DEPARTMENT OF AGRICULTURE

2018 Pesticide Usage on Wheat and Hay Grown in Minnesota

6/23/2021

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Introduction

Acknowledgements

This survey was a cooperative effort between the Minnesota Department of Agriculture (MDA) and the United States Department of Agriculture (USDA): 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 busy lives, and for this we are extremely grateful. Similarly, the assistance of agricultural chemical dealers and cooperatives is much appreciated. Special thanks go 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.

2018 Pesticide Use Summary and Highlights

The 2018 pesticide use report on wheat and hay is the first Minnesota report presenting data that have been weighted by NASS to represent all farmers who grew spring wheat and harvested hay in Minnesota. Previous reports were based on non-weighted survey results that could over represent or under represent counties, depending on participation in those counties. The NASS surveys are designed to statistically represent a non-homogenous population, thus data were "weighted" to account for sample size, county size, crop acreage, and nonresponse, among other factors.[1] [2] By giving a statistical weight to each operation, data can better represent pesticide use by all Minnesota farmers with wheat and hay acres.

This report summarizes herbicide, insecticide, and fungicide use on wheat and hay[3] acres in Minnesota for the 2018 crop year. Collectively, these two crops accounted for approximately 16% of Minnesota's field crops harvested in 2018. Pesticide use information was collected by survey and data were statistically weighted to represent the 2,840,492 acres of wheat and hay cropland across the state. Pesticide application information was collected from 309 wheat operations on 97,057 spring wheat acres, and data were weighted to represent 4,619 operations with 1,620,892 hay acres. Information was collected from 1,594 hay farmers on 115,296 acres, and data were weighted to represent 17,120 operations with 1,219,600 acres of hay. Excellent participation and good record keeping by Minnesota farmers and agricultural chemical dealerships played a vital part in providing complete and detailed pesticide information.

[1] 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". This site will provide specific details about agricultural chemical use surveys.

[2] Reports available at section of NASS "Agricultural Chemical Usage - Field Crops" https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Chemical_Use/ and click on "Methodology and Quality Measures".

[3] Hay acres include alfalfa, hay, haylage, and grass/alfalfa mix.

Table 1 provides a summary of the wheat and hay acres in Minnesota that were treated with pesticides in the 2018 crop year based on the weighted survey data.

Table 1. Summary of wheat and hay acres in Minnesota treated with pesticides for the 2018 crop year

Crop	Total Minnesota Acres	Herbicide Acres Treated	Percent Applied	Insecticide Acres Treated	Percent Applied	Fungicide Acres Treated	Percent Applied
Wheat	1,620,892	1,552,994	96	688,992	43	1,298,153	80
Hay	1,219,600	20,675	2	45,116	4	2,774	<1
Totals	2,840,492	1,573,669	55	734,107	26	1,300,927	46

Wheat Highlights: The top five herbicide active ingredients (based on percent acres covered) were bromoxynil (52%), MCPA (39%), clopyralid (33%), pyrasulfotole (32%), and thiencarbazone-methyl (21%). The major wheat insecticide active ingredients used were lambda-cyhalothrin (27%) and chlorpyrifos (9%). The major fungicide active ingredients applied on wheat acres were tebuconazole (57%), prothioconazole (44%), propiconazole (33%), and pyraclostrobin (5%).

Hay Highlights: The only herbicide active ingredient used on 1% or more of the hay acres (based on percent acres covered) was glyphosate (1%). The major hay insecticide active ingredients used were lambda-cyhalothrin (2%) and chlorpyroifos (1%). No fungicide data were published on hay acres.

This report represents the ninth survey conducted on pesticide use in Minnesota by the MDA. The previous surveys collected information for the 2003, 2005, 2007, 2009, 2011, 2013, 2015, and 2016 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. Because USDA NASS collected data for corn and soybeans for the 2018 crop year, the MDA did not survey farmers with those specific crops.

The MDA surveys can be found at:
https://www.mda.state.mn.us/agricultural-pesticide-sales-use-reports-statewide

The USDA NASS surveys can be found at:
https://www.nass.usda.gov/Statistics_by_State/Minnesota/Publications/Other_Press_Releases/index.php

Survey Design and Implementation

Figure 1 outlines the ten PMRs as defined by the MDA. Counties were 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.

Five counties were not included in the survey due to lack of sufficient wheat or hay acres. These counties were Cook, Lake, Lake of the Woods, Ramsey, and Watonwan. All PMRs were included in the survey. If a PMR did not have at least nine responses, those PMRs were grouped into a 'Combined PMR'.

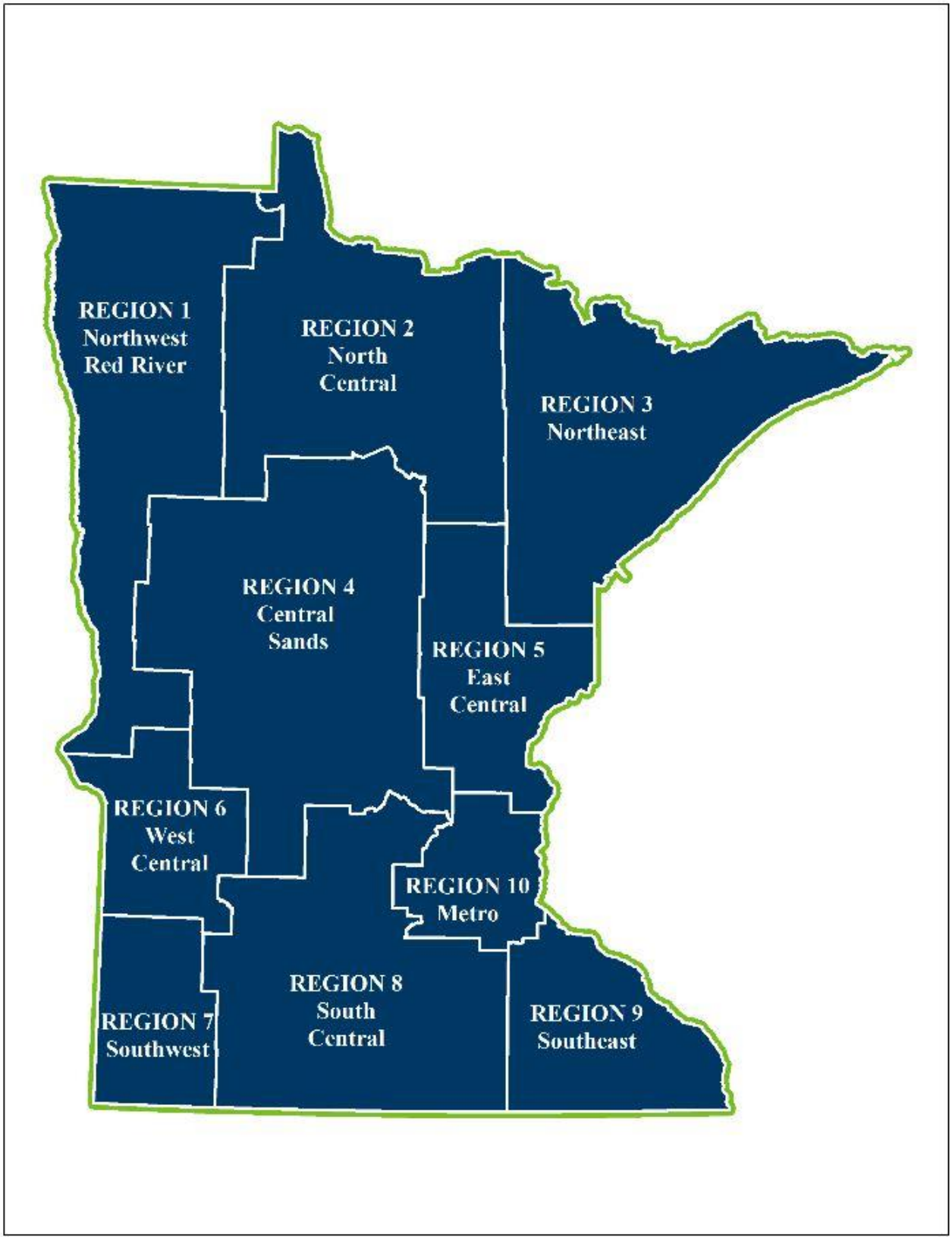

Figure 1. MDA Pesticide Management Regions (PMRs)

NASS developed the survey sample of 7,600 farms. This was done by selecting approximately 93 farms from each of the 82 agricultural counties surveyed in this report. All farmers from each county who grew one or both of the target crops (hay and wheat) were eligible for selection. This number provided a large enough pool to reach the desired goal of obtaining statistically weighted data for all farms that grew wheat or hay in 2018. A total of 309 farms that grew wheat were surveyed, and 1,594 farms that grew hay were surveyed throughout Minnesota.

Respondents were required to have records of 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 hay acres, but could not find the records for the insecticides applied to the wheat crop. In this scenario, the hay acres would be used and the wheat acres would be dropped from the data set.

Table 2 summarizes the total number of operations and crop acres by PMR for both wheat and hay in 2018.[4] Because PMRs 3, 5, and 10 each had less than nine responses, they were grouped into the 'Combined PMR'.

Table 2. Number of farms and crop acreage in Minnesota by PMR

PMR	Number of Farms Planted Wheat	Wheat Acres	Number of Farms Harvested Hay	Hay Acres
1	2,450	1,429,934	1,271	168,773
2	148	25,646	**	**
4	900	93,151	5,303	412,452
6	345	38,157	**	**
7	**	**	956	34,913
8	377	15,149	2,824	100,475
9	**	**	2,413	125,573
Combined PMR[5]	399	18,855	4,354	377,414
State	**4,619**	**1,620,892**	**17,120**	**1,219,600**

** Less than nine responses per PMR

[4] https://downloads.usda.library.cornell.edu/usda-esmis/files/k3569432s/w3764081j/5712n018r/cropan21.pdf page 24 and page 34.

[5] PMRs with less than nine responses were grouped into 'Combined PMR'. The combined PMR category for wheat includes PMRs 3, 5, 7, 9, and 10, while the combined PMR category for hay includes PMRs, 2, 3, 5, 6, and 10.

Data Collection Process

Farmers were interviewed over the phone in February 2019. These were "cold calls," meaning the farmers did not get any type of notification about the survey prior to the call. The interviews typically lasted 5 to 10 minutes.

1. Farmers were first asked to identify the number of acres of hay and wheat grown in the 2018 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 respondent, 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 include:

- 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: corn, soybeans, wheat, and hay;

- 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 with similar names can be applied at different rates. The pesticide rates must be recorded in the correct unit during the survey process. For example, Tundra EC and Tundra Supreme are sold as a liquid. The maximum legal application rate of Tundra EC is 4.00 ounces/acre while Tundra Supreme is 10.6 ounces/acre.

Data Reporting and Limitations

As previously mentioned, the 2018 Minnesota survey is statistically weighted to represent 2,840,492 crop acres statewide. Farmers that grew hay or wheat were randomly selected from county lists of producers accessed by NASS to participate in the survey. Because NASS surveys are designed to represent a non-homogenous population, data are "weighted" to account for sample size, county size, crop acreage, nonresponse, etc. By giving a statistical weight to each operation based standard protocol for NASS, data can better represent all Minnesota farmers with these two crops.[6]

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.

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 northwestern Minnesota (PMR 1) use a pre-emergence, soil-applied herbicide for grass control and follow-up post-emergence for broadleaves. Following this general pesticide strategy, Sharpen may be selected for pre-emergence annual broadleaf weed control and Huskie Complete as the post-emergence product for grass and broadleaf weeds on wheat acres. Because the products are reported individually, it is not possible to determine whether both products were applied to the same acres.

[6] Details on NASS Methodology and Quality Measures are available at: https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Ag_Resource_Management/. Click on the "Methodology and Quality Measures" tab for more information.

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 3. However, data were only reported if there were nine or more respondents in each PMR. All responses in the following tables were published data if five or more responses were collected from producers for the state level or each PMR. This is consistent with standard reporting protocol used by NASS in other agricultural chemical use reports.

Table 3. Publication status for wheat pesticide active ingredients[7]

Active Ingredient	Published	Active Ingredient	Published
Herbicide		**Insecticide**	
2,4-D	P	Beta-cyfluthrin	*
Bromoxynil	P	Bifenthrin	*
Carfentrazone	*	Chlorpyrifos	P
Clodinafop-propargyl	*	Lambda-cyhalothrin	P
Clopyralid	P	Zeta-cypermethrin	*
Dicamba	*		
Fenoxaprop	P	**Fungicide**	
Florasulam	*	Azoxystrobin	*
Flucarbazone	P	Boscalid	*
Fluroxypyr	P	Chlorothalonil	*
Glyphosate	P	Cyproconazole	*
MCPA	P	Fluxapyroxad	P
Pinoxaden	P	Mancozeb	*
Propoxycarbazone	*	Metconazole	*
Pyrasulfotole	P	Propiconazole	P
Pyroxsulam	*	Prothioconazole	P
Saflufenacil	*	Pyraclostrobin	P
Thifensulfuron	P	Tebuconazole	P
Triallate	*	Tetraconazole	P
Tribenuron	P	Trifloxystrobin	P
Thiencarbazone-methyl	P		

[7] "P" indicates data for the a.i. is publishable. 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 4. Minnesota farmers grew 1,620,892 acres of wheat for the 2018 season. Herbicides were applied to 96% of all wheat acres; insecticides were applied to 43% of all acres; and fungicides were applied to 80% of all acres.

Table 4. Pesticide applications and rates by active ingredient for wheat statewide[8]

Active Ingredient	Planted Acres Treated *Percent*	Average Applications *Number*	Average Rate Per Application *Pounds per Acre*	Average Rate Per Crop Year *Pounds per Acre*	Total Applied Per Crop Year *Total Pounds*
Herbicides					
2,4-D	9	1.0	0.46	0.46	64,822
Bromoxynil	52	1.0	0.21	0.21	181,389
Clopyralid	33	1.0	0.10	0.10	54,507
Fenoxaprop	4	1.0	0.09	0.09	5,618
Flucarbazone	13	1.0	0.02	0.02	5,206
Fluroxypyr	35	1.0	0.10	0.10	55,664
Glyphosate	1	1.0	0.90	0.90	19,099
MCPA	39	1.0	0.34	0.34	213,833
Pinoxaden	7	1.0	0.05	0.05	5,971
Pyrasulfotole	32	1.0	0.03	0.03	14,733
Thifensulfuron	12	1.0	0.01	0.01	1,949
Tribenuron	9	1.0	0.01	0.01	1,422
Thiencarbazone-methyl	21	1.0	0.00	0.00	1,546
Insecticides					
Chlorpyrifos	9	1.0	0.37	0.37	56,742
Lambda-cyhalothrin	27	1.0	0.02	0.02	9,322
Fungicides					
Fluxapyroxad	4	1.0	0.05	0.05	3,221
Propiconazole	33	1.1	0.07	0.08	41,200
Prothioconazole	44	1.0	0.11	0.11	74,511
Pyraclostrobin	5	1.0	0.11	0.11	9,396
Tebuconazole	57	1.0	0.11	0.11	104,755
Tetraconazole	2	1.0	0.07	0.07	2,345
Trifloxystrobin	3	1.1	0.07	0.07	3,058

Herbicides applied but not published included the following: Dicamba, Florasulam, Propoxycarbazone, Pyroxsulam, Saflufenacil, and Triallate.

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

Fungicides applied but not published included the following: Azoxystrobin, Boscalid, Chlorothalonil, Cyproconazole, Mancozeb, and Metconazole.

[8] Any active ingredients with less than five responses were not published.

To obtain a list of products (brand names) registered in Minnesota and containing the active ingredients listed in Tables 3 and 4, 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.

Pesticide Applications on Wheat by Pesticide Management Regions

Table 5 details the number of 2018 statistically weighted respondents with usable reports in each Pesticide Management Region (PMR), the number of weighted wheat acres in each area, and the number of weighted wheat acres receiving herbicides, insecticides and fungicides. Tables 6 – 11 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 for each PMR. The PMRs were combined if the region had less than nine responses from the non-weighted data.

Table 5. 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	2,450	1,429,934	1,412,204	656,041	1,214,387
2	148	25,646	21,917	4,301	13,865
4	900	93,151	65,322	23,631	45,913
6	345	38,157	28,467	4,654	14,179
8	377	15,149	10,691	364	4,516
Combined PMRs[9]	399	18,855	14,394	0	5,293
Totals	4,619	1,620,892	1,552,994	688,992	1,298,153

[9] Wheat acres for PMRs 3, 5, 7, 9 and 10 were combined.

Table 6. Pesticide applications and rates for wheat by active ingredient – PMR 1

Active Ingredient	Planted Acres Treated *Percent*	Average Applications *Number*	Average Rate Per Application *Pounds per Acre*	Average Rate Per Crop Year *Pounds per Acre*	Total Applied Per Crop Year *Total Pounds*
Herbicides					
2,4-D	7	1.0	0.42	0.42	41,431
Bromoxynil	54	1.0	0.21	0.21	164,797
Clopyralid	37	1.0	0.10	0.10	53,495
Fenoxaprop	3	1.0	0.10	0.10	4,641
Flucarbazone	15	1.0	0.02	0.02	5,181
Fluroxypyr	39	1.0	0.10	0.10	55,056
MCPA	42	1.0	0.33	0.33	200,633
Pinoxaden	8	1.0	0.05	0.05	5,939
Pyrasulfotole	32	1.0	0.03	0.03	13,159
Thifensulfuron	13	1.0	0.01	0.01	1,936
Tribenuron	11	1.0	0.01	0.01	1,419
Thiencarbazone-methyl	23	1.0	0.00	0.00	1,443
Insecticides					
Chlorpyrifos	10	1.0	0.36	0.36	51,079
Lambda-cyhalothrin	29	1.0	0.02	0.02	9,134
Fungicides					
Fluxapyroxad	4	1.0	0.05	0.05	2,866
Propiconazole	35	1.1	0.07	0.08	39,001
Prothioconazole	47	1.0	0.11	0.11	71,054
Pyraclostrobin	5	1.0	0.10	0.10	6,829
Tebuconazole	62	1.0	0.11	0.11	101,131
Trifloxystrobin	3	1.0	0.07	0.07	2,801

Herbicides applied but not published included the following: Carfentrazone, Clodinafop-propargyl, Dicamba, Glyphosate, Propoxycarbazone, Saflufenacil, and Triallate.

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

Fungicides applied but not published included the following: Azoxystrobin, Boscalid, Cyproconazole, Mancozeb, Metconazole, and Tetraconazole.

Table 7. Pesticide applications and rates for wheat by active ingredient – PMR 2

Active Ingredient	Planted Acres Treated *Percent*	Average Applications *Number*	Average Rate Per Application *Pounds per Acre*	Average Rate Per Crop Year *Pounds per Acre*	Total Applied Per Crop Year *Total Pounds*
Herbicides					
Bromoxynil	69	1.0	0.17	0.17	3,006
Pyrasulfotole	67	1.0	0.03	0.03	510
Thiencarbazone-methyl	55	1.0	0.00	0.00	63

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

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

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

Table 8. Pesticide applications and rates for wheat by active ingredient – PMR 4

Active Ingredient	Planted Acres Treated *Percent*	Average Applications *Number*	Average Rate Per Application *Pounds per Acre*	Average Rate Per Crop Year *Pounds per Acre*	Total Applied Per Crop Year *Total Pounds*
Herbicides					
2,4-D	22	1.0	0.57	0.57	11,723
Bromoxynil	40	1.0	0.23	0.23	8,431
MCPA	15	1.0	0.40	0.40	5,508
Pyrasulfotole	29	1.0	0.03	0.03	819
Fungicides					
Prothioconazole	28	1.0	0.11	0.11	2,815
Pyraclostrobin	15	1.0	0.11	0.11	1,544

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

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

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

Table 9. Pesticide applications and rates for wheat by active ingredient – PMR 6

Active Ingredient	Planted Acres Treated *Percent*	Average Applications *Number*	Average Rate Per Application *Pounds per Acre*	Average Rate Per Crop Year *Pounds per Acre*	Total Applied Per Crop Year *Total Pounds*
Herbicide					
2,4-D	26	1.0	0.48	0.48	4,741
Bromoxynil	37	1.0	0.26	0.26	3,683
MCPA	28	1.0	0.37	0.37	3,948
Pyrasulfotole	19	1.0	0.03	0.03	199

Herbicides applied but not published included the following: Clopyralid, Fenoxaprop, Florasulam, Fluroxypyr, Glyphosate, Pyroxsulam, and Thiencarbazone-methyl.

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

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

Table 10. Pesticide applications and rates for wheat by active ingredient – PMR 8

Active Ingredient	Planted Acres Treated *Percent*	Average Applications *Number*	Average Rate Per Application *Pounds per Acre*	Average Rate Per Crop Year *Pounds per Acre*	Total Applied Per Crop Year *Total Pounds*
Herbicides					
2,4-D	42	1.0	0.59	0.59	3,749
Bromoxynil	19	1.0	0.24	0.24	692
MCPA	16	1.0	0.32	0.32	803
Fungicides					
Pyraclostrobin	21	1.0	0.08	0.08	271

Herbicides applied but not published included the following: Dicamba, Fenoxaprop, Flucarbazone, Pyrasulfotole, Saflufenacil, and Thiencarbazone-methyl.

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

Fungicides applied but not published included the following: Azoxystrobin, Fluxapyroxad, Propiconazole, Prothioconazole, Tebuconazole, and Tetraconazole.

Table 11. Pesticide applications and rates for wheat by active ingredient – Combined PMRs[10]

Active Ingredient	Planted Acres Treated *Percent*	Average Applications *Number*	Average Rate Per Application *Pounds per Acre*	Average Rate Per Crop Year *Pounds per Acre*	Total Applied Per Crop Year *Total Pounds*
Herbicide					
2,4-D	37	1.0	0.95	0.95	96

Herbicides applied but not published included the following: Bromoxynil, Clopyralid, Fluroxypyr, Glyphosate, MCPA, Pyrasulfotole, Thifensulfuron, Tribenuron, and Thiencarbazone-methyl.

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

[10] Wheat acres for PMRs 3, 5, 7, 9 and 10 were combined.

Statewide Pesticide Applications – Hay

Many pesticide active ingredients can be used in the production of hay. Hay producers responding to the survey associated with this report may have used one or more of the active ingredients listed in Table 12. However, data were only reported if there were nine or more respondents in each PMR. All responses in the following tables were published data if five or more responses were collected from producers for the state level or each PMR. This is consistent with standard reporting protocol used by NASS in other agricultural chemical use reports.

Table 12. Publication status for hay pesticide active ingredients[11]

Active Ingredient	Published	Active Ingredient	Published
Herbicide		**Insecticide**	
2,4-D	P	Beta-cyfluthrin	*
Acetochlor	*	Chlorpyrifos	P
Aminopyralid	*	Cyfluthrin	*
Clethodim	*	Gamma-cyhalothrin	*
Clopyralid	*	Lambda-cyhalothrin	P
Dicamba	*	Permethrin	P
Glyphosate	P		
Imazamox	*	**Fungicide**	
Imazethapyr	*	Azoxystrobin	*
Picloram	*	Pyraclostrobin	*
Trifluralin	*		

[11] "P" indicates data for the a.i. is publishable. An "*" denotes data is not publishable due to use by less than 5 respondents.

A statewide summary of hay pesticide applications is provided in Table 13. Minnesota farmers grew 1,219,600 acres of hay for the 2018 season. Herbicides were applied to 2% of all hay acres. Insecticides were applied to 4% of all acres and less than 1% of acres were applied with fungicides.

Table 13. Pesticide applications and rates by active ingredient for hay statewide[12]

Active Ingredient	Planted Acres Treated *Percent*	Average Applications *Number*	Average Rate Per Application *Pounds per Acre*	Average Rate Per Crop Year *Pounds per Acre*	Total Applied Per Crop Year *Total Pounds*
Herbicides					
2,4-D	<1	1.0	0.67	0.68	4,002
Glyphosate	1	1.0	1.02	1.02	12,050
Insecticides					
Chlorpyrifos	1	1.5	0.53	0.80	12,345
Lambda-cyhalothrin	2	1.2	0.02	0.03	492
Permethrin	<1	1.0	0.11	0.11	511

Herbicides applied but not published included the following: Acetochlor, Aminopyralid, Clethodim, Clopyralid, Dicamba, Imazamox, Imazethapyr, Picloram, and Trifluralin.

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

Fungicides applied but not published included the following: Azoxystrobin and Pyraclostrobin.

[12] Any active ingredients with less than five responses were not published.

To obtain a list of products (brand names) registered in Minnesota and containing the active ingredients listed in Tables 12 and 13, 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.

Pesticide Applications on Hay by Pesticide Management Region

Table 14 details the number of 2018 statistically weighted respondents with usable reports in each Pesticide Management Region (PMR), the number of weighted hay acres in each area, and the number of weighted hay acres receiving herbicides, insecticides and fungicides. Tables 15 – 20 provide hay 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 for each PMR. The PMRs were combined if the region had less than nine responses from the non-weighted data.

Table 14. Summary (by PMR) of surveyed hay acreage to which pesticides were applied[13]

PMR	Number of Respondents	Hay Acres	Herbicide Acres	Insecticide Acres	Fungicide Acres
1	1,271	168,773	5,583	5,439	0
4	5,303	412,452	6,023	11,028	**
7	956	34,913	2,550	4,156	0
8	2,824	100,475	3,902	5,389	**
9	2,413	125,573	1,096	14,470	**
Combined PMRs[14]	4,354	377,414	1,520	4,634	**
Totals	**17,120**	**1,219,600**	**20,675**	**45,116**	**2,774**

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

[14] Hay acres for PMRs 2, 3, 5, 6, and 10 were combined.

Table 15. Pesticide applications and rates for hay – PMR 1

No data is publishable for hay in Region 1

Herbicides applied but not published included the following: 2,4-D, Clopyralid, Glyphosate, Imazamox, Imazethapyr, and Trifluralin.

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

Table 16. Pesticide applications and rates for hay – PMR 4

No data is publishable for hay in Region 4

Herbicides applied but not published included the following: 2,4-D, Clopyralid and Glyphosate.

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

Fungicide applied but not published included the following: Azoxystrobin.

Table 17. Pesticide applications and rates for hay by active ingredient – PMR 7

Active Ingredient	Planted Acres Treated *Percent*	Average Applications *Number*	Average Rate Per Application *Pounds per Acre*	Average Rate Per Crop Year *Pounds per Acre*	Total Applied Per Crop Year *Total Pounds*
Herbicide					
Glyphosate	7	1.0	1.12	1.12	2,581
Insecticide					
Lambda-cyhalothrin	4	1.4	0.03	0.04	45

Herbicides applied but not published included the following: 2,4-D and Picloram.

Insecticides applied but not published included the following: Chlorpyrifos and Gamma-Cyhalothrin.

Table 18. Pesticide applications and rates for hay by active ingredient– PMR 8

Active Ingredient	Planted Acres Treated *Percent*	Average Applications *Number*	Average Rate Per Application *Pounds per Acre*	Average Rate Per Crop Year *Pounds per Acre*	Total Applied Per Crop Year *Total Pounds*
Herbicide					
2,4-D	2	1.0	1.04	1.04	1,829
Insecticides					
Chlorpyrifos	2	1.2	0.47	0.71	1,767
Lambda-cyhalothrin	2	1.2	0.03	0.03	49

Herbicides applied but not published included the following: Acetochlor, Aminopyralid, Clethodim, Dicamba, Glyphosate, and Trifluralin.

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

Fungicide applied but not published included the following: Pyraclostrobin.

Table 19. Pesticide applications and rates for hay by active ingredient – PMR 9

Active Ingredient	Planted Acres Treated *Percent*	Average Applications *Number*	Average Rate Per Application *Pounds per Acre*	Average Rate Per Crop Year *Pounds per Acre*	Total Applied Per Crop Year *Total Pounds*
Insecticide					
Lambda-cyhalothrin	3	1.3	0.03	0.03	116

Herbicides applied but not published included the following: 2,4-D, Glyphosate, and Imazethapyr.

Insecticides applied but not published included the following: Beta-cyfluthrin, Chlorpyrifos, Cyfluthrin, and Permethrin.

Fungicide applied but not published included the following: Pyraclostrobin.

Table 20. Pesticide applications and rates for hay by active ingredient – Combined PMRs[15]

Active Ingredient	Planted Acres Treated *Percent*	Average Applications *Number*	Average Rate Per Application *Pounds per Acre*	Average Rate Per Crop Year *Pounds per Acre*	Total Applied Per Crop Year *Total Pounds*
Herbicide					
Glyphosate	<1	1.0	0.79	0.79	1,174
Insecticide					
Lambda-cyhalothrin	<1	1.2	0.03	0.03	48

Herbicides applied but not published included the following: 2,4-D and Dicamba.

Insecticides applied but not published included the following: Beta-cyfluthrin and Chlorpyrifos.

Fungicide applied but not published included the following: Pyraclostrobin.

[15] Hay acres for PMRs 2, 3, 5, 6, and 10 were combined.

Appendix 1. MASS Data Sheet

MINNESOTA ANNUAL PESTICIDE AND FERTILIZER SURVEY

OMB No. 0535-0218
Approval Expires: 6/26/2016
Project Code: 778 QID: 163695
SMetaKey: 3695

USDA United States Department of Agriculture

NATIONAL AGRICULTURAL STATISTICS SERVICE

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Please make corrections to name, address, and ZIP Code, if necessary.

The Minnesota Department of Agriculture, in cooperation with the National Agricultural Statistics Service (NASS), conducts periodic surveys of major crop producers that collect information on pesticide and fertilizer use and pesticide use rates. Survey respondents are randomly selected, and the reported results are based on advanced standardized statistical analyses conducted by NASS nationwide. Your response is necessary to help provide the best statistics possible. If there are any questions, contact the Minnesota State Statistician at (615) 728-3113. In accordance with the Confidential Information Protection provisions of Title V, Subtitle A, Public Law 107-347 and other applicable Federal laws, your responses will be kept confidential and will not be disclosed in identifiable form to anyone other than employees or agents. By law, every employee and agent has taken an oath and is subject to a jail term, a fine, or both if he or she willfully discloses ANY identifiable information about you or your operation. Response is **voluntary**.

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0535-0218. The time required to complete this information collection is estimated to average 45 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

1. Did this operation plant any WHEAT or harvest any HAY in 2018?

   [1] ☐ Yes - Continue [3] ☐ No – Go to Conclusion

Section 2 – 2018 Wheat Crop Acres

	Acres
2. How many acres of wheat were planted for the 2018 crop year?	xxx
[If wheat acres greater than zero, then continue, otherwise go to **Section 3**.]	Acres
3. How many acres of wheat were treated with herbicides?	xxx
4. How many acres of wheat were treated with insecticides? (Exclude seed treatments)	xxx
5. How many acres of wheat were treated with fungicides? (Exclude seed treatments)	xxx

Section 3 – 2018 Hay Crop Acres

	Acres
6. How many acres of hay were harvested for the 2018 crop year?	xxx
[If hay acres are greater than zero then continue, otherwise go to **Section 4**.]	Acres
7. How many acres of hay were treated with herbicides?	xxx
8. How many acres of hay were treated with insecticides? (Exclude seed treatments)	xxx
9. How many acres of hay were treated with fungicides? (Exclude seed treatments)	xxx

Section 4

INSTRUCTION: The next questions will ask about USAGE OF INDIVIDUAL PESTICIDES ON 2018 CROPS. **Include** applications in the fall of 2016 on crops for the 2016 harvest. Report the acres treated with each individual chemical during 2016 by crop or land use. If pesticides were applied in combination, report each separately. (**Exclude** seed treatments and inoculants.)

Keep in mind that herbicides, insecticides and fungicides are ALL considered pesticides.
If **Section 2** wheat crop acres, items 2, 3, or 4 are greater than zero, complete. Otherwise go to **Section**

1. In the following table, please report all pesticides used on the 2018 wheat crop.

What Pesticide was applied to the 2018 Wheat Crop? Name	Product Code Code	How many acres of wheat were treated with Product? Acres	How many applications of Product were made for the 2018 wheat crop? (If product was applied multiple times in a season, record each application and its rate on separate lines). Number	At what rate was product applied Rate	Was that rate: 1 – Pounds 12 – Gallons 13 – Quarts 14 – Pints 15 – Ounces 30 – Grams Code

INSTRUCTIONS: If **Section** 3 (Hay crop acres), items 2, 3 or 4 are greater than zero, complete. Otherwise go to **Section 6**.

1. In the following table, please report all pesticides used on the 2018 Hay crop.

What Pesticide was applied to the 2018 Hay Crop?	Product Code	How many acres of Hay were treated with Product?	How many applications of Product were made for the 2018 Hay crop? (If product was applied multiple times in a season, record each application and its rate on separate lines).	At what rate was product applied	Was that rate: 1 – Pounds 12 – Gallons 13 – Quarts 14 – Pints 15 – Ounces 30 – Grams
Name	Code	Acres	Number	Rate	Code

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 financial assistance from the 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.