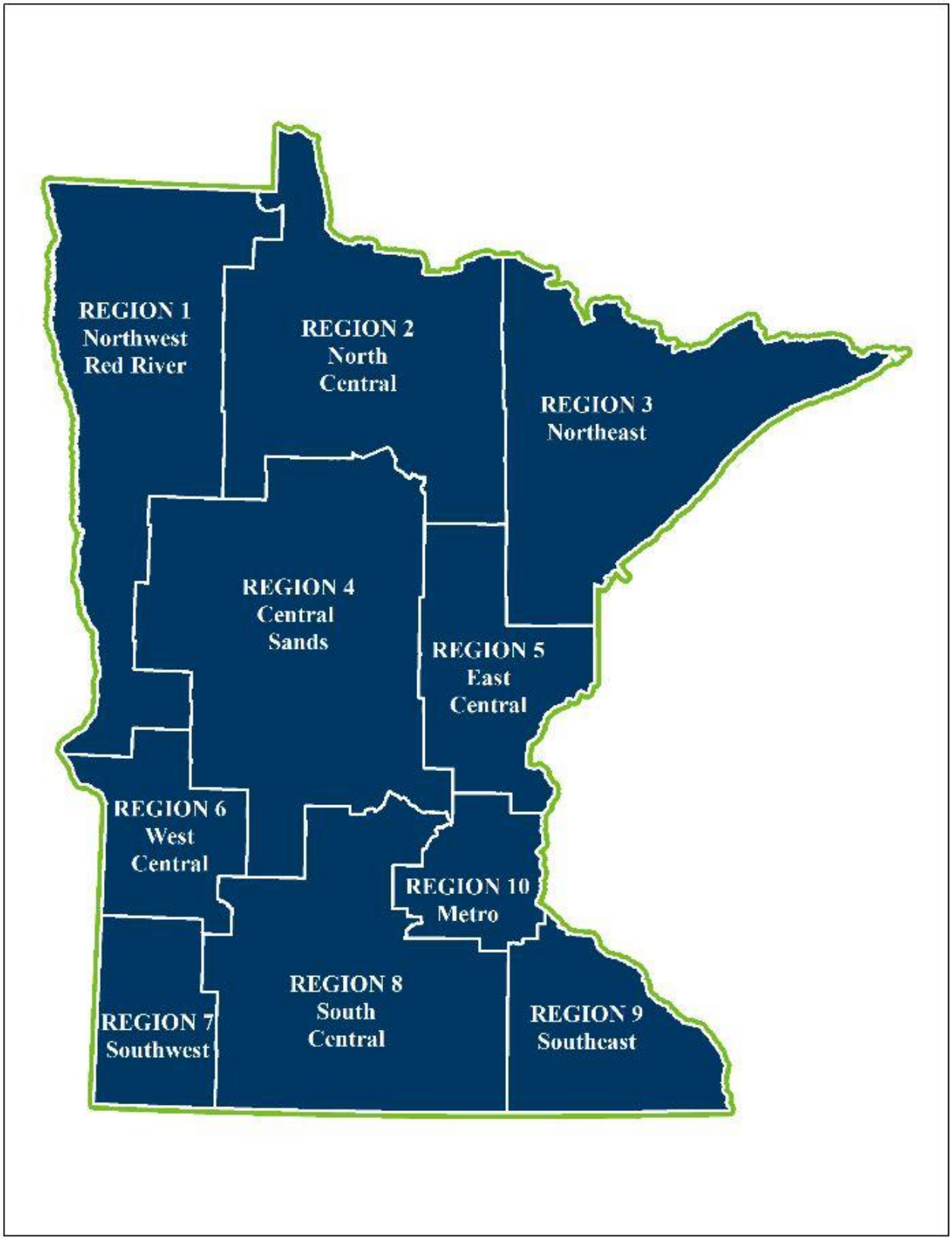

Figure 1. MDA Pesticide Management Regions (PMRs)

NASS developed the survey sample of 7,600 farms. This was done by selecting approximately 106 farms from each of 72 agricultural counties surveyed in this report. All farmers from each county who grew one or both of the target crops (soybean and wheat) were eligible to be selected. This number provided a large enough pool to reach the desired goal of obtaining approximately 34 farms per county with complete records. Counties not included in the survey are Lake of the Woods, Koochiching, Itasca, Clearwater, St. Louis, Carlton, Lake, Cook, Cass, Crow Wing, Hubbard, Wadena, Aikin, Anoka, and Ramsey Counties.

Approximately 2,200 interviews were completed. Respondents were required to have all pesticide applications and rates for a specific crop to be considered for inclusion in the survey. For example, an individual grower may have had good records for soybean acres, but could not find the records for the insecticides applied to the wheat crop. In this scenario, the soybean field would be used and the wheat field would dropped from the data set. Table 1 summarizes the number of participating farms in each county along with the total acres of each crop. The average number of participating farms per PMR was 220. Table 2 summarizes the crop acres surveyed for each crop and corresponding acreage receiving herbicide, insecticide or fungicide.

Table 1. Farms and crop acreage by PMR

PMR	# of Surveyed Farmers	Soybean Acres	Wheat Acres	Total Acres
1	528	184,532	100,884	285,416
2	33	6,438	1,780	8,218
4	287	45,769	4,341	50,150
5	144	27,154	755	27,909
6	184	51,932	3,737	55,669
7	162	43,612	847	44,459
8	496	137,359	1,480	138,839
9	215	38,606	0[iii]	38,606
10	152	21,183	272	21,455
State	2,201	556,585	114,136	670,721

Table 2. Summary of acres and corresponding percentage of each major crop receiving pesticide applications for the 2016 crop year.

Crop	Number of Respondents	Total Surveyed Acres	Herbicide Applied		Insecticide Applied		Fungicide Applied	
			Acres	(%)	Acres	(%)	Acres	(%)
Soybeans	1,796	556,585	544,747	(98%)	136,526	(25%)	98,562	(18%)
Wheat	405	114,136	107,365	(94%)	32,035	(28%)	78,745	(69%)
Totals	2,201	670,721	652,112	(97%)	168,561	(25%)	177,307	(26%)

Data Collection Process

Farmers were interviewed over the phone in April 2017. These were “cold calls,” meaning the farmers did not get any type of notification about the survey prior to the contact. The interviews typically would last 5 to 10 minutes.

1. Farmers were first asked to identify the number of acres of soybeans and wheat grown in the 2016 cropping season.
2. They were then asked to identify how many acres of each crop type received fungicide, herbicide and/or insecticide.
3. Lastly, they were asked to identify each specific pesticide product used, the acres treated, the number of applications of that specific product, and the application rate.

With the permission of the respondant, calls were also made directly to local cooperatives (co-ops), private pesticide dealers, or custom pesticide applicators to complete any missing information not provided by the respondent. Surveys requiring such a follow-up call were first sorted by co-op/dealer name. Then, the co-ops/dealers were called to obtain information for all the incomplete farms associated with that crop. This streamlined the number of calls made to the co-ops/dealers.

Some of the challenges of collecting pesticide use data are:

Unlike fertilizer formulations, which remain constant, new pesticide products and formulations are released every year;

- Currently, there are approximately 700 different pesticide products available for use in Minnesota for the four major crops: soybeans, corn, hay, and wheat;
- There are multiple product names that use the same active ingredients but frequently have different label rates and use restrictions. For example, Monsanto marketed glyphosate for many years under numerous trade names. Currently popular Monsanto glyphosate products are Roundup Power Max and Roundup Weather Max. There are also several popular glyphosate products manufactured by companies other than Monsanto such as Cornerstone, Buccaneer, and Durango. It is critical that the exact product be correctly identified in any type of use survey;
- Occasionally generic pesticide products are legally sold once a patent expires. For example, Glyphosate 4 plus, Glypro Plus, Gly Star5 Extra and Glyphos X-tra are various glyphosate based products. Minor complications may arise from these similar formulations; and
- Pesticides can come in liquid or solid formulas. Rates must be recorded in the correct unit during the survey process. For example, Dual II Magnum and Dual II Magnum SI are sold as a liquid. The maximum legal application rate of Dual II Magnum is 2.00 pints/acre while Dual II Magnum SI is 2.4 pints/acre. Confusing data collection even more, Dual II G Magnum is a granular with a maximum application rate of 15 pounds/acre.

Data Reporting and Limitations

Due to the simplified method used to collect what is typically considered complex data, it is helpful for the reader to understand the limitations of the datasets.

Potential for bias

As previously mentioned, approximately 2,200 farms in Minnesota participated in the survey. Farmers that grew soybeans or wheat were randomly selected from county lists of producers accessed by NASS. Because respondents in each county were not selected in proportion to the actual number of producers of a given crop, over- selection, or under-selection of those producing one or more of the four crops might result in unintentional bias in the results for specific crops and their related pesticide use. This bias could lead to problems in extrapolation of results, e.g., an over or under-representation of product use and rates within a county area, or statewide.

Traditional surveys employ advanced sampling strategies and are designed to statistically represent a non-homogenous population, thus data is "weighted" to account for sample size, county size, crop acreage, and nonresponse, etc. Such strategies can be very expensive and are not without their own limitations.[iv] The data in this study were not weighted to adjust for those factors.

Attempts to extrapolate data for purposes of estimating total pounds of a product or active ingredient used in a county, area, or statewide must consider an appropriate statistical analysis of the dataset for the estimations to be valid. Failure to do so may provide over- or under-representation of the data. The MDA can be contacted to further discuss interpretation of the survey data.

Areas receiving multiple products

Due to the method that was used for pesticide data collection, it is not possible to report on the number of crop acres receiving two or more products, though the individual applications and rates are captured. For example, some producers in south central Minnesota (PMR 8) use a pre-emergence, soil-applied herbicide for grass control and follow up post-emergence for broadleaves. Following this general pesticide strategy, Valor SX or Enlite may be selected for pre-emergence weed control and Roundup as the post-emergence product on soybeans acres. S-metolachlor products, such as Dual II Magnum or Prefix, were reported in this area on 8% of the soybean acres and glyphosate (such as Roundup Weather Max or Powermax) was reported on 84% of acres. Because the acres are not identical, it is not possible to capture acres with both products applied on a total number of acres.

Similarly, products containing the same active ingredient, but not the same brand name, and applied to the same acres, would not be totaled and recorded as applications to the same field. For example, Sinister might be applied to an 80 acre field, with Battle Star applied to a 60-acre subset of the same field. Both products contain Fomesafen but because two different products were used, the additive total of the Fomesafen (active ingredient) on the entire cropland may not be captured.

On individual fields, this survey indicates that the use of different brand name products containing the same active ingredients is infrequent. The average number of applications for most products was 1.0 application per year. Glyphosate is one of the exceptions for soybeans. In this survey, there were 1.3 applications of glyphosate per year on soybean (87%) of all surveyed soybean acres at a rate of 0.91 pounds/acre for each application.

Statewide Pesticide Applications – Soybeans

Many pesticide active ingredients can be used in the production of soybeans. Soybean producers responding to the survey associated with this report may have used one or more of the active ingredients listed in Table 3; however, data is only published for pesticides applied by five or more respondents. This is consistent with standard reporting protocol used by NASS in other agricultural chemical use reports.

To obtain a list of products (brand names) registered in Minnesota and containing the active ingredients listed below, visit http://npirspublic.ceris.purdue.edu/state/state_menu.aspx?state=MN, enter the database, submit "active ingredient" as the search option, enter the name of the active ingredient, click "submit," Then click on Display Companies to show companies with that specific active ingredient. This will display all companies that have products with that active ingredient. Next click on "Display Products" to obtain a list of all registered products containing the active ingredient for a specific company.

Table 3. Publication status for soybean pesticide active ingredients

Active Ingredient	Published	Active Ingredient	Published
Herbicide		**Insecticide**	
2,4-D	P	Beta-cyfluthrin	P
Acetochlor	P	Bifenthrin	P
Acifluorfen	P	Chlorpyrifos	P
Bentazon	*	Esfenvalerate	P
Chlorimuron	P	Gamma-cyhalothrin	P
Clethodim	P	Imidacloprid	P
Cloransulam	P	Lambda-cyhalothrin	P
Dimethenamid-p	P	Thiamethoxam	P
Ethalfluralin	*	Zeta-cypermethrin	P
Fenoxaprop	*		
Fluazifop	P	**Fungicide**	
Flumetsulam	*	Azoxystrobin	P
Flumiclorac	*	Boscalid	P
Flumioxazin	P	Cyproconazole	*
Fluthiacet-methyl	P	Fluoxastrobin	P
Fomesafen	P	Flutriafol	P
Glufosinate-ammonium	P	Fluxapyroxad	P
Glyphosate	P	Picoxystrobin	*
Imazamox	P	Propiconazole	P
Imazethapyr	P	Prothioconazole	*
Lactofen	P	Pyraclostrobin	P
Metolachlor	P	Tebuconazole	*
Metribuzin	P	Tetraconazole	P
Pendimethalin	P	Trifloxystrobin	P
Pyroxasulfone	P		
Quizalofop	P		
S-metolachlor	P		
Saflufenacil	P		
Sethoxydim	*		
Sulfentrazone	P		

Active Ingredient	Published	Active Ingredient	Published
Herbicide			
Thifensulfuron	P		
Tribenuron	*		
Trifluralin	P		

An “*” denotes data is not publishable due to use by less than 5 respondents.

A statewide summary of soybean pesticide applications is provided in Table 4. Seven percent (7%) of all Minnesota soybean acres were surveyed for the 2016 season. Herbicides were applied to 98% of all surveyed soybean acres. Insecticides were applied to 25% of all acres and 18% of surveyed acres received fungicides.

Table 4. Pesticide applications and rates by active ingredient (a.i.) for soybeans statewide.[v]

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicide					
2,4-D	1	1.0	0.47	0.47	1,403
Acetochlor	2	1.0	1.12	1.13	15,058
Acifluorfen	<1	1.0	0.30	0.30	630
Chlorimuron	1	1.0	0.01	0.01	38
Clethodim	4	1.0	0.06	0.06	1,439
Cloransulam	18	1.0	0.02	0.02	2,222
Dimethenamid-p	5	1.0	0.24	0.26	7,235
Fluazifop	3	1.0	0.08	0.08	1,313
Flumioxazin	9	1.0	0.07	0.07	3,443
Fluthiacet-methyl	1	1.1	0.01	0.01	32
Fomesafen	24	1.0	0.19	0.19	25,571
Glufosinate-ammonium	6	1.4	0.42	0.65	21,807
Glyphosate	87	1.3	0.91	1.29	625,899
Imazamox	1	1.0	0.02	0.02	61
Imazethapyr	5	1.0	0.05	0.05	1,326
Lactofen	1	1.0	0.12	0.12	775
Metolachlor	1	1.0	0.98	0.98	5,099
Metribuzin	6	1.0	0.19	0.19	6,120
Pendimethalin	1	1.0	0.99	0.99	4,854
Pyroxasulfone	6	1.0	0.08	0.08	2,765
Quizalofop	<1	1.0	0.03	0.03	60
S-metolachlor	5	1.0	1.03	1.03	26,293
Saflufenacil	5	1.0	0.02	0.02	720
Sulfentrazone	21	1.0	0.17	0.17	19,320
Thifensulfuron	2	1.0	0.01	0.01	109
Trifluralin	1	1.0	0.81	0.81	2,984
Insecticide					
Beta-cyfluthrin	1	1.0	0.02	0.02	88
Bifenthrin	4	1.0	0.07	0.07	1,762
Chlorpyrifos	8	1.0	0.42	0.42	18,283
Esfenvalerate	1	1.0	0.04	0.04	180
Gamma-cyhalothrin	1	1.1	0.01	0.01	44
Imidacloprid	1	1.0	0.04	0.04	199
Lambda-cyhalothrin	12	1.0	0.02	0.02	1,412
Thiamethoxam	2	1.0	0.03	0.03	398
Zeta-cypermethrin	<1	1.0	0.02	0.02	17
Fungicide					
Azoxystrobin	2	1.0	0.09	0.09	1,034

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Boscalid	<1	1.0	0.38	0.38	955
Fluoxastrobin	<1	1.0	0.05	0.05	31
Flutriafol	<1	1.0	0.06	0.06	39
Fluxapyroxad	7	1.0	0.06	0.06	2,388
Propiconazole	4	1.0	0.05	0.05	1,093
Pyraclostrobin	11	1.0	0.12	0.12	6,940
Tetraconazole	4	1.0	0.08	0.08	1,955
Trifloxystrobin	3	1.0	0.07	0.07	1,143

[1]Data in this column is calculated from "raw" data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: Bentazon, Ethalfluralin, Fenoxaprop, Flumetsulam, Flumiclorac, Sethoxydim, and Tribenuron.

Fungicides applied but not published included the following: Cyproconazole, Picoxystrobin, Prothioconazole, and Tebuconazole.

Pesticide Applications on Soybeans by Pesticide Management Region

Table 5 details the number of 2016 respondents with usable reports in each Pesticide Management Region (PMR), the number of soybean acres reported in each area, and the number of soybean acres receiving herbicides, insecticides and fungicides. Tables 6 – 13 provide soybean pesticide applications and rates for individual PMRs. Soybean acres were limited in PMR 3; therefore, they are not listed in this report. All responses in the following tables were published data five or more responses were collected from producers.

Table 5. Summary (by PMR) of surveyed soybean acreage to which pesticides were applied.

PMR	Number of Respondents	Soybean Acres	Herbicide Acres	Insecticide Acres	Fungicide Acres
1	311	184,532	181,916	19,357	23,982
2	21	6,438	6,338	*	*
4	230	45,769	44,729	9,703	8,318
5	130	27,154	26,339	*	*
6	143	51,932	49,439	13,073	5,390
7	146	43,612	43,484	18,589	7,172
8	461	137,359	134,745	60,299	33,140
9	215	38,606	36,931	13,836	15,184
10	139	21,183	20,826	1,644	3,468
Totals	**1,796**	**556,585**	**544,747**	**136,526**	**98,562**

* Data is not publishable due to use by less than 5 respondents.

Table 6. Pesticide applications and rates for soybean – PMR 1

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicides					
Cloransulam	4	1.0	0.02	0.02	192
Dimethenamid-p	2	1.3	0.20	0.39	1,422
Flumioxazin	7	1.0	0.07	0.07	889
Fomesafen	13	1.0	0.17	0.17	4,002
Glufosinate-ammonium	10	1.7	0.41	0.68	12,209
Glyphosate	86	1.6	0.91	1.41	223,399
Imazamox	1	1.0	0.02	0.02	55
Imazethapyr	1	1.0	0.05	0.05	60
Lactofen	2	1.0	0.11	0.11	360
Metribuzin	3	1.0	0.17	0.17	1,071
Pyroxasulfone	3	1.0	0.09	0.09	569
S-metolachlor	3	1.0	0.81	0.81	3,836
Saflufenacil	2	1.0	0.03	0.03	127
Sulfentrazone	5	1.0	0.16	0.16	1,410
Insecticide					
Chlorpyrifos	1	1.0	0.41	0.41	840
Lambda-cyhalothrin	7	1.0	0.02	0.02	251
Fungicide					
Fluxapyroxad	6	1.0	0.06	0.06	661
Propiconazole	2	1.0	0.04	0.04	109
Pyraclostrobin	9	1.0	0.12	0.12	2,058
Tetraconazole	2	1.0	0.08	0.08	328
Trifloxystrobin	1	1.0	0.06	0.06	153

[1]Data in this column is calculated from “raw” data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: Acetochlor, Acifluorfen, Bentazon, Clethodim, Ethalfluralin, Fluazifop, Flumetsulam, Flumiclorac, Fluthiacet-methyl, Metolachlor, Pendimethalin, Quizalofop, Sethoxydim, and Trifluralin.

Insecticides applied but not published included the following: Beta-cyfluthrin, Bifenthrin, Esfenvalerate, Gamma-cyhalothrin, Imidacloprid, Thiamethoxam, and Zeta-cypermethrin.

Fungicides applied but not published included the following: Azoxystrobin, Boscalid, Cyproconazole, Picoxystrobin, Prothioconazole, and Tebuconazole.

Table 7. Pesticide applications and rates for soybean – PMR 4

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicides					
Clethodim	6	1.0	0.07	0.07	182
Cloransulam	17	1.0	0.02	0.02	162
Dimethenamid-p	4	1.0	0.22	0.22	402
Flumioxazin	5	1.0	0.07	0.07	154
Fomesafen	14	1.0	0.17	0.17	1,074
Glufosinate-ammonium	5	1.3	0.45	0.55	1,291
Glyphosate	90	1.4	0.91	1.26	51,973
Imazethapyr	1	1.0	0.06	0.06	21
Metribuzin	5	1.0	0.25	0.25	618
Saflufenacil	4	1.0	0.03	0.03	52
Sulfentrazone	20	1.0	0.15	0.15	1,362
Insecticides					
Chlorpyrifos	5	1.0	0.46	0.46	1,041
Lambda-cyhalothrin	16	1.0	0.02	0.02	162
Fungicides					
Fluxapyroxad	11	1.0	0.05	0.05	245
Pyraclostrobin	11	1.0	0.11	0.11	541

[1]Data in this column is calculated from “raw” data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: 2,4-D, Acetochlor, Chlorimuron, Ethalfluralin, Fluazifop, Flumiclorac, Fluthiacet-methyl, Imazamox, Lactofen, Pendimethalin, Pyroxasulfone, S-metolachlor, Thifensulfuron, and Trifluralin.

Insecticides applied but not published included the following: Bifenthrin, Thiamethoxam, and Zeta-cypermethrin.

Fungicides applied but not published included the following: Azoxystrobin, Fluoxastrobin, Flutriafol, Propiconazole, Tetraconazole, and Trifloxystrobin.

Table 8. Pesticide applications and rates for soybean – PMR 5

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicides					
Cloransulam	3	1.0	0.02	0.02	13
Flumioxazin	46	1.0	0.06	0.06	774
Fomesafen	3	1.0	0.18	0.18	135
Glyphosate	97	1.5	0.82	1.21	31,718
Imazethapyr	8	1.0	0.04	0.04	93
Sulfentrazone	6	1.0	0.14	0.14	240
Thifensulfuron	6	1.0	0.01	0.01	20

[1]Data in this column is calculated from "raw" data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: 2,4-D, Acetochlor, Chlorimuron, Clethodim, Dimethenamid-p, Fluthiacet-methyl, Glufosinate-ammonium, Lactofen, Metolachlor, Metribuzin, Pendimethalin, Pyroxasulfone, Quizalofop, S-metolachlor, and Tribenuron.

Insecticides applied but not published included the following: Bifenthrin, Chlorpyrifos, and Gamma-cyhalothrin.

Fungicides applied but not published included the following: Azoxystrobin, Fluoxastrobin, Flutriafol, Fluxapyroxad, Propiconazole, Pyraclostrobin, Tetraconazole, and Trifloxystrobin.

Table 9. Pesticide applications and rates for soybean – PMR 6

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicides					
Acetochlor	2	1.0	1.13	1.13	1,457
Clethodim	9	1.0	0.05	0.05	261
Cloransulam	27	1.0	0.02	0.02	293
Dimethenamid-p	12	1.0	0.31	0.31	1,888
Flumioxazin	12	1.0	0.07	0.07	429
Fomesafen	35	1.0	0.19	0.19	3,504
Glufosinate-ammonium	6	1.3	0.46	0.62	1,790
Glyphosate	87	1.5	0.92	1.41	63,329
Pyroxasulfone	11	1.0	0.09	0.09	497
S-metolachlor	5	1.0	0.99	0.99	2,429
Saflufenacil	9	1.0	0.03	0.03	115
Sulfentrazone	31	1.0	0.16	0.16	2,549
Trifluralin	4	1.0	0.89	0.89	1,731
Insecticides					
Bifenthrin	2	1.0	0.06	0.06	50
Chlorpyrifos	11	1.0	0.56	0.56	3,320
Lambda-cyhalothrin	11	1.0	0.02	0.02	121
Fungicides					
Propiconazole	4	1.0	0.04	0.04	99

[1]Data in this column is calculated from "raw" data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: 2,4-D, Acifluorfen, Chlorimuron, Fluazifop, Fluthiacet-methyl, Imazethapyr, Lactofen, Metolachlor, Metribuzin, Pendimethalin, and Thifensulfuron.

Insecticides applied but not published included the following: Beta-cyfluthrin, Esfenvalerate, Gamma-cyhalothrin, Imidacloprid, and Thiamethoxam.

Fungicides applied but not published included the following: Azoxystrobin, Boscalid, Fluxapyroxad, Pyraclostrobin, Tetraconazole, and Trifloxystrobin.

Table 10. Pesticide applications and rates for soybean – PMR 7

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicides					
Clethodim	6	1.0	0.07	0.07	167
Cloransulam	50	1.0	0.02	0.02	451
Fluazifop	10	1.0	0.04	0.04	191
Flumioxazin	6	1.0	0.06	0.06	151
Fomesafen	34	1.0	0.18	0.18	2,734
Glufosinate-ammonium	4	1.4	0.46	0.65	1,185
Glyphosate	86	1.3	0.96	1.26	47,358
Imazethapyr	3	1.0	0.04	0.04	44
Metribuzin	12	1.0	0.18	0.18	948
Pyroxasulfone	5	1.0	0.09	0.09	173
S-metolachlor	6	1.0	1.07	1.07	2,625
Sulfentrazone	53	1.0	0.16	0.16	3,645
Insecticides					
Bifenthrin	3	1.0	0.07	0.07	79
Chlorpyrifos	25	1.0	0.39	0.39	4,359
Lambda-cyhalothrin	19	1.0	0.02	0.02	172
Fungicides					
Azoxystrobin	2	1.0	0.09	0.09	90
Propiconazole	13	1.0	0.04	0.04	201
Trifloxystrobin	10	1.0	0.07	0.07	321

[1]Data in this column is calculated from “raw” data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: Acetochlor, Acifluorfen, Chlorimuron, Dimethenamid-p, Fluthiacet-methyl, Lactofen, Metolachlor, Pendimethalin, Saflufenacil, Thifensulfuron, and Trifluralin.

Insecticides applied but not published included the following: Gamma-cyhalothrin and Thiamethoxam.

Fungicides applied but not published included the following: Cyproconazole, Fluoxastrobin, Flutriafol, Fluxapyroxad, Picoxystrobin, and Tetraconazole.

Table 11. Pesticide applications and rates for soybean – PMR 8

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicides					
Acetochlor	4	1.0	1.07	1.07	6,064
Chlorimuron	2	1.0	0.01	0.01	14
Clethodim	5	1.0	0.06	0.06	417
Cloransulam	29	1.0	0.02	0.02	869
Dimethenamid-p	6	1.0	0.27	0.27	2,391
Fluazifop	4	1.0	0.10	0.10	517
Flumioxazin	9	1.0	0.07	0.07	887
Fluthiacet-methyl	1	1.3	0.00	0.00	5
Fomesafen	41	1.0	0.20	0.20	11,107
Glufosinate-ammonium	5	1.5	0.42	0.61	4,352
Glyphosate	84	1.2	0.92	1.17	134,921
Imazethapyr	9	1.0	0.05	0.05	528
Lactofen	1	1.0	0.13	0.13	174
Metolachlor	1	1.0	1.06	1.06	1,578
Metribuzin	8	1.0	0.20	0.20	2,312
Pendimethalin	1	1.0	0.88	0.88	692
Pyroxasulfone	3	1.0	0.09	0.09	408
S-metolachlor	8	1.0	1.06	1.06	11,510
Saflufenacil	7	1.0	0.03	0.03	247
Sulfentrazone	34	1.0	0.17	0.17	8,191
Thifensulfuron	3	1.0	0.01	0.01	49
Trifluralin	1	1.0	0.71	0.71	999
Insecticides					
Beta-cyfluthrin	1	1.0	0.02	0.02	35
Bifenthrin	11	1.0	0.08	0.08	1,192
Chlorpyrifos	14	1.0	0.42	0.42	8,021
Esfenvalerate	2	1.0	0.04	0.04	97
Imidacloprid	1	1.0	0.04	0.04	70
Lambda-cyhalothrin	17	1.0	0.02	0.02	508
Thiamethoxam	4	1.0	0.03	0.03	183
Fungicides					
Azoxystrobin	4	1.0	0.09	0.09	435
Fluxapyroxad	9	1.0	0.06	0.06	717
Propiconazole	5	1.0	0.05	0.05	349
Pyraclostrobin	15	1.0	0.12	0.12	2,388
Tetraconazole	6	1.0	0.07	0.07	556
Trifloxystrobin	3	1.0	0.08	0.08	329

[1]Data in this column is calculated from “raw” data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: 2,4-D, Acifluorfen, Fenoxaprop, Flumiclorac, Imazamox, and Quizalofop.

Insecticides applied but not published included the following: Gamma-cyhalothrin and Zeta-cypermethrin.

Fungicides applied but not published included the following: Cyproconazole, Fluoxastrobin, Flutriafol, Prothioconazole, and Tebuconazole.

Table 12. Pesticide applications and rates for soybean – PMR 9

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicides					
Acetochlor	3	1.0	1.25	1.25	1,322
Clethodim	7	1.0	0.05	0.05	130
Cloransulam	17	1.0	0.03	0.03	188
Dimethenamid-p	12	1.0	0.12	0.12	534
Fluazifop	8	1.0	0.09	0.09	247
Flumioxazin	4	1.0	0.08	0.08	106
Fomesafen	26	1.0	0.20	0.20	1,987
Glyphosate	87	1.4	0.90	1.24	41,629
Imazethapyr	19	1.0	0.05	0.05	402
Metribuzin	10	1.0	0.20	0.20	759
S-metolachlor	8	1.0	1.04	1.04	3,130
Saflufenacil	15	1.0	0.02	0.02	127
Sulfentrazone	17	1.0	0.22	0.22	1,424
Insecticides					
Bifenthrin	10	1.0	0.04	0.04	169
Chlorpyrifos	8	1.0	0.17	0.17	520
Imidacloprid	3	1.0	0.04	0.04	51
Lambda-cyhalothrin	20	1.0	0.02	0.02	171
Thiamethoxam	9	1.0	0.03	0.03	109
Fungicides					
Azoxystrobin	5	1.0	0.10	0.10	195
Fluxapyroxad	25	1.0	0.06	0.06	581
Propiconazole	7	1.0	0.08	0.08	214
Pyraclostrobin	31	1.0	0.12	0.12	1,427
Tetraconazole	19	1.0	0.09	0.09	630

[1]Data in this column is calculated from "raw" data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: 2,4-D, Bentazon, Chlorimuron, Flumiclorac, Fluthiacet-methyl, Glufosinate-ammonium, Lactofen, Metolachlor, Quizalofop, and Thifensulfuron.

Insecticides applied but not published included the following: Beta-cyfluthrin, Esfenvalerate, and Gamma-cyhalothrin.

Fungicides applied but not published included the following: Trifloxystrobin.

Table 13. Pesticide applications and rates for soybean – PMR 10

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicides					
Chlorimuron	3	1.0	0.01	0.01	4
Clethodim	3	1.0	0.06	0.06	44
Cloransulam	11	1.0	0.02	0.02	54
Dimethenamid-p	9	1.0	0.15	0.15	287
Fluazifop	10	1.0	0.07	0.07	137
Flumioxazin	4	1.0	0.07	0.07	52
Fluthiacet-methyl	6	1.0	0.00	0.00	5
Fomesafen	22	1.0	0.22	0.22	1,029
Glyphosate	92	1.3	0.93	1.17	22,809
Imazethapyr	13	1.0	0.04	0.04	123
Metribuzin	3	1.0	0.11	0.11	59
Saflufenacil	10	1.0	0.02	0.02	45
Sulfentrazone	14	1.0	0.17	0.17	498
Thifensulfuron	3	1.0	0.01	0.01	10
Insecticides					
Lambda-cyhalothrin	5	1.0	0.02	0.02	27
Fungicides					
Fluxapyroxad	10	1.0	0.05	0.05	96
Pyraclostrobin	11	1.0	0.09	0.09	211
Tetraconazole	10	1.0	0.06	0.06	131

[1]Data in this column is calculated from “raw” data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: 2,4-D, Acetochlor, Glufosinate-ammonium, Lactofen, Metolachlor, Pendimethalin, Pyroxasulfone, Quizalofop, S-metolachlor, and Trifluralin.

Insecticides applied but not published included the following: Bifenthrin, Chlorpyrifos, Gamma-cyhalothrin, and Thiamethoxam.

Fungicides applied but not published included the following: Azoxystrobin, Picoxystrobin, Propiconazole, and Prothioconazole.

Statewide Pesticide Applications – Wheat

Many pesticide active ingredients can be used in the production of wheat. Wheat producers responding to the survey associated with this report may have used one or more of the active ingredients listed in Table 14; however, data is only published for pesticides applied by 5 or more respondents. This is consistent with standard reporting protocol used by NASS in other agricultural chemical use reports.

To obtain a list of products (brand names) registered in Minnesota and containing the active ingredients listed below, visit:

http://npirspublic.ceris.purdue.edu/state/state_menu.aspx?state=MN

enter the database, submit "active ingredient" as the search option, enter the name of the active ingredient, click "submit," check the appropriate boxes, and "submit" to obtain a list of all registered products containing the active ingredient.

Table 14. Publication status for wheat pesticide active ingredients

Active Ingredient	Published	Active Ingredient	Published
Herbicide		**Insecticide**	
2,4-D	P	Chlorpyrifos	P
Bromoxynil	P	Lambda-cyhalothrin	P
Clopyralid	P	Malathion	*
Dicamba	*	Zeta-cypermethrin	*
Fenoxaprop	P		
Florasulam	P	**Fungicide**	
Flucarbazone	P	Azoxystrobin	P
Flumioxazin	*	Cyproconazole	*
Fluroxypyr	P	Fluoxastrobin	P
Glyphosate	P	Flutriafol	*
MCPA	P	Fluxapyroxad	P
Pendimethalin	*	Metconazole	P
Pinoxaden	P	Propiconazole	P
Pyrasulfotole	P	Prothioconazole	P
Pyroxsulam	*	Pyraclostrobin	P
Thifensulfuron	P	Tebuconazole	P
Tribenuron	P	Tetraconazole	P
Triencarbazone-methyl	P	Trifloxystrobin	P

An "*" denotes data is not publishable due to use by less than 5 respondents.

A statewide summary of wheat pesticide applications is provided in Table 15. Nine percent (9%) of all Minnesota wheat acres were surveyed for the 2016 season. Herbicides were applied to 94% of all surveyed wheat acres. Insecticides were applied to 28% of all acres and 69% surveyed acres were recorded as being applied with fungicides.

Table 15. Pesticide applications and rates by active ingredient (a.i.) for wheat statewide.

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicides					
2,4-D	8	1.0	0.68	0.68	5,992
Bromoxynil	55	1.0	0.21	0.21	13,073
Clopyralid	23	1.0	0.09	0.09	2,347
Fenoxaprop	3	1.0	0.07	0.07	221
Florasulam	1	1.0	0.00	0.00	4
Flucarbazone	7	1.0	0.01	0.01	91
Fluroxypyr	28	1.0	0.09	0.09	2,744
Glyphosate	2	1.0	0.92	0.92	1,801
MCPA	32	1.0	0.32	0.32	11,499
Pinoxaden	19	1.0	0.05	0.05	1,140
Pyrasulfotole	37	1.0	0.03	0.03	1,210
Thifensulfuron	5	1.0	0.01	0.01	91
Tribenuron	5	1.0	0.01	0.01	48
Triencarbazone-methyl	19	1.0	0.00	0.00	97
Insecticide					
Chlorpyrifos	3	1.0	0.42	0.42	1,621
Lambda-cyhalothrin	23	1.0	0.02	0.02	554
Fungicide					
Azoxystrobin	<1	1.0	0.06	0.06	26
Fluoxastrobin	1	1.0	0.07	0.07	94
Fluxapyroxad	2	1.0	0.06	0.06	160
Metconazole	5	1.0	0.07	0.07	395
Propiconazole	26	1.0	0.07	0.08	2,274
Prothioconazole	25	1.0	0.10	0.10	2,857
Pyraclostrobin	10	1.1	0.10	0.11	1,196
Tebuconazole	32	1.0	0.10	0.10	3,485
Tetraconazole	2	1.0	0.09	0.09	199
Trifloxystrobin	2	1.0	0.10	0.10	230

[1]Data in this column is calculated from "raw" data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: Dicamba, Flumioxazin, Pendimethalin, and Pyroxsulam.

Insecticides applied but not published included the following: Malathion and Zeta-cypermethrin.

Fungicides applied but not published included the following: Cyproconazole and Flutriafol.

Pesticide Applications on Wheat by Pesticide Management Regions

Table 16 details the number of 2016 respondents with usable reports in each Pesticide Management Region (PMR), the number of wheat acres in each area, and the number of wheat acres receiving herbicides, insecticides and fungicides. Tables 17 – 21 provide wheat pesticide applications and rates by individual PMRs. All responses in the following tables were published data if five or more responses were collected from producers.

Table 16. Summary (by PMR) of surveyed wheat acreage to which pesticides were applied.

PMR	Number of Respondents	Wheat Acres	Herbicide Acres	Insecticide Acres	Fungicide Acres
1	217	100,884	96,057	30,009	72,874
2	12	1,780	1,725	*	*
4	56	4,341	3,442	525	1,632
5	14	755	665	*	*
6	41	3,737	3,356	1,189	2,365
7	16	847	804	*	*
8	36	1,520	1,215	*	*
10[vi]	13	272	101	*	*
Totals	**405**	**114,136**	**107,365**	**32,035**	**78,745**

An "*" denotes data is not publishable due to use by less than 5 respondents.

Table 17. Pesticide applications and rates for wheat – PMR 1

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicides					
2,4-D	5	1.0	0.70	0.70	3,854
Bromoxynil	58	1.0	0.20	0.20	11,793
Clopyralid	25	1.0	0.09	0.09	2,232
Fenoxaprop	2	1.0	0.07	0.07	158
Flucarbazone	7	1.0	0.01	0.01	84
Fluroxypyr	30	1.0	0.09	0.09	2,621
MCPA	32	1.0	0.31	0.31	9,945
Pinoxaden	21	1.0	0.05	0.05	1,118
Pyrasulfotole	39	1.0	0.03	0.03	1,143
Thifensulfuron	6	1.0	0.01	0.01	89
Tribenuron	6	1.0	0.01	0.01	47
Triencarbazone-methyl	21	1.0	0.00	0.00	93
Insecticide					
Chlorpyrifos	4	1.0	0.42	0.42	1,513
Lambda-cyhalothrin	26	1.0	0.02	0.02	586
Fungicide					
Fluxapyroxad	3	1.0	0.06	0.06	150
Metconazole	5	1.0	0.07	0.07	379
Propiconazole	28	1.0	0.07	0.08	2,053
Prothioconazole	27	1.0	0.10	0.10	2,683
Pyraclostrobin	10	1.1	0.09	0.10	1,051
Tebuconazole	34	1.0	0.10	0.10	3,299
Tetraconazole	2	1.0	0.09	0.09	185

[1]Data in this column is calculated from “raw” data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: Dicamba, Florasulam, Glyphosate, Pendimethalin, and Pyroxsulam.

Insecticides applied but not published included the following: Malathion and Zeta-cypermethrin.

Fungicides applied but not published included the following: Fluoxastrobin, Flutriafol, and Trifloxystrobin.

Table 18. Pesticide applications and rates for wheat – PMR 2

No data is publishable for wheat in Region 2.

Herbicides applied but not published included the following: 2,4-D, Bromoxynil, Fenoxaprop, Florasulam, Flucarbazone, Fluroxypyr, Glyphosate, MCPA, Pinoxaden, Pyrasulfotole, and Pyroxsulam.

Insecticides applied but not published included the following: Chlorpyrifos.

Fungicides applied but not published included the following: Propiconazole, Prothioconazole, Tebuconazole, and Trifloxystrobin.

Table 19. Pesticide applications and rates for wheat – PMR 4

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicides					
2,4-D	27	1.1	0.71	0.73	845
Bromoxynil	36	1.0	0.31	0.31	480
MCPA	33	1.0	0.32	0.32	470
Pyrasulfotole	7	1.0	0.03	0.03	9
Fungicides					
Prothioconazole	17	1.0	0.10	0.10	74
Pyraclostrobin	18	1.0	0.11	0.11	89
Tebuconazole	18	1.0	0.10	0.10	82

[1]Data in this column is calculated from "raw" data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: Clopyralid, Dicamba, Fenoxaprop, Fluroxypyr, Glyphosate, Pinoxaden, Thifensulfuron, Tribenuron, and Triencarbazone-methyl.

Insecticides applied but not published included the following: Lambda-cyhalothrin.

Fungicides applied but not published included the following: Fluoxastrobin and Propiconazole.

Table 20. Pesticide applications and rates for wheat – PMR 5

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicide					
2,4-D	21	1.0	0.65	0.65	102
Bromoxynil	70	1.0	0.28	0.28	146

[1]Data in this column is calculated from "raw" data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: Clopyralid, Fenoxaprop, Fluroxypyr, Glyphosate, MCPA, and Pyrasulfotole.

Fungicides applied but not published included the following: Propiconazole.

Table 21. Pesticide applications and rates for wheat – PMR 6

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicide					
2,4-D	21	1.0	0.55	0.55	426
Bromoxynil	44	1.0	0.23	0.23	374
MCPA	38	1.0	0.42	0.42	588
Pyrasulfotole	30	1.0	0.03	0.03	33
Triencarbazone-methyl	15	1.0	0.00	0.00	2
Insecticide					
Lambda-cyhalothrin	37	1.0	0.02	0.02	29
Fungicide					
Propiconazole	30	1.0	0.09	0.09	100
Tebuconazole	19	1.0	0.10	0.10	67

[1]Data in this column is calculated from "raw" data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: Clopyralid, Fenoxaprop, Fluroxypyr, and Pinoxaden.

Fungicides applied but not published included the following: Azoxystrobin, Cyproconazole, Fluoxastrobin, Fluxapyroxad, Metconazole, Prothioconazole, Pyraclostrobin, Tebuconazole, and Tetraconazole.

Table 22. Pesticide applications and rates for wheat – PMR 7

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicide					
Fluroxypyr	55	1.0	0.08	0.08	37
MCPA	49	1.0	0.35	0.35	144
Fungicide					
Pyraclostrobin	26	1.0	0.07	0.07	16

[1]Data in this column is calculated from "raw" data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: 2,4-D, Bromoxynil, Clopyralid, Fenoxaprop, Glyphosate, Pyrasulfotole and Triencarbazone-methyl.

Insecticides applied but not published included the following: Lambda-cyhalothrin.

Fungicides applied but not published included the following: Azoxystrobin, Propiconazole, and Trifloxystrobin.

Table 23. Pesticide applications and rates for wheat – PMR 8

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicides					
Fluroxypyr	55	1.0	0.08	0.08	37
MCPA	49	1.0	0.35	0.35	144
Fungicides					
Pyraclostrobin	26	1.0	0.07	0.07	16

[1]Data in this column is calculated from "raw" data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Herbicides applied but not published included the following: 2,4-D, Bromoxynil, Clopyralid, Fenoxaprop, Glyphosate, Pyrasulfotole, Triencarbazone-methyl.

Insecticides applied but not published included the following: Lambda-cyhalothrin.

Fungicides applied but not published included the following: Azoxystrobin, Propiconazole, and Trifloxystrobin.

Table 24. Pesticide applications and rates for wheat – PMR 10[vii]

Agricultural Chemical (a.i.)	**Surveyed Area Applied** ***Percent***	**Average Applications** ***Number***	**Average Rate Per Application** ***Pounds per Acre*** (a.i.)	**Average Rate Per Crop Year** ***Pounds per Acre*** (a.i.)	**Total Applied Per Crop Year** ***Total Pounds*** (a.i.)[1]
Herbicides					
2,4-D	37	1.0	0.95	0.95	96

[1]Data in this column is calculated from "raw" data and represents the total pounds of active ingredient applied to the indicated crop(s) in 2016 by survey participants in this area. Data in this table and the selection of survey participants was not statistically "weighted" in any fashion. Thus, inappropriate extrapolation of the data may over- or under-estimate the total pounds of a.i. used at the state, PMR, or sub-PMR levels.

Appendix 1. MASS Data Sheet

Agricultural Statistics Service

U.S. Department of Agriculture - National Agricultural Statistics Service

P.O. Box 7068, St. Paul, MN 55107-7068
Telephone: 651-296-2230 FAX: 651-296-3192
E-mail: nass-mn@nass.usda.gov

Project 487

Minnesota Pesticide Use Survey Instrument For 2016 Cropping Year

1. ACREAGE

REPORT FOR THE FARM YOU OPERATE *(Include Land Rented From Others, Exclude Land Rented Out)*				
2016 Crop	Total Acres Planted	Total Acres Treated With Fungicide	Total Acres Treated With Herbicide	Total Acres Treated With Insecticide
SOYBEANS	201	202	203	204
WHEAT	216	217	218	219

2. USAGE OF INDIVIDUAL PESTICIDES ON 2016 CROPS - Include applications after September 1, 2015 on crops for 2016 harvest. *(Please report below the acres treated with each individual chemical during 2016 by crop and/or land use. If pesticides were applied in combination, report each separately. Exclude seed treatment and inoculants.)*

NAME OF PESTICIDE USED *(Please list chemicals used. If necessary, refer to the enclosed list)*	Office Use	Acres Treated	No. of Applications	Rate	Unit Code: 1 Pounds 12 Gallons 13 Quarts 14 Pints 15 Ounces 30 Grams
SOYBEANS					
	301	302	303	304	306
	308	307	308	309	310
	311	312	313	314	316
	318	317	318	319	320
	321	322	323	324	326
	328	327	328	329	330
	331	332	333	334	336
	338	337	338	339	340
	341	342	343	344	346
	348	347	348	349	350

	351	352	353	354	355
	356	357	358	359	360
	361	362	363	364	365
	366	367	368	369	370
NAME OF PESTICIDE USED *(Please list chemicals used. If necessary, refer to the enclosed list)*	Office Use	Acres Treated	No. of Applications	Rate	Unit Code: 1 Pounds 12 Gallons 13 Quarts 14 Pints 15 Ounces 30 Grams
WHEAT					
	601	602	603	604	605
	606	607	608	609	610
	611	612	613	614	615
	616	617	618	619	620
	621	622	623	624	625
	626	627	628	629	630
	631	632	633	634	635
	636	637	638	639	640

If rates are not known, may we call your pesticide applicator? Yes _____ No _____

If yes, Company _____ Contact _____ City _____ Phone # _____-_____-_____

		Response Code	Enum.	Eval.	Julian Date
1-Op/Mgr 2-Spouse 3-Acct/Bkpr 4-Oth 5-Est R 6-Est NR 8-Office Hold 9-Partner	101	2-Tel 3-Int 7-TR 8-IR 9-Inac	910	098	100	987

Appendix 2. Additional Project Background Information

The Minnesota Department of Agriculture (MDA) is required by state law to monitor pesticide use. In pursuit of fulfilling that responsibility, the MDA began exploring the possibility of using the existing framework of the USDA National Agricultural Statistics Service (NASS) to enhance and broaden pesticide use monitoring efforts. NASS has a long history of providing statewide crop and production statistics. Over the last decade NASS has also become an important information source for pesticide and fertilizer use. Several joint pilot projects evolved with the financial assistance from Environmental Protection Agency (EPA) and were conducted from 2001-2003. These pilots were essential to the final methodology used in this report.

The first pilot was conducted in 2001 by expanding the existing Agricultural Resource Management Study (ARMS) developed by NASS. The normal number of participating farms in an ARMS survey is about 150. The pilot increased the number of personal interviews to approximately 600 and most of the enhancements were focused on the southern third of the state. The pilot provided reliable, regionally-enhanced data on pesticide product choices and application rates. Additionally, useful information on primary sources of pesticide management information, scouting, timing, and other pesticide management related information was obtained.

In neighboring North Dakota, the USDA North Dakota Field Office and North Dakota State University Extension had already established a strong tradition in collecting statewide pesticide use by using NASS telephone enumerators. "*Pesticide Use and Pest Management Practices for Major Crops in North Dakota*" is published on a four-year cycle. With the goal of expanding to a statewide scale while reducing costs, a second pilot was developed. MDA and NASS used many techniques from the North Dakota program but decided to expand the level of detail by including pesticide application rates. Historically, most mail out or telephone style surveys have been unsuccessful at quantifying pesticide rates. Due to the numerous formulations, different application rates and units of measure (i.e., active ingredient (a.i.) can be expressed in pounds, ounces, pints or quarts), complications can quickly develop. Another major complicating factor may result from the farmer using the services of a commercial pesticide applicator. If the farmer did not apply the product, the likelihood that the farmer would be familiar with the product and rate decreases significantly.

In recognition of some of the obstacles in collecting pesticide rate information, two methods for collecting pesticide rates were tested in the second pilot. "Method One" was conducted in Douglas County with 150 randomly selected farm operators. Operators were interviewed over the phone by the NASS enumerators. If the operator did not know the pesticides and/or rates, no additional follow-up work was conducted and the data was limited to any information that was provided. In neighboring Grant County, another 150 farm operators were contacted. In this county using "Method Two", if the farm records were incomplete, follow-up calls were made the pesticide dealer to complete the survey with the operator's permission. The number of surveys with complete data sets was significantly increased with the additional assistance from the dealerships. Eighty-three (83) percent of the surveys were complete in Grant County compared to forty-six (46%) in Douglas County. Equally impressive was the overall support by the local dealerships.

[i] Statewide crop totals are from the USDA NASS survey data for 2016.
[ii] Including all forms of glyphosate.
[iii] Wheat acres for PMA Regions 9 and 10 were combined.
[iv] For an example survey methods and data quality, visit the NASS website at https://www.nass.usda.gov/Education_and_Outreach/Understanding_Statistics/index.php "Statistical Aspects of Surveys"

for more specific facts about agricultural chemical use surveys. Click on “Survey and Estimation Procedures” section of NASS “Agricultural Chemical Usage - Field Crops” reports available at http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1560

[v] Excludes any active ingredients with less than five responses.

[vi] Wheat acres for PMA Regions 9 and 10 were combined.

[vii] Wheat acres for PMA Regions 9 and 10 were combined.