DEPARTMENT OF AGRICULTURE

2019 Pesticide Usage on Corn and Soybeans Grown in Minnesota

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Executive Summary

The Minnesota Department of Agriculture (MDA) is responsible for the monitoring of pesticide use and development of pesticide best management practices (BMPs). The BMPs are designed to prevent and minimize the degradation of Minnesota's water resources while at the same time considering economic factors, availability, technical feasibility, implementability, effectiveness, and environmental effects. The BMPs also refer to practices relating to the rate and frequency of pesticide applications and adoption of integrated pest management practices. The MDA is also responsible for monitoring the adoption and effectiveness of the BMPs.

Every year the MDA has partnered with NASS to produce a detailed report on pesticide use and rates used on the state's major crops. This survey was designed and conducted in partnership with the United States Department of Agriculture's National Agricultural Statistics Service (NASS) to assess the status of BMP awareness and adoption in relation to pesticide use on corn, soybeans, wheat, and hay acres.

NASS developed the survey sample of 7,600 farms. This was done by selecting approximately 101 farms from each of the 75 agricultural counties surveyed in this report. These 75 counties had sufficient acres of either soybeans or corn in order to be contacted during the survey. All farmers from each county who grew one or both of the target crops (soybeans and corn) were eligible to be selected. This number provided a large enough pool to reach the desired goal of obtaining statistically weighted data for all farms that grew corn or soybeans in 2019. Counties not included in the survey are Aitkin, Anoka, Carlton, Cass, Cook, Hubbard, Itasca, Koochiching, Lake, Lake of the Woods, Ramsey, and Saint Louis Counties.

The general purpose of this survey was to ask farmers about pesticide applications and rates used on corn and soybeans. The survey included integrated pest management questions for farmers who applied insecticides to their soybean acres. The USDA NASS collects pesticide information on major crops in Minnesota as part of a national survey. If the USDA is collecting information on a specific crop, the MDA does not collect pesticide use data for the same crop in the same calander year. In 2019, the MDA collected pesticide application information on corn and soybeans. Due to USDA NASS collecting data for spring wheat and hay for the 2019 crop year, the MDA did not survey farmers with those specific crops.

This report summarizes herbicide, insecticide, and fungicide use on corn and soybean acres in Minnesota for the 2019 crop year. The 2019 pesticide report is the second pesticide use report presenting data that has been weighted (by NASS) to represent all farmers who grew corn and soybeans in Minnesota. Statistical weighting of data better represents Minnesota farmers with corn and soybean acres. Collectively, these two crops accounted for approximately 80% of Minnesota's field crops planted in 2019. Pesticide use information was collected by survey and data were statistically weighted to represent the 14,650,000 acres of corn and soybean cropland across the state.

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 use a pre-emergence, soil-applied herbicide for grass control and follow up post-emergence for broadleaves. Following this general pesticide strategy, Acetochlor products, such as Harness or Warrant, were reported in this area on 57% of the corn acres and glyphosate (such as Roundup Weather Max or Powermax) was reported on 76% 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, applied to the same acres, would not be totaled and recorded as applications to the same field. For example, HalexGT might be

applied to an 80 acre field, with RoundUp Power Max applied to a 60-acre subset of the same field. Both products contain glyphosate but because two different products were used, the additive total of the glyphosate (active ingredient) on the entire cropland may not be captured.

The 2019 pesticde use report included specific insecticide use questions for soybeans. This was a subset of all soybean farmers that were surveyed in February of 2020. There were 25,069 represented soybean farmers who planted 6,850,000 acres. Of those represented farmers, 4,661 soybean farmers with 1,340,828 acres applied insecticides.

Highlights of the 2019 pesticide use on corn acres:

- Herbicides were applied to 98% of corn acres
- The most common applied herbicide was glyphosate, applied to 76% of all corn acres
- Insecticides were applied to 16% of corn acres
- The most common insecticide was bifenthrin, applied to 5% of all corn acres
- Fungicides were applied to 14% of corn acres
- The most common fungicide was pyraclostrobin, applied to 5% of all corn acres

Highlights of the 2019 pesticide use on soybeans acres:

- Herbicides were applied to 98% of soybean acres
- The most common applied herbicide was glyphosate, applied to 71% of all soybean acres
- Insecticides were applied to 20% of soybean acres
- The most common insecticide was chlorpyrifos, applied to 12% of all soybean acres
- Fungicides were applied to 19% of soybean acres
- The most common fungicide was prothioconazole, applied to 5% of all soybean acres

Highlights of the 2019 Insecticide Use Questions on Soybeans

- The most common insect targeted for insecticide treatment on soybean acres was the soybean aphid at 88% of farmers surveyed
- 62% of farmers scouted their own field for soybean aphids
- 34% of farmers used the threshold of greater 250 aphids per plant before applying insecticide
- 83% of farmers kept records on all or some of their soybean fields for the soybean aphid threshold
- 38% of farmers used an agricultural consultant to consider other factors, other than threshold, to apply insecticides to their soybean acres
- 16% of farmers reported having a bee hive within three miles of their soybean field when insecticides were applied
- 65% of farmers had at least some soybean seed treated with an insecticide before planting

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 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.

2019 Pesticide Use Summary and Highlights

The 2019 pesticide use report on corn and soybeans is the second Minnesota report presenting data that have been weighted by NASS to represent all farmers who grew corn and soybeans in Minnesota. Prior to 2018, 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 are "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 corn and soybean acres.

This report summarizes herbicide, insecticide, and fungicide use on corn and soybean acres in Minnesota for the 2019 crop year. Collectively, these two crops accounted for approximately 80% of Minnesota's field crops planted in 2019. Pesticide use information was collected by survey and data were statistically weighted to represent the 14,650,000 acres of corn and soybean cropland across the state. Pesticide application information was collected from 1,276 corn operations on 355,806 corn acres, and data were weighted to represent 1,197 soybean operations on 354,100 acres of soybeans. 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 collected pesticide information and was statistically weighted to represent the 14,650,000 acres of corn and soybeans cropland across the state in all Pesticide Management Regions (PMRs). The survey was

[1] For an example of survey methods and data quality, visit the NASS website at https://www.nass.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 sections 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".

statistically weighted by NASS to cover Minnesota farmers that grew corn and soybeans; and the total acres of these crops for the 2019 crop year

The report represents the tenth survey conducted on pesticide use in Minnesota by the MDA. The previous surveys collected information for the 2003, 2005, 2007, 2009, 2011, and 2013 crop years included corn, soybeans, wheat, and hay. In 2015, pesticide use on corn and hay crops were surveyed. In 2016, pesticide use on soybeans and wheat were surveyed. In 2018, Minnesota wheat and hay crops were surveyed about pesticide use. The MDA does not collect pesticide use data in the same year for the same crops as USDA NASS. In 2019, the MDA collected pesticide application information on corn and soybeans. Due to USDA NASS collecting data for spring wheat and hay for the 2019 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

Corn Highlights: Herbicides, insecticides, and fungicides were applied to 98%, 16%, and 14%, respectively, of the corn acres planted in Minnesota. The top five herbicide products (based on percent acres covered) were glyphosate (76%), acetochlor (57%), mesotrione (48%), clopyralid (45%), and flumetsulam (27%). The major corn insecticides used were bifenthrin (5%), chlorpyrifos (4%), lambda-cyhalothrin (4%), and tefluthrin (3%). The major fungicide products applied on corn acres were pyraclostrobin (5%), propiconazole (5%), azoxystobin (4%), and metconazole (4%).

Soybeans Highlights: Herbicides, insecticides, and fungicides were applied to 98%, 20%, and 19%, respectively, on soybeans acres harvested in Minnesota. The top five herbicide products (based on percent acres covered) were glyphosate (71%), sulfentrazone (31%), cloransulam (28%), fomesafen (25%), and dicamba (23%). The major soybean insecticides used were chlorpyrifos (12%), lambda-cyhalothrin (6%), and bifenthrin (2%). The major fungicide products applied on soybean acres were prothioconazole (5%), propiconazole (5%), pyraclostrobin (5%), and trifloxystrobin (4%).

Survey Design and Implementation

Figure 1 outlines the ten Pesticide Management Regions 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.

Twelve counties were not included in the pool of farmers during the survey process due to lack of sufficient corn or soybeans acres. These counties were Aitkin, Anoka, Carlton, Cass, Cook, Hubbard, Itasca, Koochiching, Lake, Lake of the Woods, Ramsey, and St. Louis. No counties in the PMR 3 were included in the survey.

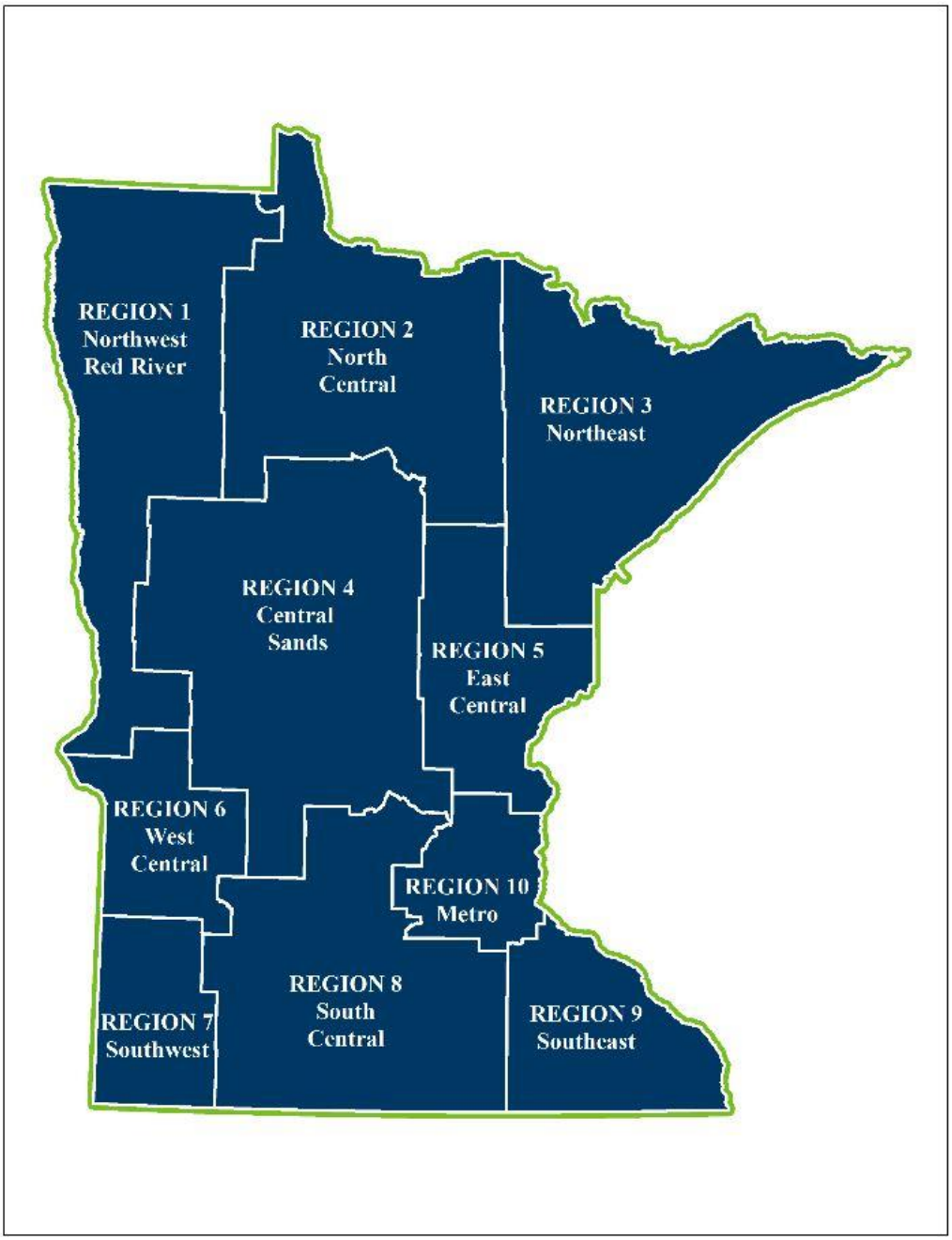

Figure 1. MDA Pesticide Management Regions (PMRs)

NASS developed the survey sample of 7,600 farms. This was done by selecting approximately 101 farms from each of 75 agricultural counties surveyed in this report. These 75 counties had sufficient acres of either soybeans or corn in order to be contacted during the survey. All farmers from each county who grew one or both of the target crops (soybeans and corn) were eligible to be selected. This number provided a large enough pool to reach the desired goal of obtaining statistically weighted data for all farms that grew corn or soybeans in 2019.

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 soybeans acres, but could not find the records for the insecticides applied to the corn crop. In this scenario, the soybeans acres would be used and the corn acres would dropped from the data set.

Table 1 summarizes the number of crop acres and operations by PMR region for both the corn and soybeans crops in 2019.

Table 1. Farms and crop acreage by PMR

PMR	Number of Farms Planted Corn	Corn Acres	Number of Farms Planted Soybeans	Soybeans Acres
1	1,774	802,358	3,012	1,790,360
2	107	6,946	131	46,866
4	5,885	1,114,026	3,879	769,266
5	864	127,794	659	75,508
6	2,124	831,184	1,987	558,129
7	2,624	747,410	2,715	600,092
8	9,267	2,911,212	8,886	2,344,653
9	4,081	1,024,162	2,887	513,464
10	1,090	234,909	914	151,660
State	**27,815**	**7,800,000**	**25,069**	**6,850,000**

Table 2 summarizes the acres of corn and soybeans grown in the 2019 crop year; the total acres of herbicides; insecticides; fungicides; and the corresponding percent of treated acres from total crop acres.

Table 2. Summary of acres and corresponding percent of each major crop receiving pesticide applications for the 2019 crop year

Crop	Total Minnesota Acres	Herbicide Acres Treated	Applied (Percent)	Insecticide Acres Treated	Applied (Percent)	Fungicide Acres Treated	Applied (Percent)
Corn	7,800,000	7,646,649	(98%)	1,235,663	(16%)	1,095,420	(14%)
Soybeans	6,850,000	6,783,563	(99%)	1,340,828	(20%)	1,286,664	(19%)
Totals	14,650,000	14,430,212	(98%)	2,576,491	(18%)	2,382,084	(16%)

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 contact. The interviews typically would last 5 to 10 minutes.

1. Farmers were first asked to identify the number of acres of soybeans and corn grown in the 2019 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 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: corn, soybeans, wheat, and soybeans;
- There are multiple product names that use the same active ingredients but frequently have different label rates and use restrictions. For example, Monsanto (now Bayer) 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 Bayer (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 be sold as liquid or solid formulas. Rates must be recorded in the correct unit during the survey process. For example, Harness, Harness Xtra, and Harness Xtra 5.6L are sold as a liquid. This maximum legal application rate of Harness is 2.75 pints/acre, while Harness Xtra and Harness Xtra 5.6L is 2.3 and 3.0 quarts/acre, respectively. Further confusing data collection, Harness 20G is a granular formulation with a maximum rate of 14 pounds/acre.

Data Reporting and Limitations

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

As previously mentioned, there were 14,650,000 crop acres are represented in the 2019 Minnesota survey. Farmers that grew soybeans or corn were randomly selected from county lists of producers accessed by NASS.

This was the second year the Minnesota survey was weighted by NASS. The NASS surveys are designed to statistically represent a non-homogenous population, thus data is "weighted" to account for sample size, county size, crop acreage, nonresponse, etc. Such strategies better represent all Minnesota farmers with these two crops by giving a statistical weight to each operation based standard protocol for NASS weighting of the data.[3] The data in this study was weighted to adjust for those factors.

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, following this general pesticide strategy, some producers in south central Minnesota (PMR 8) use a pre-emergence soil-applied herbicide for grass control, and follow up with a post-emergence foliar application for broadleaves. This reports captures each of those applications individually. It does not capture which acres had both a product for pre-emergence and a product for post-emergnece. Acetochlor products, such as Harness or Warrant, were reported in this area on 57% of the corn acres and glyphosate (such as Roundup Weather Max or Powermax) was reported on 76% 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, HalexGT might be applied to an 80 acre field, with RoundUp Power Max applied to a 60-acre subset of the same field. Both products contain glyphosate but because two different products were used, the additive total of glyphosate (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 corn. In this survey, there were 1.1 applications of glyphosate per year on corn (76%) of all surveyed soybean acres at a rate of 1.01 pounds/acre for each application.

[3] 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

Statewide Pesticide Applications – Corn

Many pesticide active ingredients can be used in the production of corn. Corn 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.

Table 3. Publication status for corn pesticide active ingredients[4]

Active Ingredient	Published	Active Ingredient	Published
Herbicide		**Insecticide**	
2,4-D	P	Beta-cyfluthrin	*
Acetochlor	P	Bifenthrin	P
Atrazine	P	Chlorethoxyfos	*
Bicyclopyrone	P	Chlorpyrifos	P
Bromoxynil	*	Cyfluthrin	P
Clopyralid	P	Esfenvalerate	*
Dicamba	P	Lambda-cyhalothrin	P
Diflufenzopyr	P	Permethrin	*
Dimethenamid-P	P	Tebupirimphos	P
Flumetsulam	P	Tefluthrin	P
Flumioxazin	P	Terbufos	*
Fluroxypyr	*	Thiamethoxam	*
Glufosinate-ammonium	P	Zeta-cypermethrin	*
Glyphosate	P		
Halosulfuron	*	**Fungicide**	
Isoxaflutole	*	Azoxystrobin	P
Mesotrione	P	Benzovindiflupyr	P
Metolachlor	P	Captan	*
Metribuzin	*	Chlorothalonil	*
Nicosulfuron	P	Cyproconazole	*
Pendimethalin	*	Fluoxastrobin	*
Primisulfuron	*	Flutriafol	*
Pyroxasulfone	P	Fluxapyroxad	P
Quizalofop	*	Mancozeb	*
Rimsulfuron	P	Metconazole	P
S-Metolachlor	P	Picoxystrobin	P
Saflufenacil	P	Propiconazole	P
Tembotrione	P	Prothioconazole	P
Thiencarbazone-methyl	P	Pyraclostrobin	P
Topramezone	P	Tetraconazole	*
Trifluralin	*	Trifloxystrobin	P

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

A statewide summary of corn pesticide applications is provided in Table 4. Minnesota farmers grew 7,800,000 acres of corn for the 2019 season. Herbicides were applied to 98% of all corn acres; insecticides were applied to 16% of all acres; and fungicides were applied to 14% of all acres.

Table 4. Pesticide applications and rates by active ingredient (a.i.) for corn statewide[5]

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicides					
2,4-D	1	1.1	0.67	0.71	57,483
Acetochlor	57	1.0	1.17	1.17	5,231,773
Atrazine	15	1.0	0.60	0.60	720,048
Bicyclopyrone	6	1.0	0.04	0.04	16,991
Clopyralid	45	1.0	0.09	0.09	323,518
Dicamba	8	1.0	0.17	0.17	111,013
Diflufenzopyr	6	1.0	0.05	0.05	22,061
Dimethenamid-p	11	1.0	0.62	0.62	535,881
Flumetsulam	27	1.0	0.03	0.03	62,493
Flumioxazin	1	1.0	0.07	0.07	3,879
Glufosinate-ammonium	6	1.1	0.49	0.51	245,602
Glyphosate	76	1.1	1.01	1.13	6,665,586
Mesotrione	48	1.0	0.12	0.12	442,523
Metolachlor	<1	1.0	1.17	1.17	21,181
Nicosulfuron	<1	1.0	0.04	0.04	625
Pyroxasulfone	<1	1.0	0.07	0.07	2,081
Rimsulfuron	<1	1.0	0.02	0.02	450
S-metolachlor	22	1.0	1.05	1.05	1,841,898
Saflufenacil	6	1.0	0.06	0.06	25,250
Tembotrione	20	1.0	0.08	0.08	122,754
Thiencarbazone-methyl	1	1.0	0.01	0.01	1,167
Topramezone	6	1.0	0.08	0.08	35,878
Insecticides					
Bifenthrin	5	1.0	0.06	0.06	25,787
Chlorpyrifos	4	1.0	0.30	0.30	83,681
Cyfluthrin	2	1.0	0.01	0.01	672
Lambda-cyhalothrin	4	1.0	0.03	0.03	10,132
Tebupirimphos	2	1.0	0.10	0.10	13,188
Tefluthrin	3	1.0	0.11	0.11	29,554
Fungicides					
Azoxystrobin	4	1.0	0.09	0.09	29,043
Benzovindiflupyr	3	1.0	0.03	0.03	6,449
Fluxapyroxad	1	1.0	0.09	0.09	4,025
Metconazole	4	1.0	0.04	0.04	10,709
Picoxystrobin	<1	1.0	0.09	0.09	1,648
Propiconazole	5	1.0	0.10	0.10	35,861

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

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Fungicides					
Prothioconazole	3	1.0	0.12	0.12	30,096
Pyraclostrobin	5	1.0	0.12	0.12	41,172
Trifloxystrobin	3	1.0	0.09	0.09	23,067

Herbicides applied but not published included the following: Bromoxynil, Fluroxypyr, Halosulfuron, Isoxaflutole, Metribuzin, Pendimethalin, Primisulfuron, Quizalofop, and Trifluralin.

Insecticides applied but not published included the following: Beta-cyfluthrin, Chlorethoxyfos, Esfenvalerate, Permethrin, Terbufos, Thiamethoxam, and Zeta-cypermethrin.

Fungicides applied but not published included the following: Captan, Chlorothalonil, Cyproconazole, Fluoxastrobin, Flutriafol, Mancozeb, and Tetraconazole.

Atrazine, acetochlor, and s-metolachlor are three commonly used herbicides for which the MDA has developed specific voluntary Best Management Practices to protect groundwater and surface water resources. Due to the additional concerns regarding the use of these products, their use frequencies are compared below. Figure 2 illustrates the range of rates reported for atrazine use on corn for 2003, 2005, 2007, 2009, 2011, 2013, 2015, and 2019.[6]

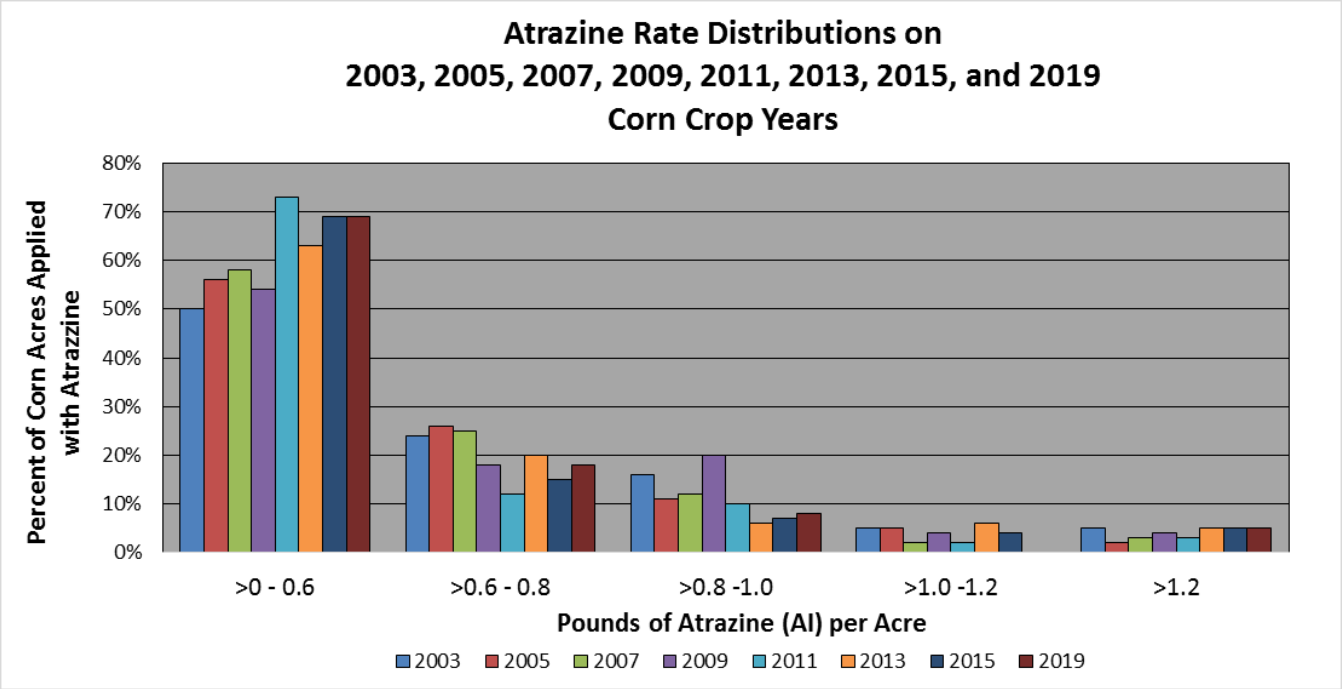

Figure 2. Atrazine rate per acre distribution across surveyed corn acres for the 2003, 2005, 2007, 2009, 2011, 2013, 2015, and 2019 crop years

Atrazine use in Minnesota on corn acres have fallen from 30% in 2003 to 15% in 2019. The application rate has fallen from 0.67 pounds per acre in 2003 to 0.60 pounds per acres in 2019.

[6] Prior to 2019, corn pesticide survey data was reported by random selection. In 2019, corn acres were weighted in accordance with NASS reporting methodology.

Acetochlor use in Minnesota is detailed in Figure 3, which illustrates the range of acetochlor rates reported for in the 2003, 2005, 2007, 2009, 2011, 2013, 2015, and 2019 crop years.[7]

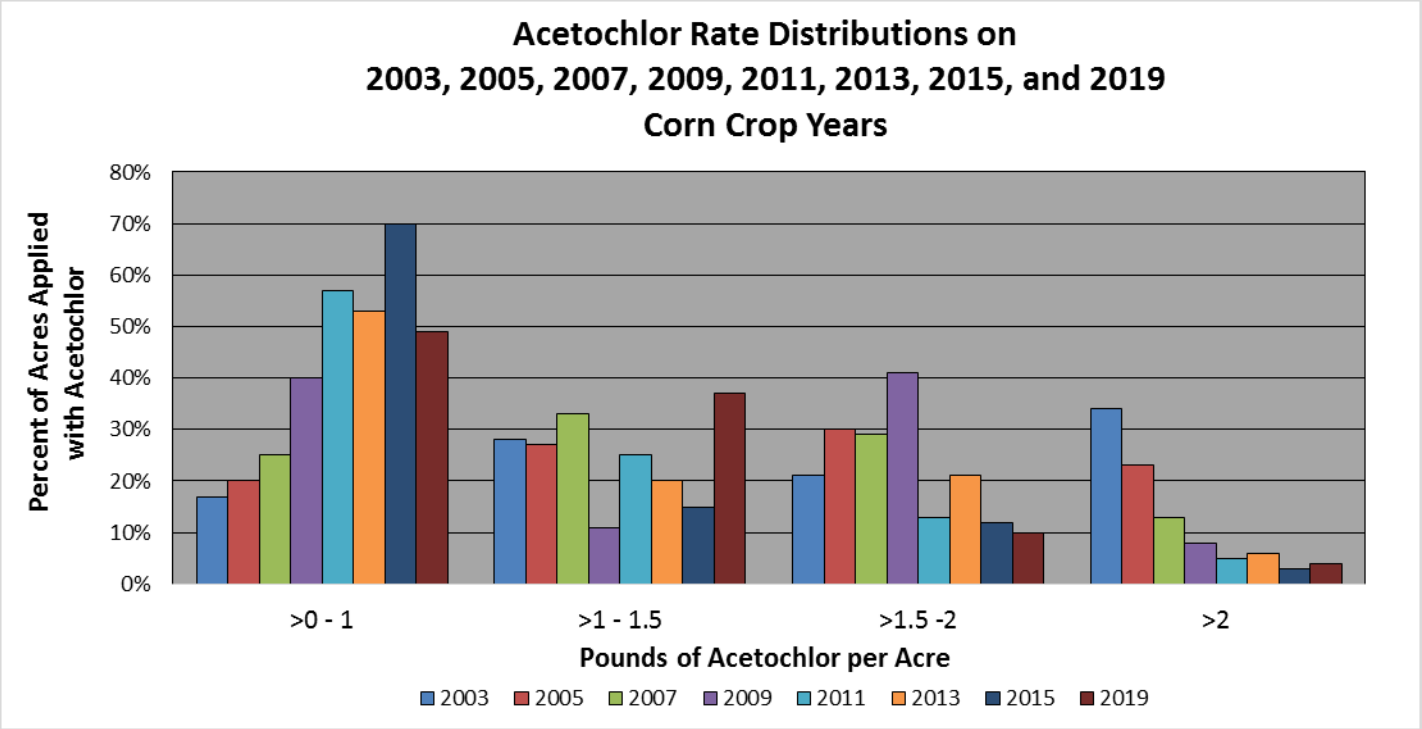

Figure 3. Acetochlor rate per acre distribution across corn acres for the 2003, 2005, 2007, 2009, 2011, 2013, 2015, and 2019 crop years

Acetochlor use in Minnesota on corn acres have risen from 25% in 2003 to 51% in 2019. The application rate has fallen from 1.63 pounds per acre in 2003 to 1.10 pounds per acre in 2019.

[7] Prior to 2019, corn pesticide survey data was reported by random selection. In 2019, corn acres were weighted in accordance with NASS reporting methodology.

S-metolachlor use in Minnesota is detailed in Figure 4, which illustrates the range of s-metolachlor rates reported for in the 2003, 2005, 2007, 2009, 2011, 2013, 2015, and 2019 crop years.[8]

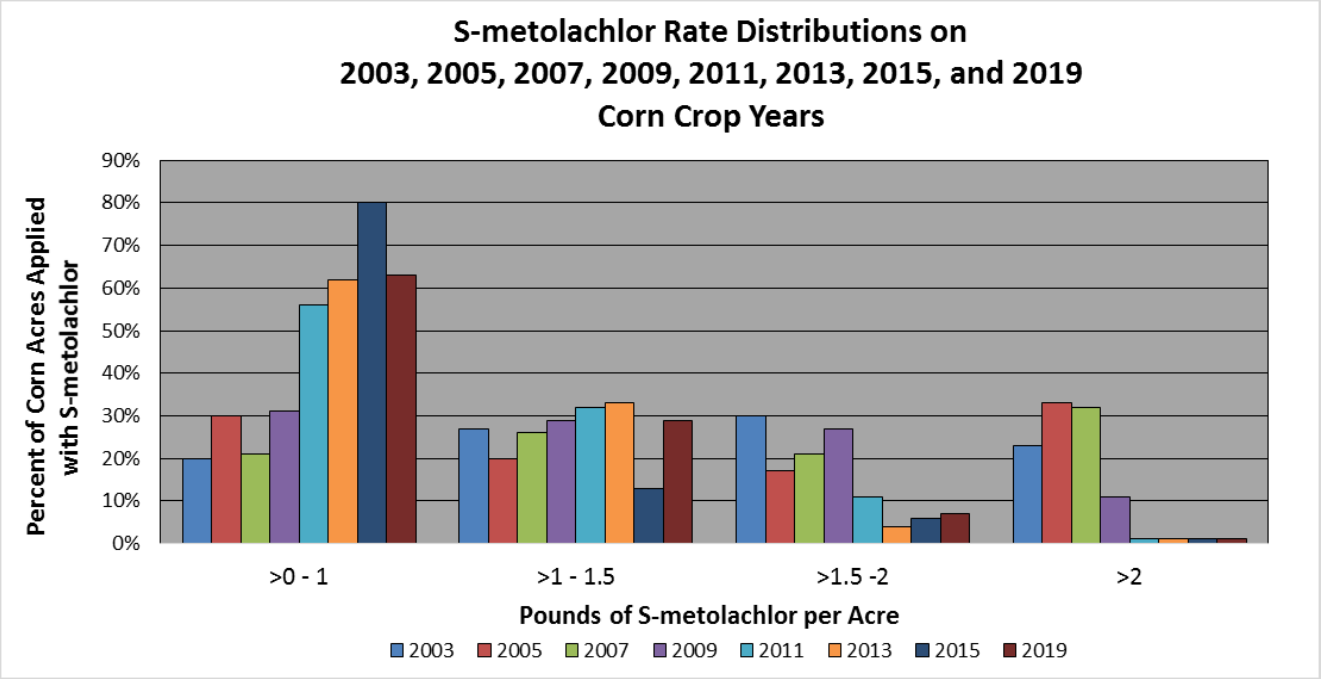

Figure 4. S-metolachlor rate per acre distribution across corn acres for the 2003, 2005, 2007, 2009, 2011, 2013, 2015, and 2019 crop years

S-metolachlor use in Minnesota on corn acres have risen from 12% in 2003 to 22% in 2019. The application rate has fallen from 1.67 pounds per acre in 2003 to 1.05 pounds per acre in 2019.

[8] Prior to 2019, corn pesticide survey data was reported by random selection. In 2019, corn acres were weighted in accordance with NASS reporting methodology.

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.

Pesticide Applications on Corn by Pesticide Management Regions

Table 5 details the number of 2019 statistically weighted respondents with usable reports in each Pesticide Management Region (PMR), the number of weighted corn acres in each area, and the number of weighted corn acres receiving herbicides, insecticides and fungicides. Tables 6 – 14 provide corn 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.

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

PMR	Number of Respondents	Corn Acres	Herbicide Acres	Insecticide Acres	Fungicide Acres
1	1,774	802,358	795,287	90,550	44,661
2	107	6,946	6,749	**	**
4	5,885	1,114,026	1,077,778	17,590	35,886
5	864	127,794	123,253	**	**
6	2,124	831,184	801,502	106,287	77,848
7	2,624	747,410	727,098	267,736	82,571
8	9,266	2,911,211	2,879,594	463,587	512,523
9	4,081	1,024,162	1,005,098	269,590	323,581
10	1,090	234,909	230,290	16,507	18,146
Totals	27,815	7,800,000	7,646,649	1,235,663	1,095,420

'**' Less than five responses

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

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicides					
Acetochlor	51	1.0	1.10	1.10	452,225
Atrazine	22	1.0	0.56	0.56	98,467
Bicyclopyrone	4	1.0	0.04	0.04	1,199
Clopyralid	45	1.0	0.09	0.09	31,199
Dicamba	15	1.0	0.24	0.24	29,734
Diflufenzopyr	11	1.0	0.06	0.06	5,031
Dimethenamid-p	12	1.0	0.68	0.68	66,483
Flumetsulam	27	1.0	0.03	0.03	6,145
Glyphosate	81	1.1	1.00	1.13	730,065
Mesotrione	44	1.0	0.11	0.11	37,283
S-metolachlor	23	1.0	0.90	0.90	165,956
Saflufenacil	4	1.0	0.05	0.05	1,792
Tembotrione	23	1.0	0.08	0.08	14,289
Thiencarbazone-methyl	3	1.0	0.02	0.02	436
Topramezone	8	1.0	0.01	0.01	961

Herbicides applied but not published included the following: 2,4-D, Bromoxynil, Fluroxypyr, Glufosinate-ammonium, and Metolachlor.

Insecticides applied but not published included the following: Chlorpyrifos, Cyfluthrin, Lambda-cyhalothrin, Tebupirimphos, and Zeta-cypermethrin.

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

Table 7. Pesticide applications and rates for corn – PMR 2

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicides					
Acetochlor	6	1.0	0.88	0.88	344
Glyphosate	92	1.1	0.97	1.07	6,812

Herbicides applied but not published included the following: Atrazine, Bicyclopyrone, Clopyralid, Dicamba, Diflufenzopyr, Dimethenamid-p, Flumetsulam, Glufosinate-ammonium, Mesotrione, S-metolachlor, and Saflufenacil.

Insecticides applied but not published included the following: Tefluthrin.

Fungicides applied but not published included the following: Captan.

Table 8. Pesticide applications and rates for corn – PMR 4

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicides					
Acetochlor	35	1.0	1.07	1.08	425,810
Atrazine	14	1.0	0.64	0.64	97,748
Bicyclopyrone	8	1.0	0.04	0.04	3,587
Clopyralid	34	1.0	0.08	0.09	31,752
Dicamba	14	1.0	0.15	0.15	23,320
Diflufenzopyr	9	1.0	0.04	0.04	4,479
Dimethenamid-p	6	1.0	0.70	0.70	44,436
Flumetsulam	25	1.0	0.03	0.03	8,498
Flumioxazin	1	1.0	0.08	0.08	858
Glufosinate-ammonium	18	1.0	0.51	0.51	101,482
Glyphosate	85	1.1	1.05	1.14	1,077,874
Mesotrione	35	1.0	0.12	0.12	46,257
S-metolachlor	17	1.0	1.22	1.22	228,189
Saflufenacil	2	1.0	0.06	0.06	1,267
Tembotrione	13	1.0	0.08	0.08	11,606
Thiencarbazone-methyl	1	1.0	0.02	0.02	142
Topramezone	6	1.0	0.16	0.16	9,621

Herbicides applied but not published included the following: 2,4-D, Isoxaflutole, Metolachlor, Nicosulfuron, Pendimethalin, Pyroxasulfone, Rimsulfuron, and Trifluralin.

Insecticides applied but not published included the following: Bifenthrin, Chlorpyrifos, Lambda-Cyhalothrin, Tefluthrin, Terbufos, and Thiamethoxam.

Fungicides applied but not published included the following: Azoxystrobin, Benzovindiflupyr, Chlorothalonil, Cyproconazole, Mancozeb, Metconazole, Picoxystrobin, Propiconazole, Prothioconazole, and Pyraclostrobin.

Table 9. Pesticide applications and rates for corn – PMR 5

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicide					
Acetochlor	43	1.0	1.09	1.09	60,031
Atrazine	11	1.1	0.53	0.54	7,350
Clopyralid	42	1.0	0.08	0.08	4,298
Flumetsulam	35	1.0	0.03	0.03	1,223
Glyphosate	89	1.1	1.04	1.21	137,679
Mesotrione	38	1.0	0.10	0.10	5,014
S-metolachlor	18	1.0	0.93	0.95	22,333
Tembotrione	15	1.0	0.07	0.07	1,446

Herbicides applied but not published included the following: 2,4-D, Bicyclopyrone, Dicamba, Diflufenzopyr, Dimethenamid-p, Flumioxazin, Glufosinate-Ammonium, Metolachlor, Nicosulfuron, Primisulfuron, Rimsulfuron, Saflufenacil, Thiencarbazone-methyl, and Topramezone.

Insecticides applied but not published included the following: Chlorpyrifos and Permethrin.

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

Table 10. Pesticide applications and rates for corn – PMR 6

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicides					
Acetochlor	69	1.0	1.21	1.21	692,798
Atrazine	5	1.0	0.47	0.47	18,565
Clopyralid	42	1.0	0.09	0.09	30,368
Dimethenamid-p	13	1.0	0.75	0.75	81,523
Flumetsulam	29	1.0	0.03	0.03	7,544
Glufosinate-ammonium	3	1.6	0.51	0.80	17,474
Glyphosate	76	1.0	1.02	1.04	656,151
Mesotrione	29	1.0	0.12	0.12	29,154
S-metolachlor	9	1.0	1.05	1.05	75,283
Tembotrione	39	1.0	0.08	0.08	26,351

Herbicides applied but not published included the following: Bicyclopyrone, Dicamba, Diflufenzopyr, Metolachlor, Nicosulfuron, Saflufenacil, Thiencarbazone-methyl, and Topramezone.

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

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

Table 11. Pesticide applications and rates for corn – PMR 7

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicide					
Acetochlor	75	1.0	1.33	1.33	741,593
Atrazine	17	1.0	0.73	0.73	95,038
Clopyralid	63	1.0	0.10	0.10	48,767
Dicamba	6	1.0	0.22	0.22	10,145
Diflufenzopyr	5	1.0	0.05	0.05	2,094
Dimethenamid-p	10	1.0	0.63	0.63	45,895
Flumetsulam	34	1.0	0.03	0.03	7,945
Glufosinate-ammonium	4	1.1	0.44	0.50	13,365
Glyphosate	68	1.1	1.06	1.15	587,083
Mesotrione	59	1.0	0.14	0.14	61,557
S-metolachlor	13	1.0	1.22	1.22	116,564
Tembotrione	5	1.0	0.08	0.08	3,151
Topramezone	6	1.0	0.01	0.01	682
Insecticide					
Bifenthrin	9	1.0	0.03	0.03	2,007
Chlorpyrifos	4	1.0	0.28	0.28	7,900
Fungicide					
Azoxystrobin	6	1.0	0.08	0.08	3,674
Propiconazole	7	1.0	0.08	0.08	3,933

Herbicides applied but not published included the following: 2,4-D, Bicyclopyrone, Rimsulfuron, Saflufenacil, and Thiencarbazone-methyl.

Insecticides applied but not published included the following: Chlorethoxyfos, Cyfluthrin, Lambda-cyhalothrin, Tebupirimphos, Tefluthrin, and Thiamethoxam.

Fungicides applied but not published included the following: Benzovindiflupyr, Fluxapyroxad, Prothioconazole, Pyraclostrobin, and Trifloxystrobin.

Table 12. Pesticide applications and rates for corn – PMR 8

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicide					
Acetochlor	66	1.0	1.16	1.16	2,236,409
Atrazine	17	1.0	0.48	0.48	243,086
Bicyclopyrone	8	1.0	0.04	0.04	8,209
Clopyralid	46	1.0	0.10	0.10	130,939
Dicamba	5	1.0	0.20	0.20	30,129
Diflufenzopyr	4	1.0	0.04	0.04	5,362
Dimethenamid-p	13	1.0	0.56	0.56	215,007
Flumetsulam	28	1.0	0.03	0.03	24,414
Glufosinate-ammonium	7	1.0	0.47	0.48	96,888
Glyphosate	70	1.1	1.00	1.09	2,218,988
Mesotrione	55	1.0	0.12	0.12	187,014
S-metolachlor	29	1.0	1.07	1.07	888,927
Saflufenacil	9	1.0	0.06	0.06	14,804
Tembotrione	25	1.0	0.08	0.08	59,387
Thiencarbazone-methyl	1	1.0	0.01	0.01	357
Topramezone	3	1.0	0.02	0.02	1,433
Insecticide					
Bifenthrin	8	1.0	0.07	0.07	16,427
Chlorpyrifos	7	1.0	0.26	0.26	50,767
Lambda-cyhalothrin	1	1.0	0.02	0.02	686
Tefluthrin	3	1.0	0.13	0.13	10,829
Fungicide					
Azoxystrobin	3	1.0	0.11	0.11	9,023
Benzovindiflupyr	3	1.1	0.03	0.04	3,133
Metconazole	5	1.0	0.03	0.03	4,478
Propiconazole	4	1.0	0.10	0.10	10,858
Prothioconazole	4	1.0	0.11	0.11	14,141
Pyraclostrobin	6	1.0	0.11	0.11	17,855
Trifloxystrobin	4	1.0	0.08	0.08	10,203

Herbicides applied but not published included the following: 2,4-D, Flumioxazin, Isoxaflutole, Metribuzin, Nicosulfuron, Primisulfuron, Pyroxasulfone, and Quizalofop.

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

Fungicides applied but not published included the following: Chlorothalonil, Cyproconazole, Fluxapyroxad, and Picoxystrobin.

Table 13. Pesticide applications and rates for corn – PMR 9

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicide					
Acetochlor	40	1.0	1.12	1.18	484,866
Atrazine	16	1.0	0.90	0.90	148,546
Bicyclopyrone	5	1.0	0.03	0.03	1,659
Clopyralid	38	1.0	0.08	0.08	33,404
Dicamba	11	1.0	0.11	0.11	12,056
Diflufenzopyr	8	1.0	0.04	0.04	3,296
Dimethenamid-p	11	1.0	0.58	0.58	65,264
Flumetsulam	17	1.0	0.03	0.03	4,990
Glyphosate	83	1.2	0.99	1.21	1,026,608
Mesotrione	49	1.0	0.11	0.12	59,257
S-metolachlor	27	1.0	0.97	0.97	267,062
Saflufenacil	9	1.0	0.06	0.06	5,218
Tembotrione	7	1.0	0.08	0.08	5,763
Insecticide					
Bifenthrin	6	1.0	0.07	0.07	4,256
Chlorpyrifos	4	1.0	0.47	0.47	16,989
Lambda-cyhalothrin	6	1.0	0.02	0.02	1,319
Tefluthrin	12	1.0	0.11	0.11	13,699
Fungicide					
Azoxystrobin	15	1.0	0.08	0.08	12,310
Benzovindiflupyr	8	1.0	0.03	0.03	2,091
Metconazole	9	1.0	0.04	0.04	3,949
Propiconazole	16	1.0	0.10	0.10	16,635
Prothioconazole	7	1.0	0.14	0.14	10,271
Pyraclostrobin	10	1.0	0.12	0.12	12,426
Trifloxystrobin	6	1.0	0.12	0.12	7,732

Herbicides applied but not published included the following: 2,4-D, Glufosinate-ammonium, Halosulfuron, Nicosulfuron, Rimsulfuron, and Thiencarbazone-methyl.

Insecticides applied but not published included the following: Cyfluthrin and Tebupirimphos.

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

Table 14. Pesticide applications and rates for corn – PMR 10

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicide					
Acetochlor	55	1.0	1.06	1.06	137,696
Atrazine	9	1.0	0.54	0.54	11,080
Bicyclopyrone	4	1.0	0.04	0.04	363
Clopyralid	60	1.0	0.09	0.09	12,765
Dicamba	9	1.0	0.13	0.13	2,591
Diflufenzopyr	9	1.0	0.05	0.05	1,036
Dimethenamid-p	9	1.0	0.73	0.73	15,828
Flumetsulam	25	1.0	0.03	0.03	1,723
Glyphosate	78	1.2	0.97	1.22	224,326
Mesotrione	68	1.0	0.11	0.11	16,888
S-metolachlor	33	1.0	1.01	1.01	77,025
Saflufenacil	6	1.0	0.03	0.03	457
Tembotrione	4	1.0	0.08	0.08	761

Herbicides applied but not published included the following: 2,4-D, Flumioxazin, Glufosinate-ammonium, Metolachlor, Pyroxasulfone, Rimsulfuron, Thiencarbazone-methyl, and Topramezone.

Insecticides applied but not published included the following: Chlorpyrifos, Cyfluthrin, Esfenvalerate, Lambda-cyhalothrin, Tebupirimphos, Tefluthrin, and Thiamethoxam.

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

Statewide Pesticide Applications – Soybeans

Many pesticide active ingredients can be used in the production of soybeans. Soybeans producers responding to the survey associated with this report may have used one or more of the active ingredients listed in Table 15; 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.

Table 15. Publication status for soybeans pesticide active ingredients[9]

Active Ingredient	Published	Active Ingredient	Published
Herbicide		**Insecticide**	
2,4-D	P	Beta-cyfluthrin	*
Acetochlor	P	Bifenthrin	P
Acifluorfen	P	Chlorpyrifos	P
Bentazon	P	Cyfluthrin	*
Chlorimuron	P	Esfenvalerate	P
Clethodim	P	Gamma-cyhalothrin	P
Cloransulam	P	Imidacloprid	P
Dicamba	P	Lambda-cyhalothrin	P
Dimethenamid-p	P	Permethrin	*
Fenoxaprop	*	Thiamethoxam	P
Fluazifop	P	Zeta-cypermethrin	*
Flumioxazin	P		
Fluthiacet-methyl	P	**Fungicide**	
Fomesafen	P	Azoxystrobin	P
Glufosinate-ammonium	P	Benzovindiflupyr	P
Glyphosate	P	Boscalid	P
Imazamox	*	Chlorothalonil	*
Imazethapyr	P	Cyproconazole	*
Lactofen	P	Difenoconazole	*
Metolachlor	P	Fluoxastrobin	*
Metribuzin	P	Fluxapyroxad	P
Pendimethalin	P	Metconazole	*
Pyroxasulfone	P	Picoxystrobin	P
Quizalofop	*	Propiconazole	P
S-metolachlor	P	Prothioconazole	P
Saflufenacil	P	Pyraclostrobin	P
Sulfentrazone	P	Tebuconazole	*
Herbicides		**Fungicides**	
Thifensulfuron	P	Tetraconazole	P
Topramezone	*	Thiophanate-methyl	*
Trifluralin	P	Trifloxystrobin	P

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

A statewide summary of soybeans pesticide applications is provided in Table 16. Minnesota farmers grew 6,850,000 acres of soybeans for the 2019 season. Herbicides were applied to 99% of all soybeans acres. Insecticides were applied to 20% of all acres and 19% of acres were recorded as being applied with fungicides.

Table 16. Pesticide applications and rates by active ingredient (a.i.) for soybeans statewide[10]

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicides					
2,4-D	4	1.0	0.79	0.81	207,013
Acetochlor	9	1.0	0.96	0.99	592,795
Acifluorfen	1	1.0	0.31	0.32	14,026
Bentazon	1	1.0	0.77	0.77	35,484
Chlorimuron	1	1.0	0.00	0.00	215
Clethodim	7	1.0	0.12	0.12	60,090
Cloransulam	28	1.0	0.02	0.02	38,758
Dicamba	23	1.0	0.49	0.50	779,313
Dimethenamid-p	6	1.0	0.35	0.39	163,511
Fluazifop	4	1.0	0.07	0.07	17,942
Flumioxazin	3	1.0	0.07	0.07	16,926
Fluthiacet-methyl	1	1.0	0.01	0.01	202
Fomesafen	25	1.0	0.18	0.19	321,002
Glufosinate-ammonium	21	1.1	0.49	0.56	803,440
Glyphosate	71	1.3	0.95	1.26	6,130,778
Imazethapyr	9	1.0	0.05	0.05	31,676
Lactofen	3	1.0	0.12	0.12	20,973
Metolachlor	2	1.1	1.37	1.44	244,762
Metribuzin	8	1.0	0.24	0.25	139,713
Pendimethalin	1	1.0	1.04	1.04	55,525
Pyroxasulfone	5	1.0	0.10	0.10	38,685
S-metolachlor	12	1.1	1.25	1.31	1,062,327
Saflufenacil	11	1.0	0.03	0.03	22,012
Sulfentrazone	31	1.0	0.16	0.16	339,063
Thifensulfuron	1	1.0	0.01	0.01	681
Trifluralin	1	1.0	0.70	0.70	25,464
Insecticides					
Bifenthrin	2	1.0	0.06	0.06	9,075
Chlorpyrifos	12	1.0	0.45	0.47	368,855
Esfenvalerate	0	1.0	0.03	0.03	849
Gamma-cyhalothrin	1	1.0	0.01	0.01	283
Lambda-cyhalothrin	6	1.0	0.02	0.02	9,617
Thiamethoxam	1	1.0	0.03	0.03	1,656
Fungicides					
Azoxystrobin	4	1.0	0.10	0.10	25,550
Fungicides					

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

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Benzovindiflupyr	1	1.0	0.03	0.03	2,758
Boscalid	2	1.1	0.24	0.27	30,622
Fluxapyroxad	3	1.0	0.05	0.05	11,055
Picoxystrobin	1	1.0	0.10	0.10	4,295
Propiconazole	5	1.0	0.09	0.09	31,240
Prothioconazole	5	1.0	0.10	0.10	33,613
Pyraclostrobin	5	1.0	0.11	0.11	41,715
Tetraconazole	2	1.0	0.06	0.06	7,060
Trifloxystrobin	4	1.0	0.08	0.08	24,238

Herbicides applied but not published included the following: Fenoxaprop, Imazamox, Quizalofop, and Topramezone.

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

Fungicides applied but not published included the following: Chlorothalonil, Cyproconazole, Difenoconazole, Fluoxastrobin, Metconazole, Tebuconazole, and Thiophanate-methyl.

To obtain a list of products (brand names) registered in Minnesota and containing the active ingredients listed in Tables 15 and 16, 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 Soybeans by Pesticide Management Region

Table 17 details the number of 2019 statistically weighted respondents with usable reports in each PMR, the number of weighted soybeans acres in each area, and the number of weighted soybeans acres receiving herbicides, insecticides and fungicides. Tables 18 – 26 provide soybeans 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.

Table 17. Summary (by PMR) of surveyed soybeans acreage to which pesticides were applied [11]

PMR	Number of Respondents	Soybeans Acres	Herbicide Acres	Insecticide Acres	Fungicide Acres
1	3,012	1,790,360	1,769,352	452,938	320,572
2	131	46,866	46,866	**	**
4	3,879	769,266	757,191	96,550	53,342
5	659	75,508	73,629	**	**
6	1,987	558,129	546,322	77,647	87,973
7	2,715	600,092	597,495	44,595	39,216
8	8,886	2,344,653	2,331,099	553,877	570,890
9	2,887	513,464	510,066	96,189	201,941
10	914	151,660	151,543	16,050	10,251
Totals	**25,069**	**6,850,000**	**6,783,563**	**1,340,828**	**1,286,664**

. '**' Less than five responses

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

Table 18. Pesticide applications and rates for soybeans – PMR 1

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicide					
2,4-D	4	1.0	0.79	0.79	59,310
Acetochlor	7	1.0	0.73	0.73	90,287
Clethodim	9	1.0	0.10	0.10	16,910
Cloransulam	13	1.0	0.02	0.02	5,386
Dicamba	26	1.0	0.50	0.50	235,981
Dimethenamid-p	7	1.0	0.30	0.32	38,181
Fluazifop	1	1.0	0.11	0.11	1,011
Flumioxazin	6	1.0	0.08	0.08	8,244
Fomesafen	13	1.0	0.18	0.18	42,193
Glufosinate-ammonium	10	1.4	0.49	0.67	125,093
Glyphosate	79	1.5	1.02	1.57	2,226,805
Imazamox	2	1.0	0.03	0.03	827
Imazethapyr	4	1.0	0.05	0.05	3,598
Metribuzin	7	1.0	0.24	0.24	31,167
Pyroxasulfone	5	1.0	0.09	0.09	8,619
S-metolachlor	10	1.0	1.23	1.23	210,084
Saflufenacil	12	1.0	0.03	0.03	6,202
Sulfentrazone	14	1.1	0.18	0.19	48,297
Insecticide					
Chlorpyrifos	17	1.1	0.43	0.47	139,407
Lambda-cyhalothrin	10	1.0	0.02	0.02	3,718
Fungicide					
Fluxapyroxad	5	1.0	0.05	0.05	4,899
Propiconazole	3	1.0	0.11	0.11	6,435
Pyraclostrobin	11	1.0	0.12	0.12	23,861
Tetraconazole	4	1.0	0.06	0.06	4,176

Herbicides applied but not published included the following: Acifluorfen, Bentazon, Chlorimuron, Fluthiacet-methyl, Imazamox, Lactofen, Metolachlor, Thifensulfuron, Trifluralin, and Trifloxystrobin.

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

Fungicides applied but not published included the following: Chlorothalonil, Fluoxastrobin, Prothioconazole, Tebuconazole, Thiophanate-methyl, and Trifloxystrobin.

Table 19. Pesticide applications and rates for soybeans – PMR 2

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicide					
Glyphosate	88	1.5	0.92	1.59	65,151

Herbicides applied but not published included the following: 2,4-D, Acetochlor, Acifluorfen, Bentazon, Cloransulam, Dicamba, Dimethenamid-p, Fomesafen, Glufosinate-ammonium, Imazamox, Imazethapyr, Lactofen, Metribuzin, Pendimethalin, Pyroxasulfone, S-metolachlor, Saflufenacil, and Sulfentrazone.

Insecticides applied but not published included the following: Bifenthrin and Chlorpyrifos.

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

Table 20. Pesticide applications and rates for soybeans – PMR 4

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicide					
2,4-D	10	1.1	0.81	0.88	64,618
Acetochlor	11	1.2	1.08	1.26	104,475
Clethodim	1	1.0	0.08	0.08	709
Cloransulam	37	1.0	0.02	0.02	5,213
Dicamba	14	1.0	0.48	0.49	52,332
Dimethenamid-p	2	1.2	0.30	0.47	7,385
Fomesafen	30	1.0	0.16	0.16	36,150
Glufosinate-ammonium	33	1.1	0.49	0.52	132,222
Glyphosate	71	1.3	0.87	1.11	611,207
Imazethapyr	3	1.0	0.05	0.05	1,335
Lactofen	5	1.0	0.11	0.11	4,409
Metribuzin	5	1.0	0.20	0.20	7,136
Pyroxasulfone	2	1.0	0.11	0.11	1,381
S-metolachlor	4	1.0	1.74	1.74	49,179
Saflufenacil	5	1.0	0.03	0.03	1,153
Sulfentrazone	41	1.0	0.15	0.15	46,687
Insecticide					
Chlorpyrifos	6	1.0	0.48	0.48	22,969

Herbicides applied but not published included the following: Acifluorfen, Chlorimuron, Fluazifop, Flumioxazin, Fluthiacet-methyl, Metolachlor, Quizalofop, and Thifensulfuron.

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

Fungicides applied but not published included the following: Boscalid, Chlorothalonil, Cyproconazole, Fluxapyroxad, Propiconazole, Prothioconazole, Pyraclostrobin, Tebuconazole, and Tetraconazole.

Table 21. Pesticide applications and rates for soybeans – PMR 5

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicide					
Chlorimuron	10	1.0	0.00	0.00	33
Cloransulam	7	1.0	0.02	0.02	85
Flumioxazin	10	1.0	0.06	0.06	431
Fomesafen	7	1.5	0.22	0.34	1,866
Glufosinate-ammonium	20	1.1	0.39	0.44	6,563
Glyphosate	93	1.3	1.00	1.33	93,407
S-metolachlor	18	1.0	1.46	1.46	19,484
Sulfentrazone	8	1.0	0.13	0.13	807
Thifensulfuron	13	1.0	0.01	0.01	112

Herbicides applied but not published included the following: 2,4-D, Acetochlor, Acifluorfen, Clethodim, Dimethenamid-p, Metolachlor, Metribuzin, Saflufenacil, and Trifluralin.

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

Fungicide applied but not published included the following: Propiconazole, Tetraconazole, and Trifloxystrobin.

Table 22. Pesticide applications and rates for soybeans – PMR 6

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicide					
Cloransulam	36	1.0	0.02	0.02	3,656
Dicamba	11	1.0	0.49	0.49	29,192
Dimethenamid-p	6	1.2	0.31	0.50	15,231
Fomesafen	23	1.0	0.17	0.17	22,343
Glufosinate-ammonium	42	1.2	0.48	0.59	139,801
Glyphosate	52	1.2	0.96	1.18	343,367
Imazethapyr	7	1.1	0.04	0.05	1,776
Pyroxasulfone	6	1.0	0.09	0.09	2,700
S-metolachlor	10	1.3	1.13	1.52	82,239
Saflufenacil	7	1.1	0.03	0.03	1,217
Sulfentrazone	45	1.1	0.13	0.14	36,101
Insecticide					
Chlorpyrifos	10	1.0	0.48	0.48	27,999
Lambda-cyhalothrin	2	1.0	0.02	0.02	260
Fungicide					
Propiconazole	13	1.0	0.05	0.05	3,394
Trifloxystrobin	11	1.0	0.10	0.10	5,811

Herbicides applied but not published included the following: 2,4-D, Acetochlor, Acifluorfen, Clethodim, Fluazifop, Flumioxazin, Lactofen, Metolachlor, Metribuzin, Quizalofop, Thifensulfuron, Topramezone, and Trifluralin.

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

Fungicide applied but not published included the following: Azoxystrobin, Benzovindiflupyr, Boscalid, Fluxapyroxad, Prothioconazole, and Pyraclostrobin.

Table 23. Pesticide applications and rates for soybeans – PMR 7

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicides					
Acetochlor	5	1.0	1.25	1.25	36,239
Clethodim	4	1.1	0.10	0.11	2,648
Cloransulam	42	1.0	0.02	0.02	5,272
Dicamba	14	1.0	0.50	0.50	42,597
Dimethenamid-p	4	1.0	0.43	0.43	10,603
Fluazifop	15	1.0	0.06	0.06	5,529
Fomesafen	28	1.0	0.20	0.20	33,066
Glufosinate-ammonium	28	1.1	0.45	0.48	81,614
Glyphosate	57	1.1	1.01	1.17	402,046
Imazethapyr	12	1.0	0.04	0.04	3,059
Metribuzin	13	1.2	0.18	0.21	16,337
Pyroxasulfone	7	1.0	0.11	0.11	4,232
S-metolachlor	10	1.1	1.15	1.26	72,356
Saflufenacil	6	1.0	0.03	0.03	1,062
Sulfentrazone	48	1.0	0.16	0.16	46,092

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

Insecticides applied but not published included the following: Bifenthrin, Chlorpyrifos, Imidacloprid, Lambda-cyhalothrin, Permethrin, and Zeta-cypermethrin.

Fungicide applied but not published included the following: Cyproconazole, Difenoconazole, Fluxapyroxad, Picoxystrobin, Propiconazole, Prothioconazole, Pyraclostrobin, Tetraconazole, and Trifloxystrobin.

Table 24. Pesticide applications and rates for soybeans – PMR 8

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicides					
2,4-D	3	1.0	0.82	0.82	54,014
Acetochlor	12	1.0	0.95	0.95	259,576
Clethodim	11	1.0	0.13	0.14	35,498
Cloransulam	32	1.0	0.02	0.02	14,890
Dicamba	31	1.0	0.49	0.50	364,023
Dimethenamid-p	8	1.0	0.37	0.38	67,609
Fluazifop	3	1.0	0.07	0.07	4,791
Fomesafen	30	1.1	0.18	0.19	130,280
Glufosinate-ammonium	22	1.0	0.52	0.54	280,686
Glyphosate	71	1.2	0.93	1.13	1,880,890
Imazethapyr	13	1.0	0.05	0.06	17,557
Lactofen	3	1.0	0.12	0.13	9,293
Metolachlor	2	1.2	1.14	1.41	60,268
Metribuzin	11	1.0	0.25	0.25	62,296
Pyroxasulfone	6	1.0	0.11	0.11	15,884
S-metolachlor	17	1.0	1.21	1.26	508,945
Saflufenacil	15	1.0	0.03	0.03	10,300
Sulfentrazone	34	1.0	0.16	0.16	129,014
Insecticides					
Bifenthrin	4	1.0	0.06	0.06	5,176
Chlorpyrifos	15	1.0	0.44	0.45	154,899
Lambda-cyhalothrin	6	1.0	0.02	0.02	3,106
Thiamethoxam	1	1.0	0.03	0.03	772
Fungicides					
Azoxystrobin	5	1.0	0.09	0.09	9,508
Benzovindiflupyr	2	1.0	0.03	0.03	1,122
Fluxapyroxad	2	1.0	0.06	0.06	2,538
Picoxystrobin	1	1.0	0.09	0.09	1,756
Propiconazole	5	1.0	0.09	0.09	11,698
Prothioconazole	12	1.0	0.10	0.10	28,922
Pyraclostrobin	3	1.0	0.10	0.10	8,178
Trifloxystrobin	8	1.0	0.07	0.07	14,698

Herbicides applied but not published included the following: Acifluorfen, Bentazon, Chlorimuron, Fenoxaprop, Flumioxazin, Fluthiacet-methyl, Imazamox, Pendimethalin, Quizalofop, Thifensulfuron, and Trifluralin.

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

Fungicide applied but not published included the following: Boscalid, Cyproconazole, Difenoconazole, Metconazole, Tetraconazole, and Thiophanate-methyl.

Table 25. Pesticide applications and rates for soybeans – PMR 9

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicides					
Acetochlor	12	1.0	1.18	1.18	74,317
Clethodim	2	1.0	0.12	0.12	1,316
Cloransulam	34	1.0	0.02	0.02	3,611
Dicamba	17	1.0	0.50	0.50	44,353
Dimethenamid-p	9	1.0	0.43	0.43	20,729
Fluazifop	9	1.0	0.07	0.07	3,238
Fomesafen	43	1.0	0.21	0.21	46,927
Glufosinate-ammonium	8	1.0	0.43	0.43	18,312
Glyphosate	70	1.2	0.90	1.09	393,865
Imazethapyr	13	1.0	0.05	0.05	3,495
Pyroxasulfone	8	1.0	0.11	0.11	4,586
S-metolachlor	13	1.0	1.51	1.54	104,455
Saflufenacil	13	1.0	0.03	0.03	1,735
Sulfentrazone	32	1.0	0.16	0.16	26,169
Insecticides					
Chlorpyrifos	7	1.0	0.47	0.47	17,477
Lambda-cyhalothrin	11	1.0	0.02	0.02	1,322
Thiamethoxam	5	1.0	0.03	0.03	792
Fungicides					
Azoxystrobin	13	1.0	0.10	0.10	7,154
Benzovindiflupyr	3	1.0	0.03	0.03	525
Fluxapyroxad	9	1.0	0.05	0.05	2,105
Propiconazole	17	1.0	0.10	0.10	8,942
Pyraclostrobin	11	1.0	0.11	0.11	5,891
Tetraconazole	4	1.0	0.06	0.06	1,246

Herbicides applied but not published included the following: 2,4-D, Acifluorfen, Chlorimuron, Fenoxaprop, Flumioxazin, Lactofen, Metribuzin, Pendimethalin, and Thifensulfuron.

Insecticides applied but not published included the following: Permethrin.

Fungicide applied but not published included the following: Boscalid, Difenoconazole, Picoxystrobin, Prothioconazole, Tebuconazole, and Trifloxystrobin.

Table 26. Pesticide applications and rates for soybeans – PMR 10

Agricultural Chemical (a.i.)	Planted Acres Treated *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.)
Herbicides					
Acetochlor	4	1.0	0.80	0.80	5,282
Clethodim	7	1.0	0.08	0.08	889
Cloransulam	24	1.0	0.02	0.02	635
Dicamba	11	1.0	0.50	0.50	8,672
Dimethenamid-p	3	1.2	0.47	0.60	3,128
Fomesafen	25	1.0	0.21	0.21	7,714
Glufosinate-ammonium	18	1.4	0.48	0.67	18,228
Glyphosate	72	1.2	0.87	1.04	114,041
Metolachlor	7	1.0	1.08	1.08	11,919
S-metolachlor	9	1.0	1.10	1.10	15,489
Saflufenacil	2	1.4	0.03	0.04	142
Sulfentrazone	27	1.0	0.14	0.14	5,650

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

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

Fungicide applied but not published included the following: Boscalid, Fluoxastrobin, Prothioconazole, Tetraconazole, and Trifloxystrobin.

2019 Insecticide Use Questions on Soybeans

The 2019 Insecticide Use Questions on Soybeans portion of the survey is for soybean farmers that applied insecticides to the 2019 soybean crop. This was a subset of the soybean farmers that were surveyed in February of 2020. There were 25,069 represented soybean farmers who planted 6,850,000 acres. This survey portion representes 4,661 soybean farmers with 1,340,828 acres that were applied with insecticides.

2019 Insecticide Use Questions and Answers

Application Method

Insecticides applied on soybean acres can be applied via ground application that is either self-propelled or can be pulled behind a tractor. Insecticides can also be applied aerially by either airplane or helicopter. Insecticides are self-applied or custom applied by a dealer or applicator. Generally, insecticides were applied through some type of ground application on soybean acres. Ground applications by farmers were the top response reported (Figure 5). [12](SIQ-1)

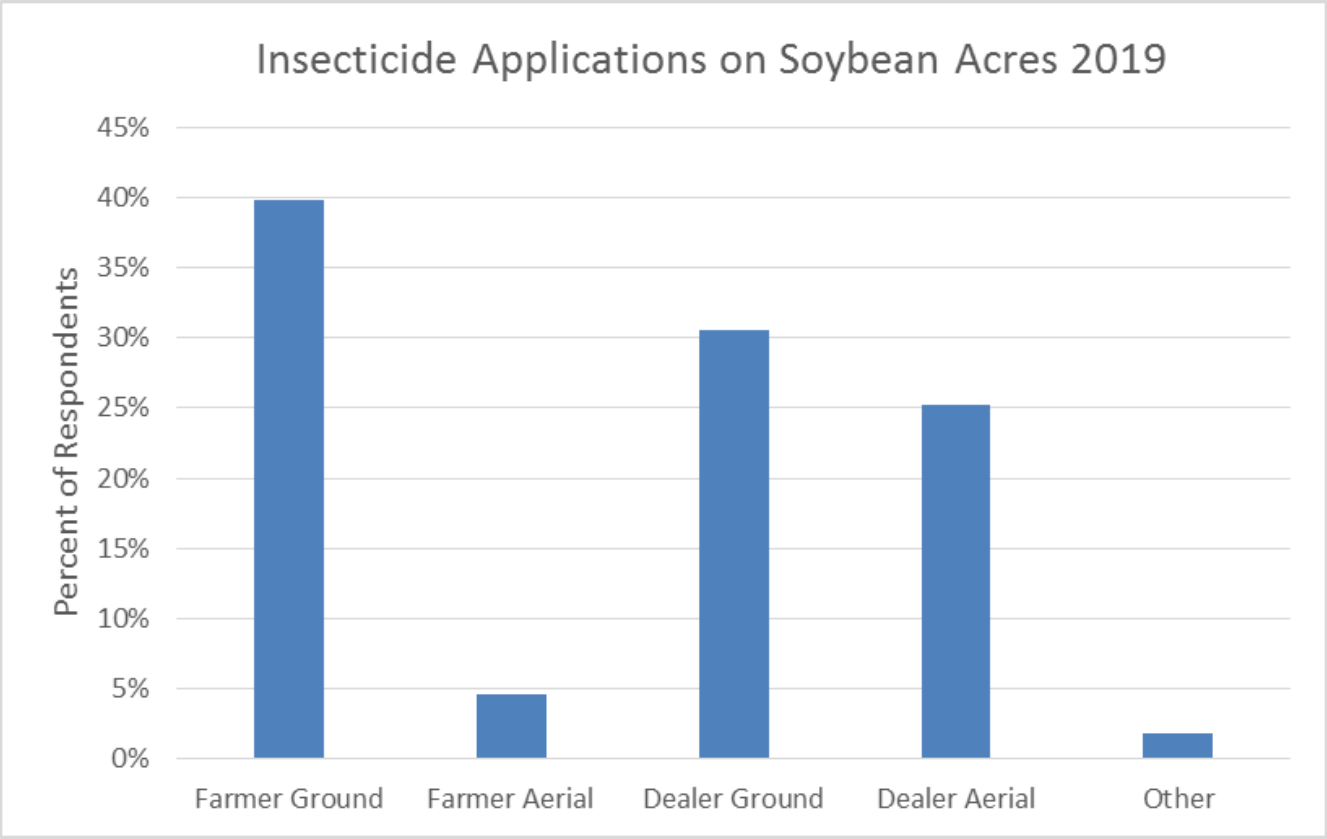

Figure 5. Insecticide applications on soybean acres

[12] Respondents could select only one answer.

Insects Targeted

Farmers can make an insecticide application for more than just soybean aphids. Farmers who responded to this question applied insecticides for soybean aphid (Figure 6). Spider mites are generally more of a problem during a drought in soybeans. Other pests on soybean acres could be grass hoppers, Japanese beetles, leaf hoppers, and a variety of caterpillars.[13] (SIQ-2)

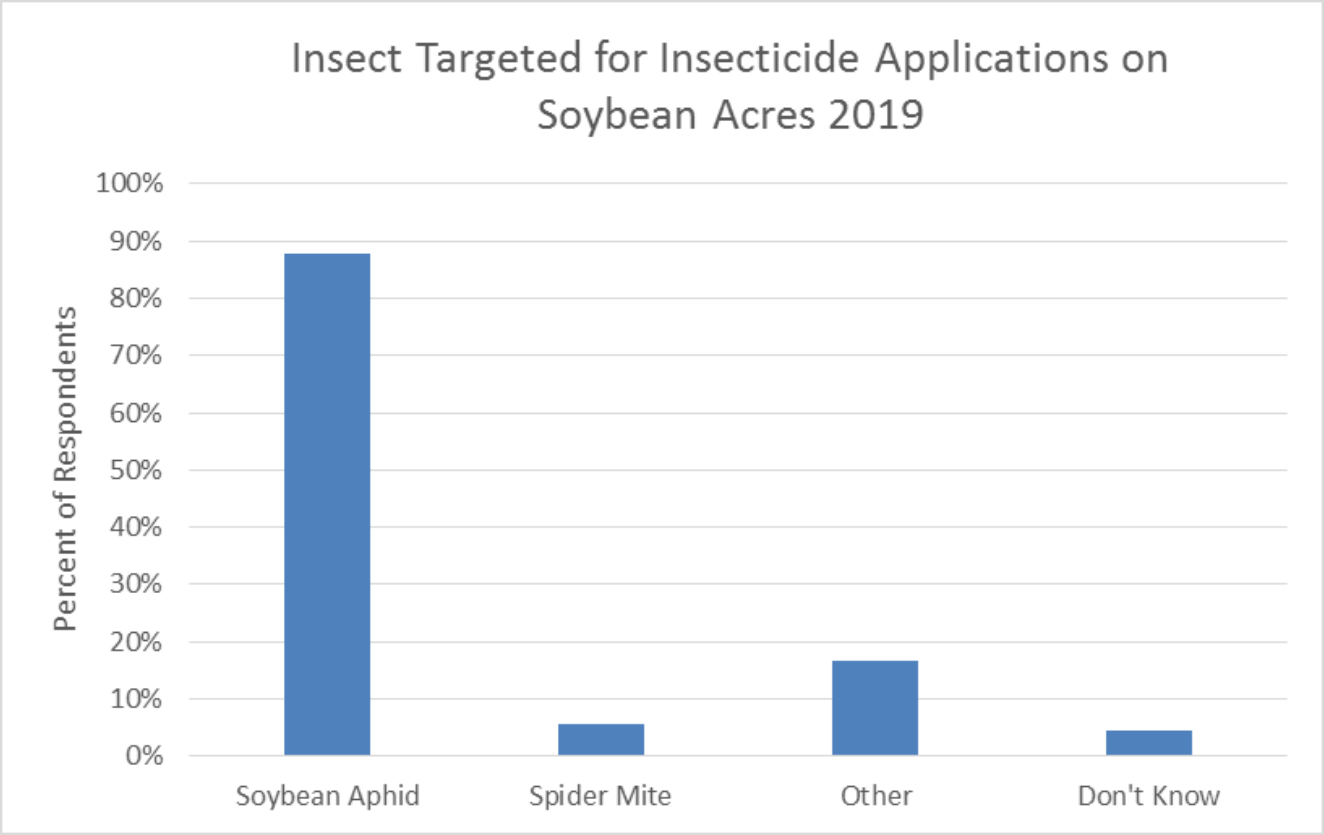

Figure 6. Type of insect targeted by the insecticide application

[13] The percent of respondents can add up to over 100 percent due to farmers treating for more than one pest.

Aphid Scouting

Scouting is important when determining if and when to spray for soybean aphids. Farmers, dealers, and crop consultants all play a role in scouting for soybean aphids. In 2019, farmers were, generally, performing the scouting of the soybean aphids (Figure 7).[14] (SIQ-3) Only farmers who reported applying an insecticide for soybean acres were asked this question.

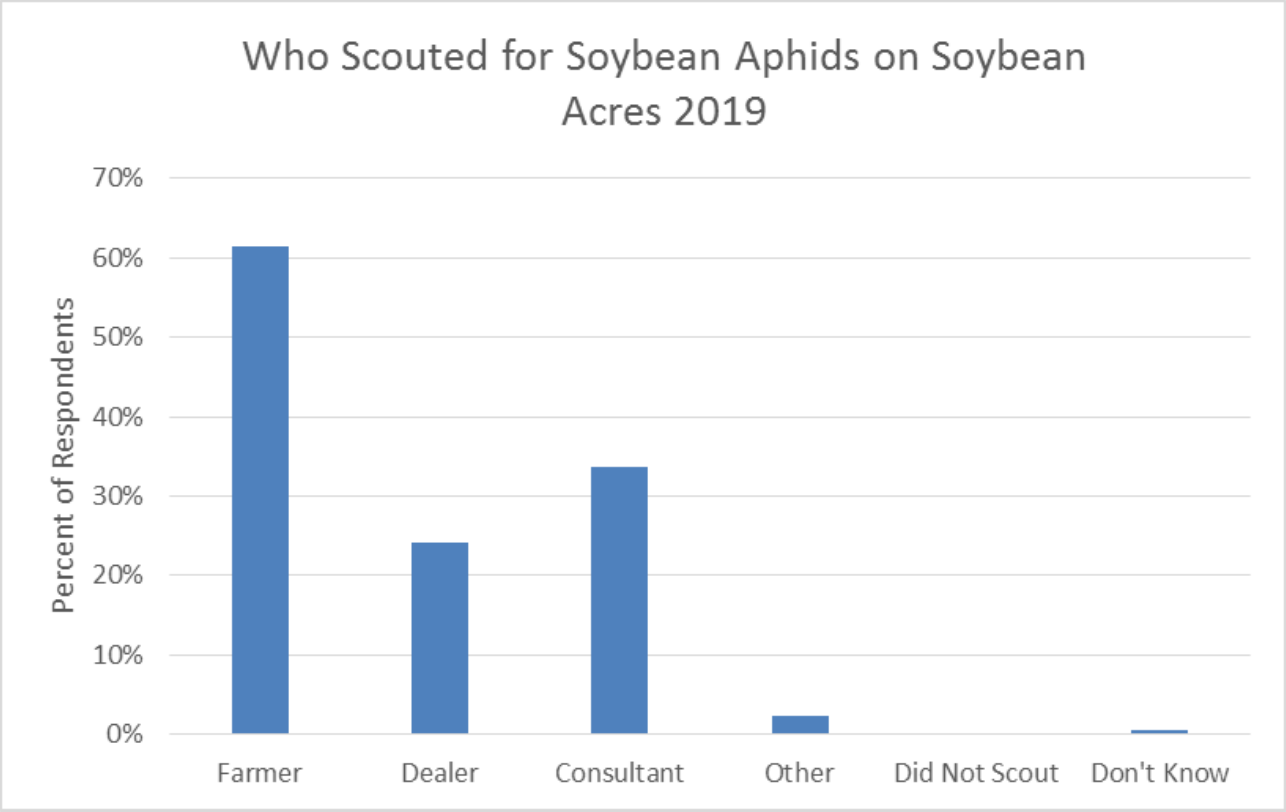

Figure 7. Who scouted for soybean aphids on soybean acres in 2019

[14] The percent of respondents can add up to over 100 percent due to farmers, dealers, and crop consultants scouting together for soybean aphids.

Aphid Threshold

The aphid threshold is the University of Minnesota recommended method of determining when to use an insecticide for control. There are no published, peer-reviewed data that show soybean aphid injury leading to a yield loss when aphid populations are below the threshold. Saving unnecessary insecticide applications would also protect the environment. There were 3,526 farmers represented in the response to the question of what threshold was used to determine an insecticide application (Figure 8).[15] (SIQ-4)

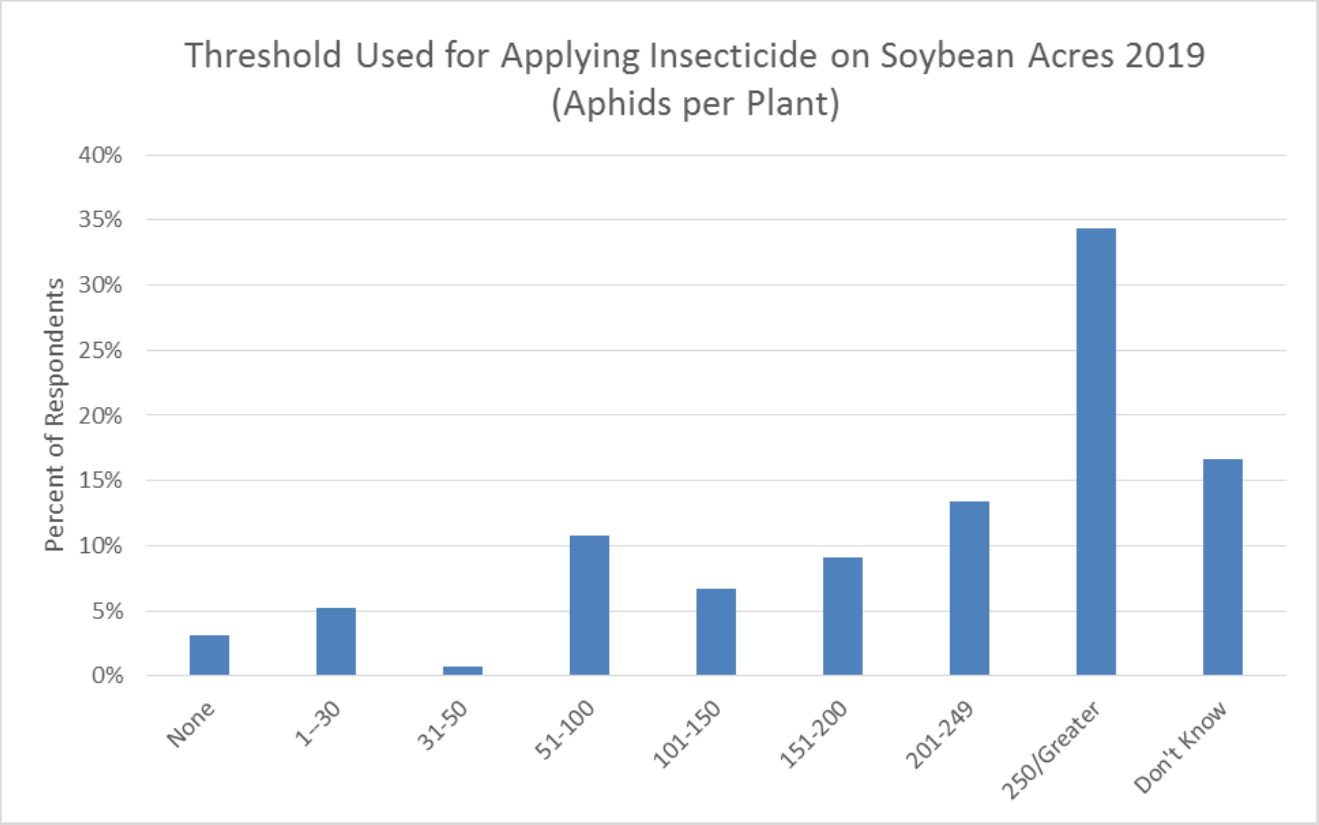

Figure 8. The threshold of 250 aphids per plant that was used for applying insecticide on soybean acres in 2019

[15] Only farmers who reported applying an insecticide for soybean aphids were asked this question. Respondents could select only one answer.

Record Keeping

Record keeping is important for all aspects of pesticide applications. It can be especially important to keep records that include thresholds to verify that soybean aphids have not become resistant to specific insecticides. Only farmers who reported applying an insecticide for soybean aphids were asked this question (Figure 9).[16] (SIQ-5)

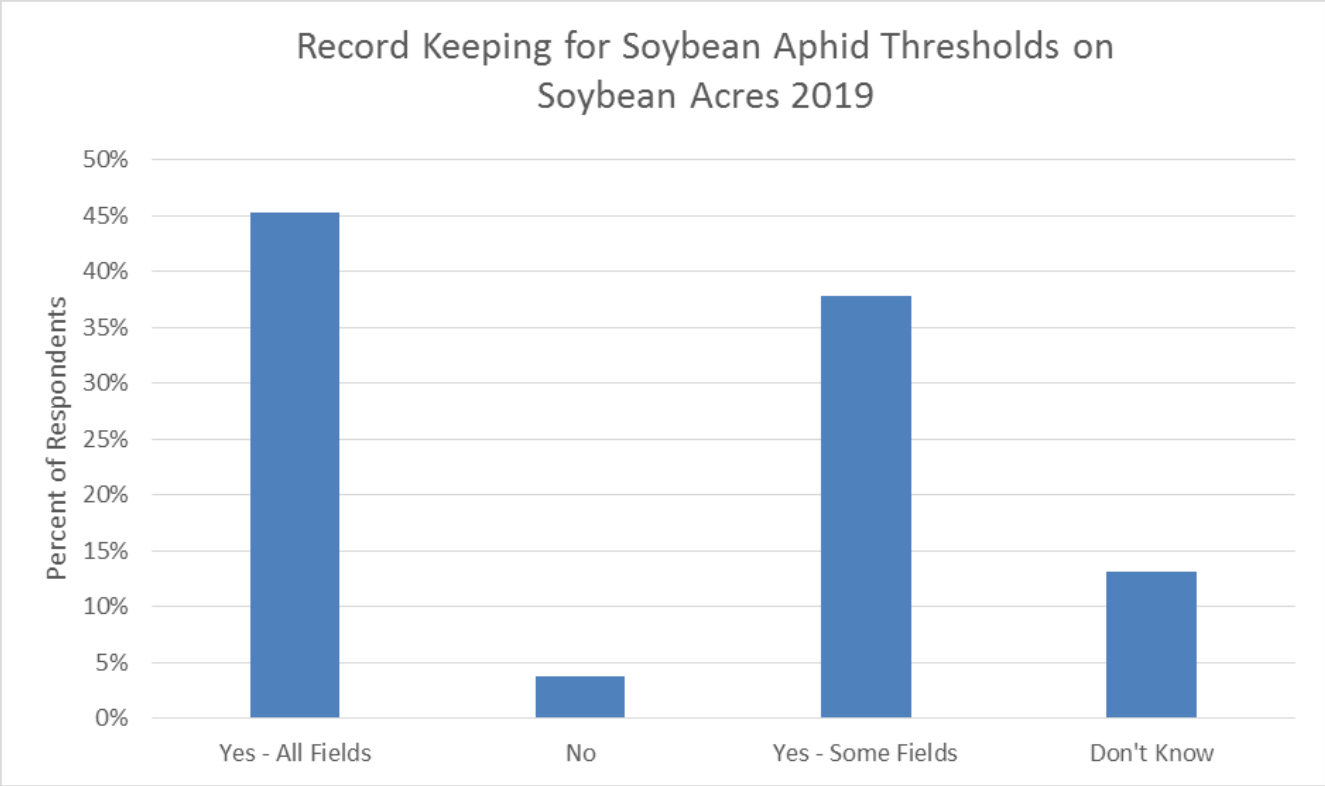

Figure 9. Record keeping on soybean aphid thresholds

[16] Respondents could select only one answer. Only farmers who reported applying an insecticide for soybean aphids were asked this question.

Other Factors for Consideration

Although the soybean aphid threshold is the method preferred by the University of Minnesota to determine an insecticide application, there are other factors that can used to determine an insecticide application. Farmers commonly have more than one reason for implementing a practice. Farmers reported that dealers and consultants were often factors, in addition to thresholds, for an insecticide application (Figure 10).[17] (SIQ-6)

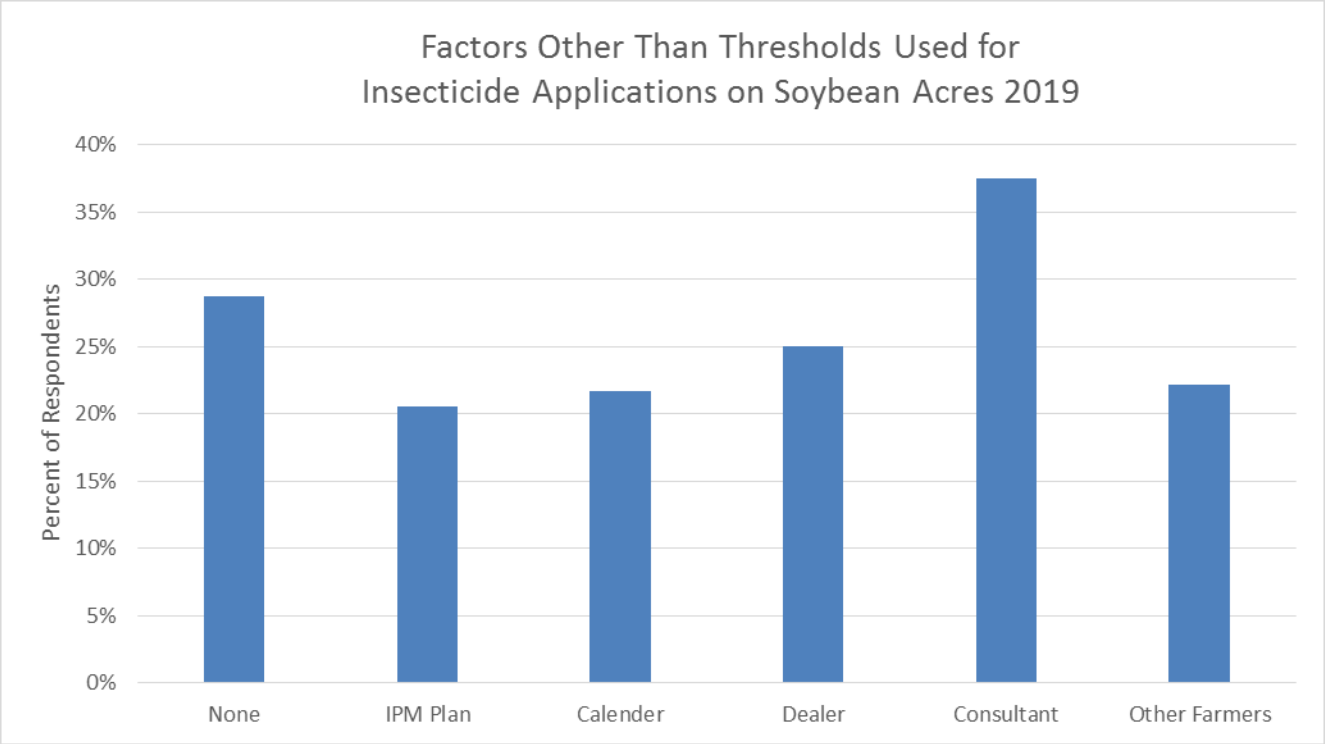

Figure 10. Factors other than thresholds used for insecticide applications for soybean aphids on soybean acres in 2019

[17] The percent of respondents can add up to over 100 percent due to multiple factors considered other than thresholds for insecticide applications on soybean acres.

Insecticide Selection Factors

Farmers can base insecticide applications for soybean aphids on multiple factors. Farmers reported that safety to the applicator and safety to the insect predators were the top two reasons in addition to cost and effectiveness for the insecticide application (Figure 11). Most farmers had more than one response beside cost and effectiveness.[18] (SIQ-7)

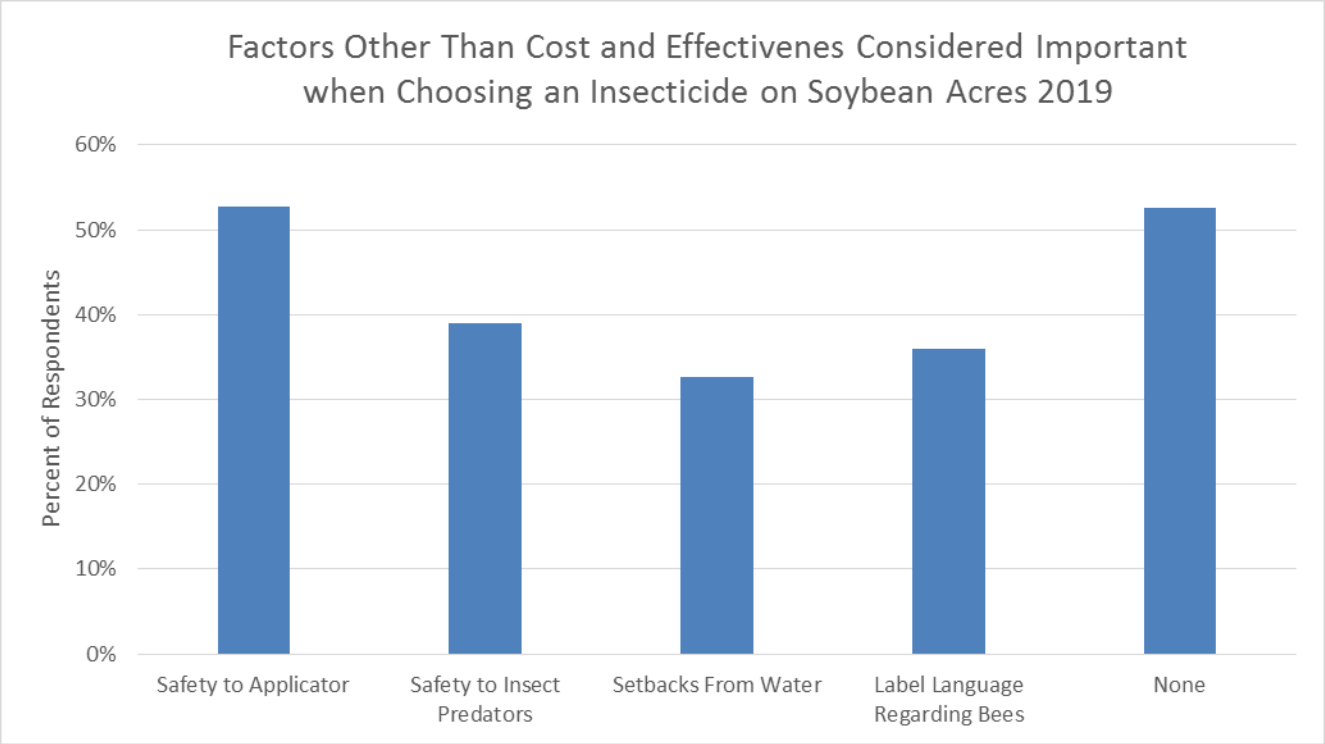

Figure 11. Factors other than cost and effectiveness were considered important when choosing an insecticide applications on soybean acres in 2019

[18] The percent of respondents can add up to over 100 percent due to multiple factors considered other than cost and effectiveness for insecticide applications on soybean acres.

Proximity to Bee Hives

Soybean farmers that applied insecticides were asked if any bee hives were within three miles of any soybean field when insecticides were applied for the 2019 crop year. Approximately two thirds of the farmers reported there were not any bee hives with three miles of any of their soybean fields when an insecticide was applied (Figure 12). (SIQ-8)

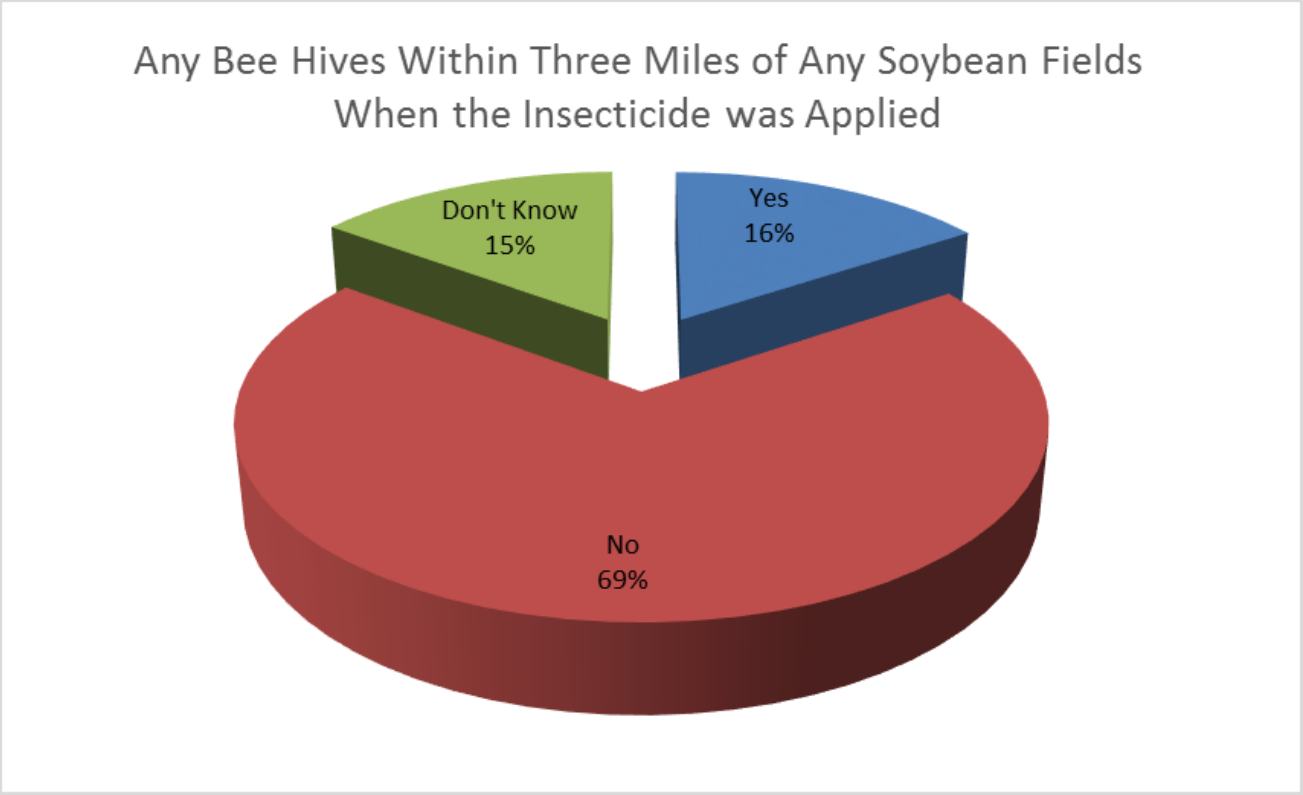

Figure 12. Any bee hives within three miles of any soybean field when insecticides were applied on soybeans for the 2019 crop year

Setbacks from Surface Water

Farmers were asked if there were setbacks from surface water on soybean acres in 2019. Almost half the farmers reported that there was no surface water by any of their soybean fields (Figure 13). (SIQ-9)

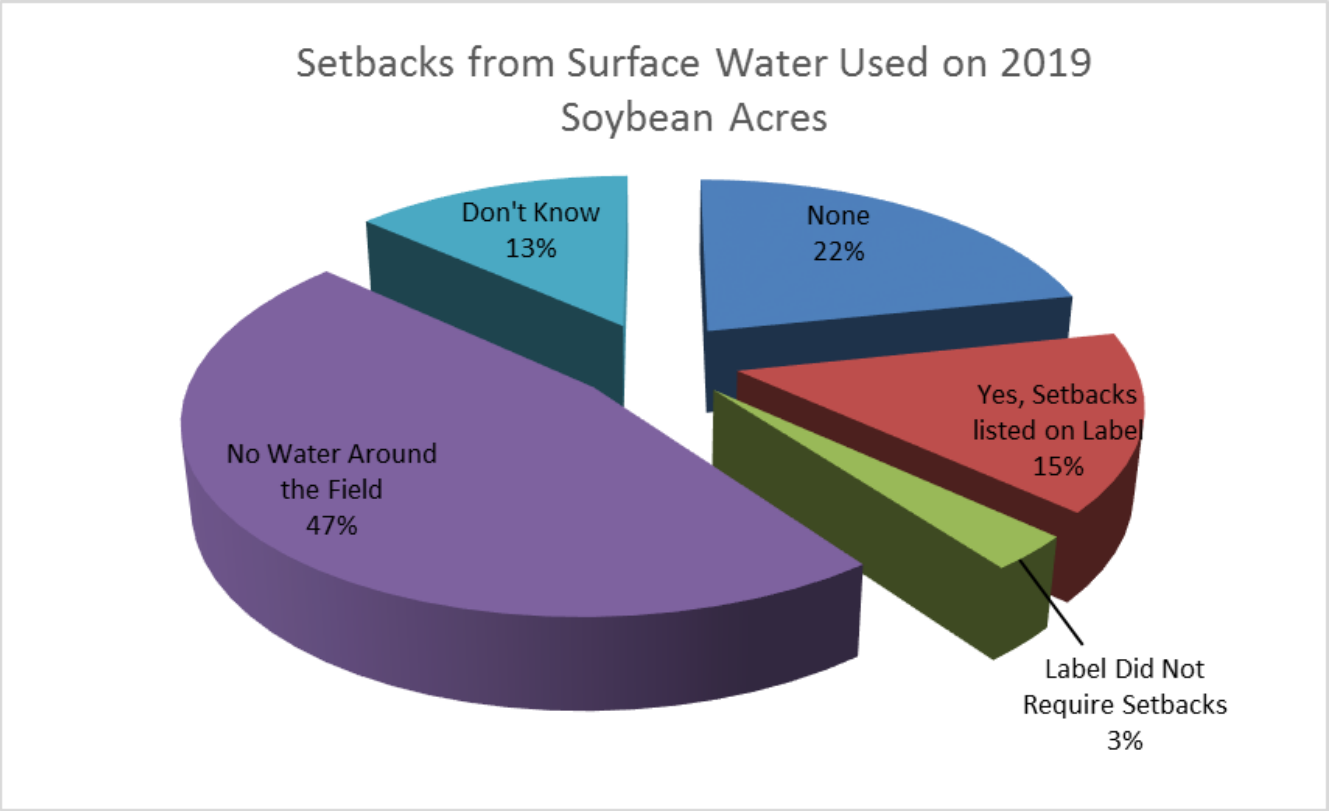

Figure 13. Setbacks from surface water used on soybean acres treated with an insecticide

Soybean Seed Treatment

Treating soybean seeds have grown in popularity over the past decade. Farmers treat soybean seed to prevent insects from eating the seed and from early season insects such as the bean leaf beetle. Almost half of the surveyed farmers treated 75% or more of their soybean seeds for the 2019 crop season (Figure 14). (SIQ-10)

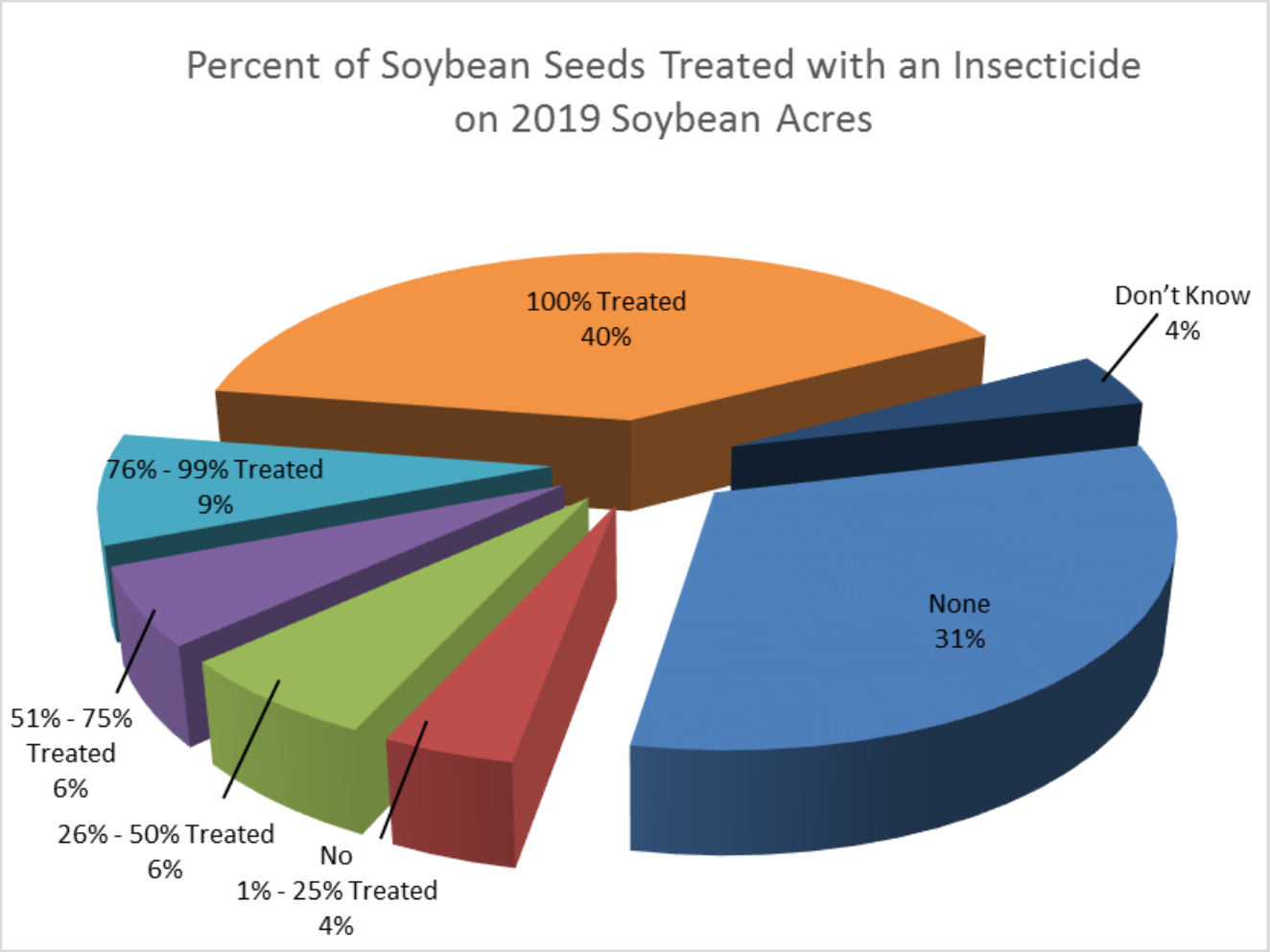

Figure 14. Percent of soybean seeds treated with an insecticide on soybean acres in 2019

Appendix 1. MASS Data Sheet

Minnesota Pesticide Use Survey Instrument for the 2019 Cropping Year

OMB No. 0535-0218
Approval Expires: 6/26/*[Prev Year]*
Project Code: 778 QID: 163695
SMetaKey: 3695

USDA United States Department of Agriculture

NATIONAL AGRICULTURAL STATISTICS SERVICE

USDA/NASS - MN
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Des Moines, IA 50309
Phone: 1-800-772-0825
FAX: 1-855-271-9802
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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 *[[Corn]]* or *[[Soybeans]]* in *[2019]*?

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

Section 2 – *[2019] [Corn]* Crop Acres

		Acres
2.	How many acres of *[Corn]* were planted for the *[2019]* crop year?	xxx
	[If *[Corn]* acres greater than zero, then continue, otherwise go to **Section 3**.]	
3.	How many acres of *[Corn]* were treated with herbicides?	xxx
4.	How many acres of *[Corn]* were treated with insecticides? (Exclude seed treatments)	xxx
5.	How many acres of *[Corn]* were treated with fungicides? (Exclude seed treatments)	xxxx

Section 3 – *[2019] [[Soybean]]* Crop Acres

		Acres
6.	How many acres of *[[Soybeans]]* were planted for the *[2019]* crop year?	xxx
	[If *[[Soybean]]* acres are greater than zero then continue, otherwise go to **Section 4**.]	
7.	How many acres of *[[Soybeans]]* were treated with herbicides?	xxx
8.	How many acres of *[[Soybeans]]* were treated with insecticides? (Exclude seed treatments)	xxx
9.	How many acres of *[[Soybeans]]* were treated with fungicides? (Exclude seed treatments)	xxxx

Section 4

INSTRUCTION: The next questions will ask about USAGE OF INDIVIDUAL PESTICIDES ON *[2019]* CROPS. **Include** applications in the fall of *[2018]* on crops for the *[2019]* harvest. Report the acres treated with each individual chemical during *[2019]* 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** *[Corn]* crop acres, items 2, 3, or 4 are greater than zero, complete.

1. In the following table, please report all pesticides used on the *[2019] [Corn]* crop.

What Pesticide was applied to the *[2019] [Corn]* Crop? Name	Product Code Code	How many acres of *[Corn]* were treated with Product? Acres	How many applications of Product were made for the *[2019] [Corn]* 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

Section 5

INSTRUCTIONS: If **Section** 3 (*[[Soybean]]* crop acres), items 2, 3 or 4 are greater than zero, complete.

1. In the following table, please report all pesticides used on the *[2019] [[Soybean]]* crop.

What Pesticide was applied to the *[2019] [[Soybean]]* Crop? Name	Product Code Code	How many acres of *[[Soybeans]]* were treated with Product? Acres	How many applications of Product were made for the *[2019] [[Soybean]]* 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

Soybean Insecticide Questions 2019 Crop Season

SOYBEAN FIELDS Soybeans Applied with Insecticide

Soybean Insecticide Question 1 Soybean Insecticide If insecticide was applied to the 2019 soybean crop, how was it applied? Choose all that applied (farmer can choose more than one option)

(1) Farmer – Ground Application
(2) Farmer – Aerial Application
(3) Dealer – Ground Application
(4) Dealer – Ground Application
(5) Other

Soybean Insecticide Question 2 Soybean Insecticide For your soybean acres for which insects did you apply your insecticides (choose all that apply)? (Farmer can choose more than one option)

(1) Soybean Aphid
(2) Spider Mites
(3) Other
(4) Don't Know

For soybean farmers that applied insecticides to treat soybean aphids:

Soybean Insecticide Question 3 Soybean Insecticide Who scouted the fields for soybean aphids (choose all that apply)?

(1) Farmer
(2) Dealer
(3) Consultant
(4) Other
(5) Didn't Scout
(6) Don't Know

Soybean Insecticide Question 4 Soybean Insecticide What threshold (aphids per plant) did you use for applying for soybean aphids (select one)?

(1) Did not use thresholds
(2) 1-30
(3) 31-50
(4) 51-100
(5) 101-150
(6) 151-200
(7) 201-249
(8) 250 or more
(9) Do not know

Soybean Insecticide Question 5 Soybean Insecticide Were records kept for soybean aphid thresholds?

(1) Yes, for all fields
(2) Yes, for some fields
(3) No
(4) Do not know

Soybean Insecticide Question 6 Soybean Insecticide What factors other than thresholds did you consider to make an insecticide application for soybean aphids (choose all that apply)?

(1) Did not consider anything other than thresholds
(2) Followed an IPM plan
(3) Followed a calendar schedule
(4) Followed advice from dealer
(5) Followed advice from crop consultant
(6) Followed other farmers

Soybean Insecticide Question 7 Soybean Insecticide What factors other than cost and effectiveness were considered important when choosing an insecticide product (choose all that apply)?

(1) Safety to the applicator
(2) Safety to insect predators
(3) Setbacks to water
(4) Label language regarding bees
(5) None

Soybean Insecticide Question 8 Soybean Insecticide Were there any bee hives within three miles of any soybean field when insecticide was applied?

(1) Yes
(2) No
(3) Don’t Know

Soybean Insecticide Question 9 Soybean Insecticide What setbacks from water, if any, were used?

(1) None
(2) Setbacks listed on label
(3) Label did not require setbacks from water
(4) No water around the field
(5) Do not know

Soybean Insecticide Question 10 Soybean Insecticide What percent of your soybean seeds were treated with insecticide (for all soybean acres)?

(1) None
(2) 1-25
(3) 26-50
(4) 51-75
(5) 76-99
(6) 100
(7) Do not know

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.