Commercial Fertilizer Usage and Manure Management Practices Associated with Minnesota's 2019 Corn and Soybean Crops

Minnesota Department of Agriculture

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Executive Summary

The Minnesota Department of Agriculture (MDA) is responsible for the development and promotion of nitrogen fertilizer Best Management Practices (BMPs). The purpose of the BMPs is to protect water quality while at the same time maintaining farm profitability. These BMPs refer to practices relating to the timing, rate, placement and source of fertilizer application and other practices that increase fertilizer use efficiency and decrease potential loss to the environment. 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 fertilizer 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 specifically assess the status of BMP awareness and adoption in relation to fertilizer and manure use on corn and soybean acres.

This year the crops that were surveyed were corn and soybeans. 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. This number provided a large pool to reach the desired goal of obtaining approximately 13 farms per county with complete records. 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 commercial fertilizer and manure applications on corn and soybeans. For commercial fertilizer, rates, applications, incorporation, types of fertilizer and other management decisions were collected through the survey. Fertilizer data was gathered for the major nutrients of nitrogen (N), phosphorus (P_2O_5), potassium (K_2O), and sulfur (SO_4-S).

Manure application data on corn and soybean acres were also collected including source of the manure, timing of the manure applications, amounts of manure applied and nitrogen inputs from the manure applications. Additional nitrogen contributions from commercial fertilizer were collected for manured corn and soybean acres. Only nitrogen data were collected for manured acres.

The 2019 report is the second fertilizer and manure use report presenting data that has been weighted by NASS to represent all farmers who grew corn and harvested soybean in Minnesota. Statistical weighting of data better represents Minnesota farmers with corn and soybean acres.

The definition of "corn" for purposes of this report includes both grain and silage and excludes sweet corn or popcorn. In Minnesota, over 99% of the corn harvested was field corn in 2019.

Highlights of the 2019 fertilizer and manure use on corn acres:

- Corn yields averaged 179 bushels per acre on non-manured acres
- 97 percent of non-manured corn fields were fertilized with commercial fertilizer
- An average of 153 pounds of nitrogen were applied to non-manured corn fields treated with nitrogen
- An average of 50 pounds of phosphorus were applied to non-manured corn fields treated with phosphorus
- An average of 68 pounds of potassium were applied to non-manured corn fields treated with potassium
- An average of 12 pounds of sulfur were applied to non-manured corn fields treated with sulfur
- 40 percent of corn operations applied manure to at least one field
- The main source of manure was beef

- An average manured corn field received 142 pounds of nitrogen from both manure and commercial sources.

Highlights of the 2019 fertilizer and manure use on soybean acres:

- Soybean yields averaged 49 bushels per acre on non-manured acres
- 27 percent of non-manured soybean fields were fertilized with commercial fertilizer
- An average of 15 pounds of nitrogen were applied to non-manured soybean fields treated with nitrogen
- An average of 37 pounds of phosphorus were applied to non-manured soybean fields treated with phosphorus
- An average of 54 pounds of potassium were applied to non-manured soybean fields treated with potassium
- An average of nine pounds of sulfur were applied to non-manured soybean fields treated with sulfur
- Six percent of soybean operations applied manure to at least one field
- The main source of manure was beef manure
- An average manured soybean field received 65 pounds of nitrogen from both manure and commercial sources

Introduction

The Minnesota Department of Agriculture (MDA) is responsible for the development and promotion of nitrogen fertilizer Best Management Practices (BMPs). The purpose of the BMPs is to protect water quality while at the same time maintaining farm profitability. These BMPs refer to practices relating to the timing, rate, placement, and source of fertilizer application and other practices that increase fertilizer use efficiency and decrease potential loss to the environment. The MDA is also responsible for monitoring the adoption and effectiveness of the BMPs. This survey was designed and conducted in partnership with the United States Department of Agriculture's National Agricultural Statistics Service (NASS) to specifically assess the status of BMP awareness and adoption in relation to the use of nitrogen on corn and soybean acres through the use of commercial nitrogen and manure.

In Minnesota, nitrate is detected frequently in groundwater and surface water resources. Nitrate may exceed the drinking water standards[1] in groundwater in some areas and sometimes exceeds the draft acute and chronic thresholds in surface water[2]. The MDA has invested considerable staff time in water monitoring, BMP assessment, and development of BMP education programs including demonstration projects. Nitrogen is the primary focus of this survey and is present in commercial fertilizer and manure. This is the third year that the MDA is collecting nitrogen, phosphorus, potash[3], and sulfur applied to the crops surveyed. In addition to collecting fertilizer information, farmers were asked about manure applications to corn and soybean acres. Only nitrogen information was collected for manured acres. The 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. All farmers from each county who grew one or both of the target crops (corn and soybeans) were eligible to be selected. This number provided a large pool to reach the desired goal of obtaining an average of 13 farms per county with complete records. 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.

NASS phone enumerators attempted to contact 7,600 producers in early 2019. From this pool, 2,471 farmers who raised corn or soybeans during the 2019 growing season were interviewed.

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[1] The drinking water standard of 10 mg/L for nitrate has been developed by the Environmental Protection Agency and can be found at: 2018 Edition of the Drinking Water Standards and Health Advisories Tables (EPA 822-F-18-100). In Minnesota, the Department of Health has adopted the federal standard as the value for the state Health Risk Limit of 10 mg/L for nitrate. A health risk limit (HRL) is the concentration of a groundwater contaminant, or a mixture of contaminates, that can be consumed with little or no risk to health.

[2] The Minnesota Pollution Control Agency has published draft nitrate-nitrogen water quality standards to address aquatic life acute and chronic toxicity to nitrate-N.

- 60 mg/L nitrate-N all class 2 waters for a one day duration
- 5 mg/L nitrate-N class 2A waters for four days duration
- 8 mg/L nitrate-N class 2B and 2Bd waters for four days duration

The draft standards can be found at: Water quality standards | Minnesota Pollution Control Agency (state.mn.us) https://www.pca.state.mn.us/sites/default/files/wq-s6-13.pdf, page 5-6.

[3] Potash and potassium are used interchangeably in this report.

The general purpose of this survey was to ask farmers about commercial fertilizer applications on corn and soybeans and manure use practices. This included rates, applications, incorporation, types of fertilizer and other management decisions based on fertilizer use on corn and soybean acres. Fertilizer inputs refer to soil enriching plant nutrients, primarily nitrogen (N), phosphorus (P_2O_5), potassium (K_2O), and sulfur (SO_4-S). It also includes manure use practices such as rates, applications, incorporation, types of manure, and other management decisions for corn and soybean acres.

These types of surveys help MDA understand regulatory compliance, adoption of voluntary best management practices, potential informational roadblocks, and opportunities for future technical assistance.

The MDA has partnered with NASS to produce a detailed report on fertilizer use and rates used on the state's major crops. The first nitrogen use survey was conducted in 2009 and was designed for commercial nitrogen use on corn. It was repeated in more detail in 2010 and included wheat acres. In 2012, the survey was expanded to include additional analysis of corn acres applied with manure, while the wheat portion of the survey did not include manure applications. The reports were expanded to include nitrogen, phosphorus, potassium, and sulfur fertilizer rates in 2016, but nitrogen use practices continue to be the primary focus of these reports. Readers are encouraged to visit the six reports from this survey: "2009 Survey of Nitrogen Fertilizer Use", the "Fertilizer and Manure Selection and Management Practices Associated with Minnesota's 2010 Corn and Wheat Production", the "Commercial Nitrogen and Manure Fertilizer Selection and Management Practices Associated with Minnesota's 2012 Corn Crop", the "Commercial Nitrogen and Manure Fertilizer Selection and Management Practices Associated with Minnesota's 2014 Corn Crop", the "Commercial Fertilizer Usage and Management Practices Associated with Minnesota's 2016 Soybean and Wheat Crops", and the "Commercial Fertilizer Usage and Manure Management Practices Associated with Minnesota's 2018 Wheat and Hay Crops" at:

https://www.mda.state.mn.us/nutrient-management-surveys

Each year NASS surveys crop farmers through the Agricultural Resource Management Survey (ARMS). To prevent farmers from being interviewed by both the MDA and the USDA NASS in the same year, the MDA will only interview farmers for crops that are not selected by the USDA NASS. For example, in 2019, the ARMS was conducted for wheat and barley crops and the MDA conducted a survey for corn and soybeans. The MDA will continue to survey only crops that are not included in the ARMS for any given year.

Acknowledgements

This survey was a cooperative effort by the Minnesota Department of Agriculture (MDA), the United States Department of Agriculture (USDA), National Agricultural Statistics Service (NASS), and the NASS Field Office in Minnesota. The detailed information about fertilizer and manure use could not have been collected without the cooperation of the thousands of farmers who voluntarily responded to the survey in the midst of their busy lives, and for this we are extremely grateful. Special thanks go to Dan Lofthus, the NASS Statistician of the Minnesota Field Office. 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. Excellent participation and good record keeping practices by Minnesota farmers played a vital part in providing complete and detailed fertilizer use information.

2019 Commercial Fertilizer Use Practices Summary and Highlights

The 2019 report is the second fertilizer and manure use report presenting data that have been weighted by NASS to represent all farmers, and the first report 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 underrepresent 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.[4] [5] By giving a statistical weight to each operation, data can better represent fertilizer and manure use by all Minnesota farmers with corn and soybean acres.

This report summarizes survey results for a number of important practices associated with commercial fertilizer applications on Minnesota's 2019 corn and soybeans. There were 52,884 corn or soybean producers represented[6] in the survey and information was statistically weighted for 7,800,000 corn acres and 6,850,000 soybean acres. The NASS surveys are designed to be statistically weighted to account for sample size, county size, crop acreage, nonresponse, etc. By giving a statistical weight to each operation based on standard protocol for NASS, data can better represent all Minnesota farmers with these two crops.[7]

The average yield for corn by represented farmers in the survey was 179 bushels per acre and the average yield for soybeans was 49 bushel per acre. Corn yields were slightly more than the USDA reported yield of 173 bushels per acre for the 2019 corn crop year. Soybean yields were slightly more than the USDA reported yield of 44 bushels per acre for the 2019 soybean crop year.

Ninety-seven percent of the corn fields[8] were fertilized, and those fertilized fields received an average rate of 153 pounds of nitrogen, 50 pounds of phosphorus, 68 pounds of potash, and 12 pounds of sulfur.

Twenty-seven percent of the soybean fields[9] were fertilized, and those fertilized fields received an average rate of 15 pounds of nitrogen, 37 pounds of phosphorus, 54 pounds of potash, and 9 pounds of sulfur.

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[4] For an example of 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.

[5] Reports available at sections of NASS "Agricultural Chemical Usage – Field Crops" https://www.nass.usda.gov/Publications/Methodology_and_Data_Quality/Agricultural_Chemical_Usage_-_Field_Crops/index.php and click on "Methodology and Quality Measures".

[6] There were 1,275 corn operations that provided information on 355,806 corn acres, and those farmers represented 27,815 operations with 7,800,000 acres of corn. There were 1,196 soybean farmers that provided information on 354,100 acres and those farmers represented 25,069 operations with 6,850,000 acres of soybeans. A total of 52,884 corn and soybean operations representing 14,650,000 acres are analyzed in the 2019 fertilizer and manure use report.

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

[8] Non-manured corn fields.

[9] Non-manured soybean fields

Twenty-one percent of the corn operations applied manure on their corn fields.

Four percent of the soybean operations applied manure on all their soybean fields.

Survey Design and Implementation

Five nitrogen BMP regions (noted as "BMP regions" throughout the report), were previously developed by MDA staff. Counties were clustered based on similarities in geology, soils, and crops. More information about BMP regions can be found at: http://www.mda.state.mn.us/nitrogenbmps. Regional nitrogen use information is used to help design and implement specific water quality monitoring and nitrogen educational programs.

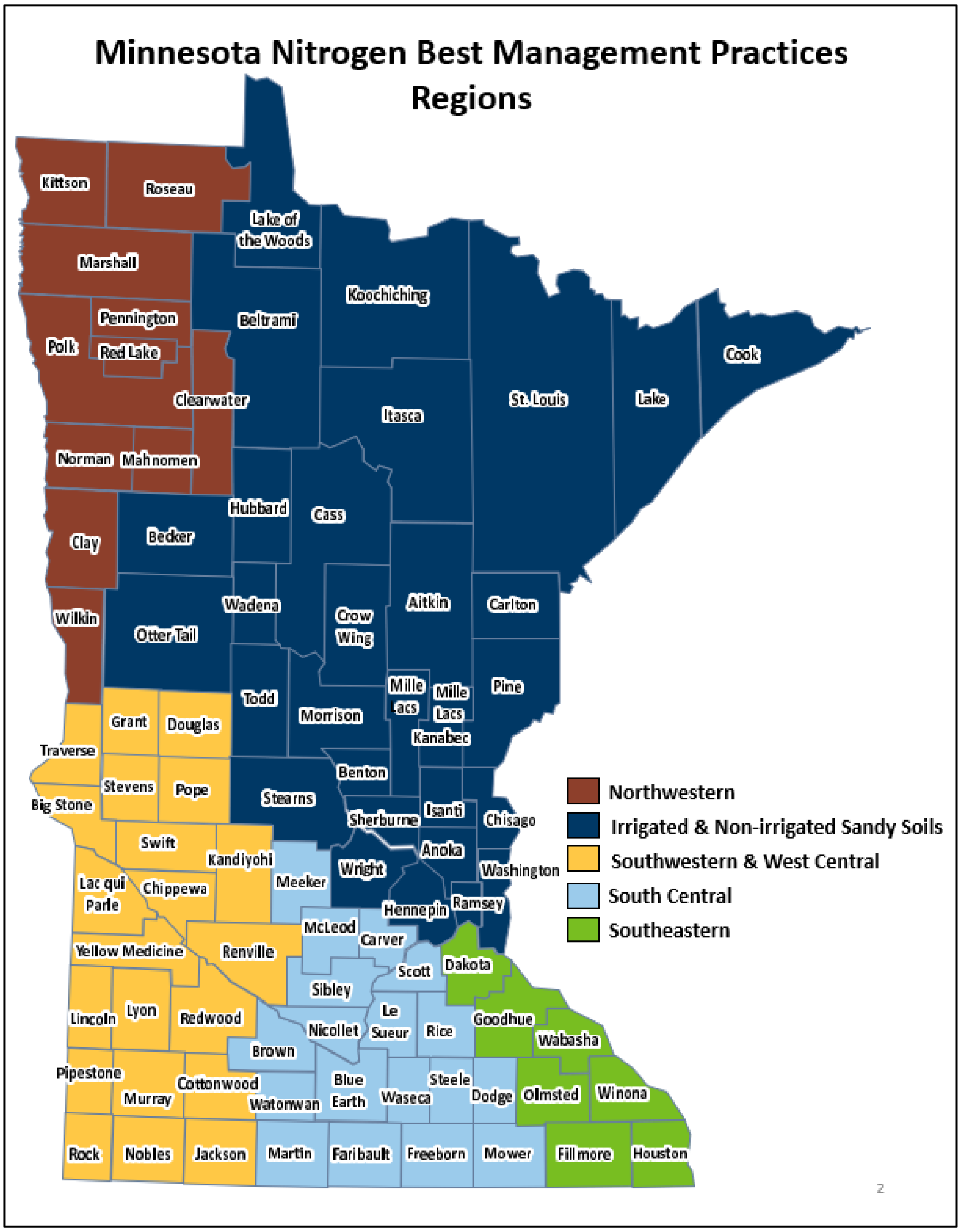

Figure 1. Minnesota Nitrogen BMP regions

For the purpose of this report the Minnesota nitrogen BMP regions will be defined as follows: Northwestern as NW, Irrigated and Non-irrigated Sandy Soils as IRR, Southwestern and West Central as SW, South Central as SC, and Southeastern as SE.

NASS developed a systematic sample of 7,600 farms by randomly drawing from its entire database of all corn and soybean growers in Minnesota. There were 52,884 corn or soybean producers represented in the survey and information was statistically weighted for 7,800,000 corn acres and 6,850,000 soybean acres. The definition of "corn" for purposes of this report includes both grain and silage and excludes sweet corn and popcorn. In Minnesota over 99% of the corn harvested was field corn and silage in 2019.

Process

Farmers were interviewed over the phone in February 2020. These were ‘cold calls’, meaning that the farmers did not get any type of direct notification about the survey prior to the contact. However, there were multiple news releases informing farmers of the annual survey. Information collected using this approach was based upon either the participant’s memory or records readily available during the interview. If the farmer did not have access to the commercial fertilizer applications, the enumerator asked the farmer if we could contact his fertilizer dealership or applicator for application information. If the farmer gave permission to contact the dealership or applicator, a follow-up call was made. Depending on the complexity of the farm, the interviews would typically last ten to thirty minutes.

Data Reporting and Limitations

The primary purpose of this survey was to obtain an understanding of commercial fertilizer applications associated with corn and soybean production in Minnesota.

Due to the simplified method used to collect what is typically considered complex data, it is imperative that the reader understand the limitations of the data sets. Farmers that grew corn or soybean 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 statistical weight to each operation based standard protocol for NASS, data can better represent all Minnesota farmers with these two crops.[10]

If there were less than nine responses in any BMP region during the survey process, that BMP region would be combined with another BMP region with the lowest number of responses, or if multiple BMP regions have less than nine responses, all BMP regions with less than nine responses would be combined. These BMP regions are referred to as ‘Combined BMPs’.

For each BMP region, if there were less than five responses for the ‘Number of Responses’, then the responses were not published and were represented by ‘**’. However, the data was still included in the overall statistical analysis. This is why certain columns will be slightly higher in the ‘Totals/Averages’ row of the relevant tables.

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

Corn Section

Corn is a major crop in Minnesota, and no BMP regions had less than nine farmers that reported growing corn in Minnesota. Therefore, all BMP region farmers were included in the following corn section.

Farmers in the survey were first asked "How many acres of corn did you plant?" Table 1 details the number of farmers[11] and corresponding corn acres planted by BMP region for the 2019 crop year (CAQ-1[12]).

Table 1. Summary of respondents and corresponding corn acres planted by BMP region for the 2019 crop year

BMP Region	Number of Respondents	Number of Corn Acres
Northwestern	1,437	598,422
Irrigated and Non-irrigated Sandy Soils	6,209	1,125,379
Southwestern and West Central	8,677	2,890,543
South Central	7,915	2,309,012
Southeastern	3,577	876,645
Statewide	**27,815**	**7,800,000**

Farmers in the survey were then asked, "Did all your corn fields receive manure for the 2019 crop year?" Table 2 details the percent of farmers who had a corn field without manure applied by BMP region (CFQ-1). Farmers that answered yes to this question applied manure on all their corn fields for the 2019 growing year.

Table 2. Percent of respondents with a corn field without manure applied

BMP Region	All Corn Fields Received Manure	Percent of Respondents
Northwestern	Yes	15
Northwestern	No	85
Irrigated and Non-irrigated Sandy Soils	Yes	34
Irrigated and Non-irrigated Sandy Soils	No	66
Southwestern and West Central	Yes	14
Southwestern and West Central	No	86
South Central	Yes	18
South Central	No	82
Southeastern	Yes	28
Southeastern	No	72
Statewide	**Yes**	**21**
Statewide	**No**	**79**

[11] Farmers and respondents are used interchangeably in this document. The farmer interviewed is the respondent.

[12] CAQ1 is Corn All Question 1 and can be found at the end of the report in the appendix. All question references will be in this format. CFQ stands for Corn Fertilizer Question and is in the same appendix.

Table 3 details the number of represented respondents, and all corn acres, who reported having a field without manure applied to the 2019 corn crop. Due to the low amount of row crop agriculture in portions of Minnesota, survey results were not listed when there were less than five responses in any category for corn with fertilizer. Respondents and acres were excluded from Table 3 who applied manure on all of their corn fields. Farmers with manured acres will be analyzed in the manure section of this report.

Table 3. Summary of respondents and corresponding corn acres by BMP region for farmers who reported a field without manure applied in the fall of 2018 or anytime in the 2019 crop year

BMP Region	Number of Respondents	Number of Corn Acres
Northwestern	1,218	586,812
Irrigated and Non-irrigated Sandy Soils	4,112	956,973
Southwestern and West Central	7,497	2,703,390
South Central	6,529	1,965,924
Southeastern	2,575	682,955
Statewide	**21,931**	**6,896,054**

All corn fields without manure applied are included in the analysis for the following tables. There were 21,931 corn fields represented in the commercial fertilizer analysis.

Farmers were then told by the phone enumerator[13] "First on a corn field with no manure or compost applied in the fall of 2018 and no manure or compost applied anytime during the 2019 crop year. Think about your largest corn field that you planted in 2019 without any manure. I will now ask you questions about that specific field. All following questions will be in relation to that specific field." Farmers were then asked, "Was this field irrigated?" Farmers were only asked about irrigation on the largest field being surveyed, therefore they could have had a field that was irrigated but not the largest corn field on their farm.

Table 4 details the percent of farmers who irrigated their largest corn field, without manure, applied by BMP region (CFQ-2).

Table 4. Percent of respondents who irrigated their largest corn field

BMP Region	Largest Corn Field was Irrigated	Percent of Respondents
Northwestern	Yes	4
Northwestern	No	96
Irrigated and Non-irrigated Sandy Soils	Yes	12
Irrigated and Non-irrigated Sandy Soils	No	88
Southwestern and West Central	Yes	2
Southwestern and West Central	No	98
South Central	Yes	1
South Central	No	99
Southeastern	Yes	3
Southeastern	No	97
Statewide	**Yes**	**4**
Statewide	**No**	**96**

[13] A phone enumerator is a NASS employee who calls on the phone to survey farmers for the Minnesota pesticide and fertilizer survey.

Next, farmers were asked, “What was the crop grown on this field in 2018 before the 2019 corn crop?” Table 5 details the previous crop planted before the current corn crop by BMP region and corresponding yield (CFQ-3, CFQ-4, and CFQ-6). The table includes the next question to the farmers “What was the average corn yield of this field over the past three corn crops?” The average corn yield was 164 bushels per acre in the Northwestern BMP region, 161 bushels per acre in the Irrigated and Non-irrigated Sandy Soils BMP region, 182 bushels per acre in the Southwestern and West Central BMP region, 186 bushels per acre in the South Central BMP region, and 187 bushels per acre in the Southeastern BMP region. The average corn yield across all corn fields in Minnesota was 179 bushels per acre.

Table 5. Percent of fields by previous crop and the corresponding corn yield in 2019

BMP Region	Previous Crop	Percent of Fields	Average Corn Yield Bushels per Acre
Northwestern	Soybeans	58	164
Northwestern	Corn	9	174
Northwestern	Corn/Alfalfa	**	**
Northwestern	Alfalfa	**	**
Northwestern	Small Grains	18	160
Northwestern	Other	11	160
Irrigated and Non-irrigated Sandy Soils	Soybeans	64	163
Irrigated and Non-irrigated Sandy Soils	Corn	22	161
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	3	143
Irrigated and Non-irrigated Sandy Soils	Alfalfa	3	149
Irrigated and Non-irrigated Sandy Soils	Small Grains	3	151
Irrigated and Non-irrigated Sandy Soils	Other	5	164
Southwestern and West Central	Soybeans	80	181
Southwestern and West Central	Corn	14	185
Southwestern and West Central	Alfalfa	**	**
Southwestern and West Central	Small Grains	2	185
Southwestern and West Central	Other	2	188
South Central	Soybeans	89	186
South Central	Corn	9	195
South Central	Alfalfa	**	**
South Central	Small Grains	**	**
South Central	Other	**	**
Southeastern	Soybeans	64	194
Southeastern	Corn	22	184
Southeastern	Corn/Alfalfa	**	**
Southeastern	Alfalfa	**	**
Southeastern	Small Grains	**	**
Southeastern	Other	6	177
Statewide	**Soybeans**	**76**	**180**
Statewide	**Corn**	**15**	**179**
Statewide	**Corn/Alfalfa**	**1**	**158**
Statewide	**Alfalfa**	**2**	**157**
Statewide	**Small Grains**	**3**	**165**
Statewide	**Other**	**3**	**170**

** Less than five responses

Commercial Fertilizer Applications on Corn

Farmers were then asked, "Was any commercial fertilizer applied to this corn field for the 2019 corn crop?" Table 6 details the percent of non-manured corn fields applied with commercial fertilizer (CFQ-7).

Table 6. Commercial fertilizer applied to non-manured corn fields

BMP Region	Fertilizer Applied	Percent of Respondents
Northwestern	Yes	>99
Northwestern	No	<1
Irrigated and Non-irrigated Sandy Soils	Yes	95
Irrigated and Non-irrigated Sandy Soils	No	5
Southwestern and West Central	Yes	97
Southwestern and West Central	No	3
South Central	Yes	97
South Central	No	3
Southeastern	Yes	97
Southeastern	No	3
Statewide	**Yes**	**97**
Statewide	**No**	**3**

Farmers were asked "Was any commercial fertilizer applied to this corn field with a variable rate or more than one rate such as by management zone or grid?" Table 7 details the percent of respondents using variable rate commercial fertilizer applied by BMP region on their largest corn field (CFQ-8).

Table 7. Variable rate commercial fertilizer application by BMP region on the farmer's largest corn field

BMP Region	Variable Rate Fertilizer Application	Percent of Respondents
Northwestern	Variable Rate	20
Northwestern	One Rate	80
Irrigated and Non-irrigated Sandy Soils	Variable Rate	26
Irrigated and Non-irrigated Sandy Soils	One Rate	74
Southwestern and West Central	Variable Rate	41
Southwestern and West Central	One Rate	59
South Central	Variable Rate	41
South Central	One Rate	59
Southeastern	Variable Rate	34
Southeastern	One Rate	66
Statewide	**Variable Rate**	**36**
Statewide	**One Rate**	**64**

There were 21,931 corn fields represented in the commercial fertilizer analysis, and farmers provided complete information for 21,931 corn fields with fertilizer applied. From these represented farmers, 21,931 that reported complete data, 21,261 farmers reported applying fertilizer that included the nutrient rate and timing on their corn fields. The following corn fertilizer tables are based on those 21,261 fields.

Table 8 details the percent of all represented corn fields applied with fertilizer and the percent of fertilized fields treated with nitrogen, phosphorus, potassium, and sulfur by BMP region (CFQ-7 and CFQ-FERT TABLE).

Table 8. The percent of corn fields applied with commercial fertilizer and the percent of fertilized fields treated with nitrogen, phosphorus, potassium, and sulfur by BMP region

BMP Region	Percent of All Represented Fields Fertilized	Percent of Fertilized Fields Treated with Nitrogen	Percent of Fertilized Fields Treated with Phosphorus	Percent of Fertilized Fields Treated with Potassium	Percent of Fertilized Fields Treated with Sulfur
Northwestern	>99	100	97	86	57
Irrigated and Non-irrigated Sandy Soils	95	100	88	89	67
Southwestern and West Central	97	100	91	86	56
South Central	97	100	93	89	63
Southeastern	97	100	93	92	63
Statewide	**97**	**100**	**92**	**88**	**61**

Table 9 details the percent of all represented corn fields with fertilizer and treated with nitrogen, the average nitrogen rate on fields treated with commercial nitrogen fertilizer, and the average nitrogen rate on all fertilized corn fields by BMP region (CFQ-7 and CFQ-FERT TABLE). All fertilized corn fields received nitrogen. These are nitrogen rates on all corn acres treated with commercial fertilizer, regardless of previous crop. Nitrogen rates are for commercial fertilizer only.

Table 9. The percent of all represented corn fields applied with commercial fertilizer containing nitrogen, the average rate on fields treated with nitrogen, and the average nitrogen rate on all fertilized fields by BMP region

BMP Region	Percent of Fertilized Fields Treated with Nitrogen	Average Commercial Nitrogen Rate On Fields Treated with Nitrogen Pounds per Acre	Average Commercial Nitrogen Rate Across All Fertilized Corn Fields Pounds per Acre
Northwestern	100	142	142
Irrigated and Non-irrigated Sandy Soils	100	141	141
Southwestern and West Central	100	154	154
South Central	100	161	161
Southeastern	100	152	152
Statewide	**100**	**153**	**153**

Table 10 details the percent of all represented corn fields with fertilizer and treated with phosphorus, the average phosphorus rate on fields treated with commercial phosphorus fertilizer, and the average phosphorus rate on all fertilized corn fields by BMP region (CFQ-7 and CFQ-FERT TABLE). Statewide, 92% of fertilized corn fields received phosphorus. These are phosphorus rates on all corn acres treated with commercial fertilizer, regardless of previous crop. Phosphorus rates are for commercial fertilizer only.

Table 10. The percent of all represented corn fields applied with commercial fertilizer containing phosphorus, the average rate on fields treated with phosphorus, and the average phosphorus rate on all fertilized fields by BMP region

BMP Region	Percent of Fertilized Fields Treated with Phosphorus	Average Commercial Phosphorus Rate On Fields Treated with Phosphorus Pounds per Acre	Average Commercial Phosphorus Rate Across All Fertilized Corn Fields Pounds per Acre
Northwestern	97	51	49
Irrigated and Non-irrigated Sandy Soils	88	41	36
Southwestern and West Central	91	54	49
South Central	93	51	47
Southeastern	93	48	45
Statewide	**92**	**50**	**46**

Table 11 details the percent of all represented corn fields with fertilizer and treated with potassium, the average potassium rate on fields treated with commercial potassium fertilizer, and the average potassium rate on all fertilized corn fields by BMP region (CFQ-7 and CFQ-FERT TABLE). Statewide, 88% of fertilized corn fields received potassium. These are potassium rates on all corn acres treated with commercial fertilizer, regardless of previous crop. Potassium rates are for commercial fertilizer only.

Table 11. The percent of all represented corn fields applied with commercial fertilizer containing potassium, the average rate on fields treated with potassium, and the average potassium rate on all fertilized fields by BMP region

BMP Region	Percent of Fertilized Fields Treated with Potassium	Average Commercial Potassium Rate On Fields Treated with Potassium Pounds per Acre	Average Commercial Potassium Rate Across All Fertilized Corn Fields Pounds per Acre
Northwestern	86	56	48
Irrigated and Non-irrigated Sandy Soils	89	64	58
Southwestern and West Central	86	62	53
South Central	89	76	67
Southeastern	92	74	68
Statewide	**88**	**68**	**60**

Table 12 details the percent of all represented corn fields with fertilizer and treated with sulfur, the average sulfur rate on fields treated with commercial sulfur fertilizer, and the average sulfur rate on all fertilized corn fields by BMP region (CFQ-7 and CFQ-FERT TABLE). Statewide, 61% of fertilized corn fields received sulfur. These are sulfur rates on all corn acres treated with commercial fertilizer, regardless of previous crop. Sulfur rates are for commercial fertilizer only.

Table 12. The percent of all represented corn fields applied with commercial fertilizer containing sulfur, the average rate on fields treated with sulfur, and the average sulfur rate on all fertilized fields by BMP region

BMP Region	Percent of Fertilized Fields Treated with Sulfur	Average Commercial Sulfur Rate On Fields Treated with Sulfur Pounds per Acre	Average Commercial Sulfur Rate Across All Fertilized Corn Fields Pounds per Acre
Northwestern	57	12	7
Irrigated and Non-irrigated Sandy Soils	67	11	7
Southwestern and West Central	56	11	6
South Central	63	12	8
Southeastern	63	14	9
Statewide	**61**	**12**	**7**

Table 13 details the nitrogen fertilizer rate and corn yield by BMP region on corn following various crops (CFQ-3, CFQ-4, CFQ-6 and CFQ-FERT TABLE). These are corn fields applied with commercial nitrogen fertilizer and no manure applications.

Table 13. Average amount of nitrogen applied and corresponding corn yield by BMP region and previous crop

BMP Region	Previous Crop	Average Nitrogen Rate Pounds per Acre	Average Corn Yield Bushels per Acre
Northwestern	Soybeans	145	164
Northwestern	Corn	145	174
Northwestern	Corn/Alfalfa	**	**
Northwestern	Alfalfa	**	**
Northwestern	Small Grains	137	160
Northwestern	Other	131	160
Irrigated and Non-irrigated Sandy Soils	Soybeans	148	165
Irrigated and Non-irrigated Sandy Soils	Corn	138	158
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	119	148
Irrigated and Non-irrigated Sandy Soils	Alfalfa	121	152
Irrigated and Non-irrigated Sandy Soils	Small Grains	98	151
Irrigated and Non-irrigated Sandy Soils	Other	117	164
Southwestern and West Central	Soybeans	153	181
Southwestern and West Central	Corn	165	185
Southwestern and West Central	Alfalfa	**	**
Southwestern and West Central	Small Grains	147	185
Southwestern and West Central	Other	180	196
South Central	Soybeans	161	186
South Central	Corn	171	195
South Central	Alfalfa	**	**
South Central	Small Grains	**	**
Southeastern	Soybeans	157	194
Southeastern	Corn	146	187
Southeastern	Corn/Alfalfa	**	**
Southeastern	Alfalfa	**	**
Southeastern	Small Grains	**	**
Southeastern	Other	**	**
Statewide	**Soybeans**	**155**	**181**
Statewide	**Corn**	**155**	**180**
Statewide	**Corn/Alfalfa**	**125**	**163**
Statewide	**Alfalfa**	**132**	**155**
Statewide	**Small Grains**	**125**	**165**
Statewide	**Other**	**144**	**176**

** Less than five responses

Table 14 details the nitrogen fertilizer rate and corn yield by BMP region on dryland corn[14] following various crops (CFQ-2, CFQ-3, CFQ-4, CFQ-6 and CFQ-FERT TABLE). These are dryland corn fields applied with commercial nitrogen fertilizer and no manure applications.

Table 14. Average amount of nitrogen applied and corresponding corn yield by BMP region and previous crop on dryland corn

BMP Region	Previous Crop	Average Nitrogen Rate on Dryland Corn Pounds per Acre	Average Corn Yield Bushels per Acre
Northwestern	Soybeans	144	167
Northwestern	Corn	147	172
Northwestern	Corn/Alfalfa	**	**
Northwestern	Alfalfa	**	**
Northwestern	Small Grains	137	160
Northwestern	Other	131	160
Irrigated and Non-irrigated Sandy Soils	Soybeans	144	162
Irrigated and Non-irrigated Sandy Soils	Corn	132	153
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	119	148
Irrigated and Non-irrigated Sandy Soils	Alfalfa	118	152
Irrigated and Non-irrigated Sandy Soils	Small Grains	98	151
Irrigated and Non-irrigated Sandy Soils	Other	83	141
Southwestern and West Central	Soybeans	153	182
Southwestern and West Central	Corn	164	186
Southwestern and West Central	Alfalfa	**	**
Southwestern and West Central	Small Grains	147	185
Southwestern and West Central	Other	180	196
South Central	Soybeans	161	186
South Central	Corn	171	195
South Central	Alfalfa	**	**
South Central	Small Grains	**	**
Southeastern	Soybeans	157	194
Southeastern	Corn	145	186
Southeastern	Corn/Alfalfa	**	**
Southeastern	Alfalfa	**	**
Southeastern	Small Grains	**	**
Southeastern	Other	**	**
Statewide	**Soybeans**	**154**	**181**
Statewide	**Corn**	**154**	**179**
Statewide	**Corn/Alfalfa**	**125**	**163**
Statewide	**Alfalfa**	**131**	**155**
Statewide	**Small Grains**	**125**	**165**
Statewide	**Other**	**139**	**171**

** Less than five responses

[14] Dryland corn is corn with no irrigation

Table 15 details the nitrogen fertilizer rate and corn yield by BMP region on irrigated corn following various crops (CFQ-2, CFQ-3, CFQ-4, CFQ-6 and CFQ-FERT TABLE). These are irrigated corn fields applied with commercial nitrogen fertilizer and no manure applications.

Table 15. Average amount of nitrogen applied and corresponding corn yield by BMP region and previous crop on irrigated corn

BMP Region	Previous Crop	Average Nitrogen Rate on Irrigated Corn Pounds per Acre	Average Corn Yield Bushels per Acre
Northwestern	Soybeans	**	**
Northwestern	Corn	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	172	180
Irrigated and Non-irrigated Sandy Soils	Corn	**	**
Irrigated and Non-irrigated Sandy Soils	Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Other	**	**
Southwestern and West Central	Soybeans	**	**
Southwestern and West Central	Corn	**	**
South Central	Soybeans	**	**
Southeastern	Soybeans	**	**
Southeastern	Corn	**	**
Statewide	**Soybeans**	**164**	**177**
Statewide	**Corn**	**179**	**195**
Statewide	**Alfalfa**	**	**
Statewide	**Other**	**	**

** Less than five responses

Table 16 details the phosphorus fertilizer rate and corn yield by BMP region on corn following various crops (CFQ-3, CFQ-4, CFQ-6 and CFQ-FERT TABLE). These are corn fields applied with commercial phosphorus fertilizer and no manure applications.

Table 16. Average amount of phosphorus applied and corresponding corn yield by BMP region and previous crop

BMP Region	Previous Crop	Average Phosphorus Rate Pounds per Acre	Average Corn Yield Bushels per Acre
Northwestern	Soybeans	52	165
Northwestern	Corn	40	177
Northwestern	Corn/Alfalfa	**	**
Northwestern	Alfalfa	**	**
Northwestern	Small Grains	42	160
Northwestern	Other	59	160
Irrigated and Non-irrigated Sandy Soils	Soybeans	42	166
Irrigated and Non-irrigated Sandy Soils	Corn	35	162
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	57	148
Irrigated and Non-irrigated Sandy Soils	Alfalfa	41	155
Irrigated and Non-irrigated Sandy Soils	Small Grains	47	152
Irrigated and Non-irrigated Sandy Soils	Other	28	142
Southwestern and West Central	Soybeans	55	181
Southwestern and West Central	Corn	50	188
Southwestern and West Central	Alfalfa	**	**
Southwestern and West Central	Small Grains	37	179
Southwestern and West Central	Other	68	196
South Central	Soybeans	51	187
South Central	Corn	50	195
South Central	Alfalfa	**	**
South Central	Small Grains	**	**
Southeastern	Soybeans	49	194
Southeastern	Corn	47	188
Southeastern	Corn/Alfalfa	**	**
Southeastern	Alfalfa	**	**
Southeastern	Small Grains	**	**
Southeastern	Other	**	**
Statewide	**Soybeans**	**51**	**181**
Statewide	**Corn**	**45**	**182**
Statewide	**Corn/Alfalfa**	**53**	**164**
Statewide	**Alfalfa**	**45**	**155**
Statewide	**Small Grains**	**43**	**164**
Statewide	**Other**	**51**	**169**

** Less than five responses

Table 17 details the potassium fertilizer rate and corn yield by BMP region on corn following various crops (CFQ-3, CFQ-4, CFQ-6 and CFQ-FERT TABLE). These are corn fields applied with commercial potassium fertilizer and no manure applications.

Table 17. Average amount of potassium applied and corresponding corn yield by BMP region and previous crop

BMP Region	Previous Crop	Average Potassium Rate Pounds per Acre	Average Corn Yield Bushels per Acre
Northwestern	Soybeans	59	165
Northwestern	Corn	48	175
Northwestern	Corn/Alfalfa	**	**
Northwestern	Alfalfa	**	**
Northwestern	Small Grains	45	160
Northwestern	Other	55	164
Irrigated and Non-irrigated Sandy Soils	Soybeans	65	166
Irrigated and Non-irrigated Sandy Soils	Corn	58	160
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	78	148
Irrigated and Non-irrigated Sandy Soils	Alfalfa	53	152
Irrigated and Non-irrigated Sandy Soils	Small Grains	56	151
Irrigated and Non-irrigated Sandy Soils	Other	91	164
Southwestern and West Central	Soybeans	62	180
Southwestern and West Central	Corn	66	186
Southwestern and West Central	Alfalfa	**	**
Southwestern and West Central	Small Grains	41	163
Southwestern and West Central	Other	53	196
South Central	Soybeans	76	187
South Central	Corn	74	196
South Central	Alfalfa	**	**
South Central	Small Grains	**	**
Southeastern	Soybeans	77	194
Southeastern	Corn	63	189
Southeastern	Corn/Alfalfa	**	**
Southeastern	Alfalfa	**	**
Southeastern	Small Grains	**	**
Southeastern	Other	**	**
Statewide	**Soybeans**	**69**	**181**
Statewide	**Corn**	**64**	**181**
Statewide	**Corn/Alfalfa**	**74**	**164**
Statewide	**Alfalfa**	**57**	**153**
Statewide	**Small Grains**	**54**	**158**
Statewide	**Other**	**76**	**175**

** Less than five responses

Table 18 details the sulfur fertilizer rate and corn yield by BMP region on corn following various crops (CFQ-3, CFQ-4, CFQ-6 and CFQ-FERT TABLE). These are corn fields applied with commercial sulfur fertilizer and no manure applications.

Table 18. Average amount of sulfur applied and corresponding corn yield by BMP region and previous crop

BMP Region	Previous Crop	Average Sulfur Rate Pounds per Acre	Average Corn Yield Bushels per Acre
Northwestern	Soybeans	12	171
Northwestern	Corn	**	**
Northwestern	Corn/Alfalfa	**	**
Northwestern	Small Grains	14	164
Northwestern	Other	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	10	166
Irrigated and Non-irrigated Sandy Soils	Corn	12	162
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Alfalfa	13	152
Irrigated and Non-irrigated Sandy Soils	Small Grains	9	154
Irrigated and Non-irrigated Sandy Soils	Other	9	154
Southwestern and West Central	Soybeans	11	181
Southwestern and West Central	Corn	11	188
Southwestern and West Central	Alfalfa	**	**
Southwestern and West Central	Small Grains	**	**
Southwestern and West Central	Other	**	**
South Central	Soybeans	12	188
South Central	Corn	12	199
South Central	Alfalfa	**	**
South Central	Small Grains	**	**
Southeastern	Soybeans	14	194
Southeastern	Corn	19	190
Southeastern	Corn/Alfalfa	**	**
Southeastern	Alfalfa	**	**
Southeastern	Small Grains	**	**
Southeastern	Other	**	**
Statewide	**Soybeans**	**12**	**182**
Statewide	**Corn**	**13**	**174**
Statewide	**Corn/Alfalfa**	**5**	**185**
Statewide	**Alfalfa**	**9**	**157**
Statewide	**Small Grains**	**13**	**160**
Statewide	**Other**	**7**	**177**

** Less than five responses

Fertilizer Sources and Timing

Table 19 details the respondents and corresponding corn acres by BMP region for all farmers in this study who fall applied nitrogen on the largest corn field (CFQ-FERT TABLE). This table includes all sources of fall applied nitrogen from commercial fertilizer.

Table 19. Average amount of fall applied nitrogen and corresponding corn yield by BMP region

BMP Region	Percent of Respondents: Fall Applied Nitrogen	Average Fall Nitrogen Rate Pounds per Acre	Average Corn Yield Bushels per Acre
Northwestern	11	91	156
Irrigated and Non-irrigated Sandy Soils	5	64	188
Southwestern and West Central	31	97	190
South Central	32	103	193
Southeastern	13	80	204
Statewide	**23**	**97**	**191**

Table 20 details the respondents and corresponding corn acres by BMP region for all farmers in this study who fall applied phosphorus on the largest corn field (CFQ-FERT TABLE). This table includes all sources of fall applied phosphorus from commercial fertilizer.

Table 20. Average amount of fall applied phosphorus and corresponding corn yield by BMP region

BMP Region	Percent of Respondents: Fall Applied Phosphorus	Average Fall Phosphorus Rate Pounds per Acre	Average Corn Yield Bushels per Acre
Northwestern	8	53	170
Irrigated and Non-irrigated Sandy Soils	5	37	189
Southwestern and West Central	18	55	187
South Central	17	53	194
Southeastern	9	51	206
Statewide	**14**	**53**	**191**

Table 21 details the respondents and corresponding corn acres by BMP region for all farmers in this study who fall applied potassium on the largest corn field (CFQ-FERT TABLE). This table includes all sources of fall applied potassium from commercial fertilizer.

Table 21. Average amount of fall applied potassium and corresponding corn yield by BMP region

BMP Region	Percent of Respondents: Fall Applied Potassium	Average Fall Potassium Rate Pounds per Acre	Average Corn Yield Bushels per Acre
Northwestern	8	45	173
Irrigated and Non-irrigated Sandy Soils	6	80	196
Southwestern and West Central	1	65	185
South Central	21	86	196
Southeastern	8	98	200
Statewide	**15**	**76**	**191**

Table 22 details the percent of respondents and corresponding corn acres by BMP region for all farmers in this study who fall applied sulfur on the largest corn field (CFQ-FERT TABLE). This table includes all sources of fall applied sulfur from commercial fertilizer.

Table 22. Average amount of fall applied sulfur and corresponding corn yield by BMP region

BMP Region	Percent of Respondents: Fall Applied Sulfur	Average Fall Sulfur Rate Pounds per Acre	Average Corn Yield Bushels per Acre
Northwestern	**	**	**
Irrigated and Non-irrigated Sandy Soils	3	11	197
Southwestern and West Central	11	9	189
South Central	17	13	196
Southeastern	8	10	201
Statewide	**11**	**11**	**193**

** Less than five responses

Table 23 details the major form of nitrogen fertilizer applied in each BMP region and statewide along with the percent of respondents for those forms (CFQ-9b). 'Other' forms of fertilizer containing nitrogen would include sources of phosphorus, such as MAP or DAP, and sulfur, such as AMS[15], on represented corn fields.

Table 23. The major form of nitrogen applied to the farmer's largest corn field

BMP Region	Major Form of Nitrogen Applied	Percent of Respondents
Northwestern	Anhydrous	3
Northwestern	Urea	94
Northwestern	Liquid Nitrogen	2
Northwestern	Other	1
Northwestern	Unknown	0
Irrigated and Non-irrigated Sandy Soils	Anhydrous	9
Irrigated and Non-irrigated Sandy Soils	Urea	82
Irrigated and Non-irrigated Sandy Soils	Liquid Nitrogen	5
Irrigated and Non-irrigated Sandy Soils	Other	4
Irrigated and Non-irrigated Sandy Soils	Unknown	1
Southwestern and West Central	Anhydrous	18
Southwestern and West Central	Urea	75
Southwestern and West Central	Liquid Nitrogen	7
Southwestern and West Central	Other	<1
Southwestern and West Central	Unknown	0
South Central	Anhydrous	33
South Central	Urea	50
South Central	Liquid Nitrogen	15
South Central	Other	2
South Central	Unknown	0
Southeastern	Anhydrous	24
Southeastern	Urea	65
Southeastern	Liquid Nitrogen	11
Southeastern	Other	0
Southeastern	Unknown	0
Statewide	**Anhydrous**	**20**
Statewide	**Urea**	**69**
Statewide	**Liquid Nitrogen**	**9**
Statewide	**Other**	**2**
Statewide	**Unknown**	**<1**

[15] AMS is the acronym for ammonium sulfate, MAP is monoammonium phosphate, and DAP is diammonium phosphate.

Table 24 details the major form of nitrogen used, average nitrogen rate from all sources, and average corn yield of the 2019 corn crop (CFQ-6, CFQ-9 and CFQ-9b).

Table 24. Average amount of nitrogen applied and corresponding yield by BMP region and type of nitrogen

BMP Region	Major Form of Nitrogen Applied	Average Nitrogen Rate Pound per Acre	Average Corn Yield Bushels per Acre
Northwestern	Anhydrous	**	**
Northwestern	Urea	141	166
Northwestern	Liquid Nitrogen	**	**
Northwestern	Other	**	**
Irrigated and Non-irrigated Sandy Soils	Anhydrous	157	176
Irrigated and Non-irrigated Sandy Soils	Urea	143	160
Irrigated and Non-irrigated Sandy Soils	Liquid Nitrogen	167	188
Irrigated and Non-irrigated Sandy Soils	Other	61	139
Irrigated and Non-irrigated Sandy Soils	Unknown	**	**
Southwestern and West Central	Anhydrous	166	196
Southwestern and West Central	Urea	153	179
Southwestern and West Central	Liquid Nitrogen	148	178
Southwestern and West Central	Other	**	**
South Central	Anhydrous	171	195
South Central	Urea	155	180
South Central	Liquid Nitrogen	159	189
South Central	Other	162	186
Southeastern	Anhydrous	169	195
Southeastern	Urea	151	186
Southeastern	Liquid Nitrogen	121	195
Statewide	**Anhydrous**	**168**	**193**
Statewide	**Urea**	**150**	**175**
Statewide	**Liquid**	**152**	**187**
Statewide	**Other**	**112**	**161**
Statewide	**Unknown**	**	**

** Less than five responses

Table 25 details any commercial fertilizer applied in the fall of 2018 for the 2019 corn crop across all fertilized fields (CFQ-FERT TABLE).

Table 25. Commerical fertilizer applied in the fall of 2018 for the 2019 corn crop

BMP Region	Any Commercial Fertilizer Application in the Fall of 2018	Percent of Respondents
Northwestern	Yes	13
Northwestern	No	87
Irrigated and Non-irrigated Sandy Soils	Yes	6
Irrigated and Non-irrigated Sandy Soils	No	94
Southwestern and West Central	Yes	30
Southwestern and West Central	No	70
South Central	Yes	34
South Central	No	66
Southeastern	Yes	12
Southeastern	No	88
Statewide	**Yes**	**24**
Statewide	**No**	**76**

Table 26 details anhydrous ammonia applied in the fall of 2018 for the 2019 corn crop (CFQ-FERT TABLE).

Table 26. Anhydrous ammonia applied in the fall of 2018 for the 2019 corn crop

BMP Region	Anhydrous Ammonia Application in the Fall of 2018	Percent of Respondents
Northwestern	Yes	2
Northwestern	No	98
Irrigated and Non-irrigated Sandy Soils	Yes	1
Irrigated and Non-irrigated Sandy Soils	No	99
Southwestern and West Central	Yes	13
Southwestern and West Central	No	87
South Central	Yes	15
South Central	No	85
Southeastern	Yes	4
Southeastern	No	96
Statewide	**Yes**	**10**
Statewide	**No**	**90**

Table 27 details urea applied in the fall of 2018 for the 2019 corn crop (CFQ-FERT TABLE).

Table 27. Urea applied in the fall of 2018 for the 2019 corn crop

BMP Region	Urea Application in the Fall of 2018	Percent of Respondents
Northwestern	Yes	4
Northwestern	No	96
Irrigated and Non-irrigated Sandy Soils	Yes	0
Irrigated and Non-irrigated Sandy Soils	No	100
Southwestern and West Central	Yes	6
Southwestern and West Central	No	94
South Central	Yes	3
South Central	No	97
Southeastern	Yes	2
Southeastern	No	98
Statewide	**Yes**	**4**
Statewide	**No**	**96**

Table 28 details liquid nitrogen fertilizer applied in the fall of 2018 for the 2019 corn crop (CFQ-FERT TABLE).

Table 28. Liquid nitrogen fertilizer applied in the fall of 2018 for the 2019 corn crop

BMP Region	Liquid Nitrogen (28%, 32%) Application in the Fall of 2018	Percent of Respondents
Northwestern	Yes	2
Northwestern	No	98
Irrigated and Non-irrigated Sandy Soils	Yes	0
Irrigated and Non-irrigated Sandy Soils	No	100
Southwestern and West Central	Yes	2
Southwestern and West Central	No	98
South Central	Yes	5
South Central	No	95
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**2**
Statewide	**No**	**98**

Table 29 details other fertilizers containing nitrogen applied in the fall of 2018 for the 2019 corn crop (CFQ-FERT TABLE).

Table 29. Other fertilizers containing nitrogen applied in the fall of 2018 for the 2019 corn crop

BMP Region	Other Sources of Fertilizer Containing Nitrogen in the Fall of 2018	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	<1
Irrigated and Non-irrigated Sandy Soils	No	>99
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	1
South Central	No	99
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**<1**
Statewide	**No**	**>99**

Table 30 details phosphorus fertilizer, such as MAP or DAP, applied in the fall of 2018 for the 2019 corn crop (CFQ-FERT TABLE).

Table 30. Fertilizer containing phosphorus applied in the fall of 2018 for the 2019 corn crop

BMP Region	Phosphorus Application in the Fall of 2018	Percent of Respondents
Northwestern	Yes	11
Northwestern	No	89
Irrigated and Non-irrigated Sandy Soils	Yes	5
Irrigated and Non-irrigated Sandy Soils	No	95
Southwestern and West Central	Yes	23
Southwestern and West Central	No	77
South Central	Yes	25
South Central	No	75
Southeastern	Yes	11
Southeastern	No	89
Statewide	**Yes**	**18**
Statewide	**No**	**82**

Table 31 details potassium fertilizer applied in the fall of 2018 for the 2019 corn crop (CFQ-FERT TABLE).[16]

Table 31. Fertilizer containing potassium applied in the fall of 2018 for the 2019 corn crop

BMP Region	Potassium Application in the Fall of 2018	Percent of Respondents
Northwestern	Yes	10
Northwestern	No	90
Irrigated and Non-irrigated Sandy Soils	Yes	6
Irrigated and Non-irrigated Sandy Soils	No	94
Southwestern and West Central	Yes	24
Southwestern and West Central	No	76
South Central	Yes	26
South Central	No	74
Southeastern	Yes	10
Southeastern	No	90
Statewide	**Yes**	**19**
Statewide	**No**	**81**

Table 32 details sulfur fertilizer, such as AMS[17], applied in the fall of 2018 for the 2019 corn crop (CFQ-FERT TABLE).

Table 32. Fertilizer containing sulfur applied in the fall of 2018 for the 2019 corn crop

BMP Region	Sulfur Application in the Fall of 2018	Percent of Respondents
Northwestern	Yes	4
Northwestern	No	96
Irrigated and Non-irrigated Sandy Soils	Yes	2
Irrigated and Non-irrigated Sandy Soils	No	98
Southwestern and West Central	Yes	11
Southwestern and West Central	No	89
South Central	Yes	17
South Central	No	83
Southeastern	Yes	8
Southeastern	No	92
Statewide	**Yes**	**10**
Statewide	**No**	**90**

[16] Potassium, also known as potash (0-0-60), does not contain nitrogen.
[17] AMS is an example of a fertilizer that contains sulfur. There are many fertilizers that contain sulfur.

Table 33 details commercial fertilizer applied in the spring as a preplant for the 2019 corn crop (CFQ-FERT TABLE).

Table 33. Commercial fertilizer in the spring applied as a preplant for the 2019 corn crop

BMP Region	Any Commercial Fertilizer Application as a Preplant in the Spring of 2019	Percent of Respondents
Northwestern	Yes	86
Northwestern	No	14
Irrigated and Non-irrigated Sandy Soils	Yes	69
Irrigated and Non-irrigated Sandy Soils	No	31
Southwestern and West Central	Yes	73
Southwestern and West Central	No	27
South Central	Yes	70
South Central	No	30
Southeastern	Yes	85
Southeastern	No	15
Statewide	**Yes**	**73**
Statewide	**No**	**27**

Table 34 details anhydrous ammonia applied in the spring as a preplant for the 2019 corn crop (CFQ-FERT TABLE).

Table 34. Anhydrous ammonia applied in the spring as a preplant for the 2019 corn crop

BMP Region	Anhydrous Ammonia Application as a Preplant in the Spring of 2019	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	7
Irrigated and Non-irrigated Sandy Soils	No	93
Southwestern and West Central	Yes	4
Southwestern and West Central	No	96
South Central	Yes	14
South Central	No	86
Southeastern	Yes	18
Southeastern	No	82
Statewide	**Yes**	**9**
Statewide	**No**	**91**

Table 35 details urea applied in the spring as a preplant for the 2019 corn crop (CFQ-FERT TABLE).

Table 35. Urea applied in the spring as a preplant for the 2019 corn crop

BMP Region	Urea Application as a Preplant in the Spring of 2019	Percent of Respondents
Northwestern	Yes	81
Northwestern	No	19
Irrigated and Non-irrigated Sandy Soils	Yes	50
Irrigated and Non-irrigated Sandy Soils	No	50
Southwestern and West Central	Yes	59
Southwestern and West Central	No	41
South Central	Yes	39
South Central	No	61
Southeastern	Yes	51
Southeastern	No	49
Statewide	**Yes**	**52**
Statewide	**No**	**48**

Table 36 details liquid nitrogen fertilizer applied in the spring as a preplant for the 2019 corn crop (CFQ-FERT TABLE).

Table 36. Liquid nitrogen fertilizer applied in the spring as a preplant for the 2019 corn crop

BMP Region	Liquid Nitrogen (28%, 32%) Application as a Preplant in the Spring of 2019	Percent of Respondents
Northwestern	Yes	2
Northwestern	No	98
Irrigated and Non-irrigated Sandy Soils	Yes	3
Irrigated and Non-irrigated Sandy Soils	No	97
Southwestern and West Central	Yes	6
Southwestern and West Central	No	94
South Central	Yes	9
South Central	No	91
Southeastern	Yes	13
Southeastern	No	87
Statewide	**Yes**	**7**
Statewide	**No**	**93**

Table 37 details other nitrogen fertilizer sources applied in the spring as a preplant for the 2019 corn crop (CFQ-FERT TABLE).

Table 37. Other nitrogen sources applied in the spring as a preplant for the 2019 corn crop

BMP Region	Other Sources of Nitrogen Fertilizer as a Preplant in the Spring of 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	1
Irrigated and Non-irrigated Sandy Soils	No	99
Southwestern and West Central	Yes	<1
Southwestern and West Central	No	>99
South Central	Yes	1
South Central	No	99
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**1**
Statewide	**No**	**99**

Table 38 details phosphorus fertilizer, such as MAP or DAP, applied in the spring as a preplant for the 2019 corn crop (CFQ-FERT TABLE).

Table 38. Fertilizer containing phosphorus applied in the spring as a preplant for the 2019 corn crop

BMP Region	Phosphorus Application as a Preplant in the Spring of 2019	Percent of Respondents
Northwestern	Yes	78
Northwestern	No	22
Irrigated and Non-irrigated Sandy Soils	Yes	46
Irrigated and Non-irrigated Sandy Soils	No	54
Southwestern and West Central	Yes	53
Southwestern and West Central	No	47
South Central	Yes	50
South Central	No	50
Southeastern	Yes	65
Southeastern	No	35
Statewide	**Yes**	**54**
Statewide	**No**	**46**

Table 39 details potassium fertilizer applied in the spring as a preplant for the 2019 corn crop (CFQ-FERT TABLE).

Table 39. Fertilizer containing potassium applied in the spring as a preplant for the 2019 corn crop

BMP Region	Potassium Application as a Preplant in the Spring of 2019	Percent of Respondents
Northwestern	Yes	73
Northwestern	No	27
Irrigated and Non-irrigated Sandy Soils	Yes	52
Irrigated and Non-irrigated Sandy Soils	No	48
Southwestern and West Central	Yes	53
Southwestern and West Central	No	47
South Central	Yes	50
South Central	No	50
Southeastern	Yes	65
Southeastern	No	35
Statewide	**Yes**	**55**
Statewide	**No**	**45**

Table 40 details sulfur fertilizer, such as AMS, applied in the spring as a preplant for the 2019 corn crop (CFQ-FERT TABLE).

Table 40. Fertilizer containing sulfur applied in the spring as a preplant for the 2019 corn crop

BMP Region	Sulfur Application as a Preplant in the Spring of 2019	Percent of Respondents
Northwestern	Yes	49
Northwestern	No	51
Irrigated and Non-irrigated Sandy Soils	Yes	35
Irrigated and Non-irrigated Sandy Soils	No	65
Southwestern and West Central	Yes	38
Southwestern and West Central	No	62
South Central	Yes	35
South Central	No	65
Southeastern	Yes	44
Southeastern	No	56
Statewide	**Yes**	**38**
Statewide	**No**	**62**

Table 41 details commercial fertilizer applied in the spring as a starter or at planting for the 2019 corn crop (CFQ-FERT TABLE). No anhydrous ammonia was applied as a starter or at planting.

Table 41. Commercial fertilizer applied in the spring at planting for the 2019 corn crop

BMP Region	Any Commercial Fertilizer Application as a Starter or at Planting in the Spring of 2019	Percent of Respondents
Northwestern	Yes	45
Northwestern	No	55
Irrigated and Non-irrigated Sandy Soils	Yes	46
Irrigated and Non-irrigated Sandy Soils	No	54
Southwestern and West Central	Yes	24
Southwestern and West Central	No	76
South Central	Yes	36
South Central	No	64
Southeastern	Yes	41
Southeastern	No	59
Statewide	**Yes**	**35**
Statewide	**No**	**65**

Table 42 details urea applied in the spring as a starter or at planting for the 2019 corn crop (CFQ-FERT TABLE).

Table 42. Urea applied in the spring at planting for the 2019 corn crop

BMP Region	Urea Application as a Starter or at Planting in the Spring of 2019	Percent of Respondents
Northwestern	Yes	6
Northwestern	No	94
Irrigated and Non-irrigated Sandy Soils	Yes	5
Irrigated and Non-irrigated Sandy Soils	No	95
Southwestern and West Central	Yes	1
Southwestern and West Central	No	99
South Central	Yes	1
South Central	No	99
Southeastern	Yes	2
Southeastern	No	98
Statewide	**Yes**	**2**
Statewide	**No**	**98**

Table 43 details liquid nitrogen fertilizer applied in the spring as a starter or at planting for the 2019 corn crop (CFQ-FERT TABLE).

Table 43. Liquid nitrogen fertilizer applied in the spring at planting for the 2019 corn crop

BMP Region	Liquid Nitrogen (28%, 32%) Application as a Starter or at Planting in the Spring of 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	0
Irrigated and Non-irrigated Sandy Soils	No	100
Southwestern and West Central	Yes	1
Southwestern and West Central	No	99
South Central	Yes	1
South Central	No	99
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**1**
Statewide	**No**	**99**

Table 44 details other nitrogen fertilizers applied in the spring or at planting for the 2019 corn crop (CFQ-FERT TABLE).

Table 44. Other nitrogen fertilizers applied in the spring at planting for the 2019 corn crop

BMP Region	Other Nitrogen Fertilizers as a Starter or at Planting in the in the Spring of 2019	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	1
Irrigated and Non-irrigated Sandy Soils	No	99
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	1
South Central	No	99
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**1**
Statewide	**No**	**99**

Table 45 details phosphorus fertilizer, such as MAP or DAP, applied in the spring at planting for the 2019 corn crop (CFQ-FERT TABLE).

Table 45. Fertilizer containing phosphorus applied in the spring at planting for the 2019 corn crop

BMP Region	Phosphorus Application as a Starter or at Planting in the in the Spring of 2019	Percent of Respondents
Northwestern	Yes	41
Northwestern	No	59
Irrigated and Non-irrigated Sandy Soils	Yes	41
Irrigated and Non-irrigated Sandy Soils	No	59
Southwestern and West Central	Yes	22
Southwestern and West Central	No	78
South Central	Yes	34
South Central	No	66
Southeastern	Yes	37
Southeastern	No	63
Statewide	**Yes**	**32**
Statewide	**No**	**68**

Table 46 details potassium fertilizer applied in the spring at planting for the 2019 corn crop (CFQ-FERT TABLE).

Table 46. Fertilizer containing potassium applied in the spring at planting for the 2019 corn crop

BMP Region	Potassium Application as a Starter or at Planting in the in the Spring of 2019	Percent of Respondents
Northwestern	Yes	24
Northwestern	No	76
Irrigated and Non-irrigated Sandy Soils	Yes	34
Irrigated and Non-irrigated Sandy Soils	No	66
Southwestern and West Central	Yes	11
Southwestern and West Central	No	89
South Central	Yes	23
South Central	No	77
Southeastern	Yes	34
Southeastern	No	66
Statewide	**Yes**	**20**
Statewide	**No**	**80**

Table 47 details sulfur fertilizer, such as AMS, applied in the spring at planting for the 2019 corn crop (CFQ-FERT TABLE).

Table 47. Fertilizer containing sulfur applied in the spring at planting for the 2019 corn crop

BMP Region	Sulfur Application as a Starter or at Planting in the in the Spring of 2019	Percent of Respondents
Northwestern	Yes	7
Northwestern	No	93
Irrigated and Non-irrigated Sandy Soils	Yes	25
Irrigated and Non-irrigated Sandy Soils	No	75
Southwestern and West Central	Yes	5
Southwestern and West Central	No	95
South Central	Yes	10
South Central	No	90
Southeastern	Yes	12
Southeastern	No	88
Statewide	**Yes**	**11**
Statewide	**No**	**89**

Table 48 details commercial fertilizers sidedress applied after crop emergence for the 2019 corn crop (CFQ-FERT TABLE).

Table 48. Commercial fertilizers sidedress applied after crop emergence for the 2019 corn crop

BMP Region	Any Commercial Fertilizer as a Sidedress Application After Crop Emergence	Percent of Respondents
Northwestern	Yes	16
Northwestern	No	84
Irrigated and Non-irrigated Sandy Soils	Yes	21
Irrigated and Non-irrigated Sandy Soils	No	79
Southwestern and West Central	Yes	16
Southwestern and West Central	No	84
South Central	Yes	18
South Central	No	82
Southeastern	Yes	16
Southeastern	No	84
Statewide	**Yes**	**18**
Statewide	**No**	**82**

Table 49 details anhydrous ammonia applied as a sidedress after crop emergence the for the 2019 corn crop (CFQ-FERT TABLE).

Table 49. Anhydorus ammonia applied as a sidedress after crop emergence for the 2019 corn crop

BMP Region	Anhydrous Ammonia as a Sidedress Application After Crop Emergence in the Summer of 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	1
Irrigated and Non-irrigated Sandy Soils	No	99
Southwestern and West Central	Yes	3
Southwestern and West Central	No	97
South Central	Yes	3
South Central	No	97
Southeastern	Yes	1
Southeastern	No	99
Statewide	**Yes**	**2**
Statewide	**No**	**98**

Table 50 details urea applied as a sidedress after crop emergence the for the 2019 corn crop (CFQ-FERT TABLE).

Table 50. Urea applied as a sidedress after crop emergence for the 2019 corn crop

BMP Region	Urea as a Sidedress Application After Crop Emergence in the Summer of 2019	Percent of Respondents
Northwestern	Yes	13
Northwestern	No	87
Irrigated and Non-irrigated Sandy Soils	Yes	16
Irrigated and Non-irrigated Sandy Soils	No	84
Southwestern and West Central	Yes	8
Southwestern and West Central	No	92
South Central	Yes	6
South Central	No	94
Southeastern	Yes	12
Southeastern	No	88
Statewide	**Yes**	**10**
Statewide	**No**	**90**

Table 51 details liquid nitrogen fertilizer applied as a sidedress after crop emergence the for the 2019 corn crop (CFQ-FERT TABLE).

Table 51. Liquid nitrogen fertilizer (28%, 32%) applied as a sidedress after crop emergence for the 2019 corn crop

BMP Region	Liquid Nitrogen (28%, 32%) as a Sidedress Application After Crop Emergence in the Summer of 2019	Percent of Respondents
Northwestern	Yes	2
Northwestern	No	98
Irrigated and Non-irrigated Sandy Soils	Yes	3
Irrigated and Non-irrigated Sandy Soils	No	97
Southwestern and West Central	Yes	3
Southwestern and West Central	No	97
South Central	Yes	9
South Central	No	91
Southeastern	Yes	4
Southeastern	No	96
Statewide	**Yes**	**5**
Statewide	**No**	**95**

Table 52 details other nitrogen fertilizers applied as a sidedress after crop emergence the for the 2019 corn crop (CFQ-FERT TABLE).

Table 52. Other nitrogen fertilizers applied as a sidedress after crop emergence for the 2019 corn crop

BMP Region	Other Nitrogen Fertilizers as a Sidedress Application After Crop Emergence in the Summer of 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	2
Irrigated and Non-irrigated Sandy Soils	No	98
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	0
South Central	No	100
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**<1**
Statewide	**No**	**>99**

Table 53 details phosphorus fertilizer, such as MAP or DAP applied as a sidedress after crop emergence the for the 2019 corn crop (CFQ-FERT TABLE).

Table 53. Fertilizer containing phosphorus applied as a sidedress after crop emergence for the 2019 corn crop

BMP Region	Phosphorus Application as a Sidedress Application After Crop Emergence in the Summer of 2019	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	4
Irrigated and Non-irrigated Sandy Soils	No	96
Southwestern and West Central	Yes	2
Southwestern and West Central	No	98
South Central	Yes	3
South Central	No	97
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**2**
Statewide	**No**	**98**

Table 54 details potassium fertilizer applied as a sidedress after crop emergence the for the 2019 corn crop (CFQ-FERT TABLE).

Table 54. Fertilizer containing potassium applied as a sidedress after crop emergence for the 2019 corn crop

BMP Region	Potassium as a Sidedress Application After Crop Emergence in the Summer of 2019	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	5
Irrigated and Non-irrigated Sandy Soils	No	95
Southwestern and West Central	Yes	1
Southwestern and West Central	No	99
South Central	Yes	3
South Central	No	97
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**2**
Statewide	**No**	**98**

Table 55 details sulfur fertilizer, such as AMS, applied as a sidedress after crop emergence the for the 2019 corn crop (CFQ-FERT TABLE).

Table 55. Fertilizer containing sulfur applied as a sidedress after crop emergence for the 2019 corn crop

BMP Region	Sulfur as a Sidedress Application After Crop Emergence in the Summer of 2019	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	5
Irrigated and Non-irrigated Sandy Soils	No	95
Southwestern and West Central	Yes	2
Southwestern and West Central	No	98
South Central	Yes	3
South Central	No	97
Southeastern	Yes	1
Southeastern	No	99
Statewide	**Yes**	**3**
Statewide	**No**	**97**

Table 56 details any commercial fertilizers applied as a top dress after crop emergence the for the 2019 corn crop (CFQ-FERT TABLE).

Table 56. Commercial fertilizers applied as a top dress after crop emergence for the 2019 corn crop

BMP Region	Any Commercial Fertilizer as a Top Dress Application After Crop Emergence	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	8
Irrigated and Non-irrigated Sandy Soils	No	92
Southwestern and West Central	Yes	4
Southwestern and West Central	No	96
South Central	Yes	2
South Central	No	98
Southeastern	Yes	3
Southeastern	No	97
Statewide	**Yes**	**4**
Statewide	**No**	**96**

Table 57 details urea applied as a top dress after crop emergence the for the 2019 corn crop (CFQ-FERT TABLE).

Table 57. Urea applied as a top dress after crop emergence for the 2019 corn crop

BMP Region	Urea as a Top Dress Application After Crop Emergence in the Summer of 2019	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	7
Irrigated and Non-irrigated Sandy Soils	No	93
Southwestern and West Central	Yes	3
Southwestern and West Central	No	97
South Central	Yes	0
South Central	No	100
Southeastern	Yes	3
Southeastern	No	97
Statewide	**Yes**	**3**
Statewide	**No**	**97**

Table 58 details liquid nitrogen applied as a top dress after crop emergence the for the 2019 corn crop (CFQ-FERT TABLE).

Table 58. Liquid nitrogen fertilizer (28%, 32%) applied as a top dress after crop emergence for the 2019 corn crop

BMP Region	Liquid Nitrogen (28%, 32%) as a Top Dress Application After Crop Emergence in the Summer of 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	<1
Irrigated and Non-irrigated Sandy Soils	No	>99
Southwestern and West Central	Yes	1
Southwestern and West Central	No	99
South Central	Yes	1
South Central	No	99
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**1**
Statewide	**No**	**99**

Table 59 details other nitrogen fertilizers applied as a top dress after crop emergence the for the 2019 corn crop (CFQ-FERT TABLE).

Table 59. Other nitrogen fertilizers applied as a top dress after crop emergence for the 2019 corn crop

BMP Region	Other Nitrogen Fertilizers as a Top Dress Application After Crop Emergence in the Summer of 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	<1
Irrigated and Non-irrigated Sandy Soils	No	>99
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	0
South Central	No	100
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**<1**
Statewide	**No**	**>99**

Table 60 details phosphorus fertilizer, such as MAP or DAP, applied as a top dress after crop emergence the for the 2019 corn crop (CFQ-FERT TABLE).

Table 60. Fertilizer containing phosphorus applied as a top dress after crop emergence for the 2019 corn crop

BMP Region	Phosphorus as a Top Dress Application After Crop Emergence in the Summer of 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	1
Irrigated and Non-irrigated Sandy Soils	No	99
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	0
South Central	No	100
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**<1**
Statewide	**No**	**>99**

Table 61 details potassium fertilizer applied as a top dress after crop emergence the for the 2019 corn crop (CFQ-FERT TABLE).

Table 61. Fertilizer containing potassium applied as a top dress after crop emergence for the 2019 corn crop

BMP Region	Potassium as a Top Dress Application After Crop Emergence in the Summer of 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	1
Irrigated and Non-irrigated Sandy Soils	No	99
Southwestern and West Central	Yes	<1
Southwestern and West Central	No	>99
South Central	Yes	0
South Central	No	100
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**<1**
Statewide	**No**	**>99**

Table 62 details sulfur fertilizer, such as AMS, applied as a top dress after crop emergence the for the 2019 corn crop (CFQ-FERT TABLE).

Table 62. Fertilizer containing sulfur applied as a top dress after crop emergence for the 2019 corn crop

BMP Region	Sulfur as a Top Dress Application After Crop Emergence in the Summer of 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	2
Irrigated and Non-irrigated Sandy Soils	No	98
Southwestern and West Central	Yes	1
Southwestern and West Central	No	99
South Central	Yes	<1
South Central	No	>99
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**1**
Statewide	**No**	**99**

Table 63 details commercial fertilizers applied through irrigation or fertigation for the 2019 corn crop (CFQ-FERT TABLE).

Table 63. Commercial fertilizers applied through irrigation or fertigation for the 2019 corn crop

BMP Region	Any Commercial Fertilizer Application Through Irrigation	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	5
Irrigated and Non-irrigated Sandy Soils	No	95
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	0
South Central	No	100
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**1**
Statewide	**No**	**99**

Figure 2 details the form of nitrogen that was applied to corn acres statewide based on total pounds of nitrogen applied (CFQ-FERT TABLE).

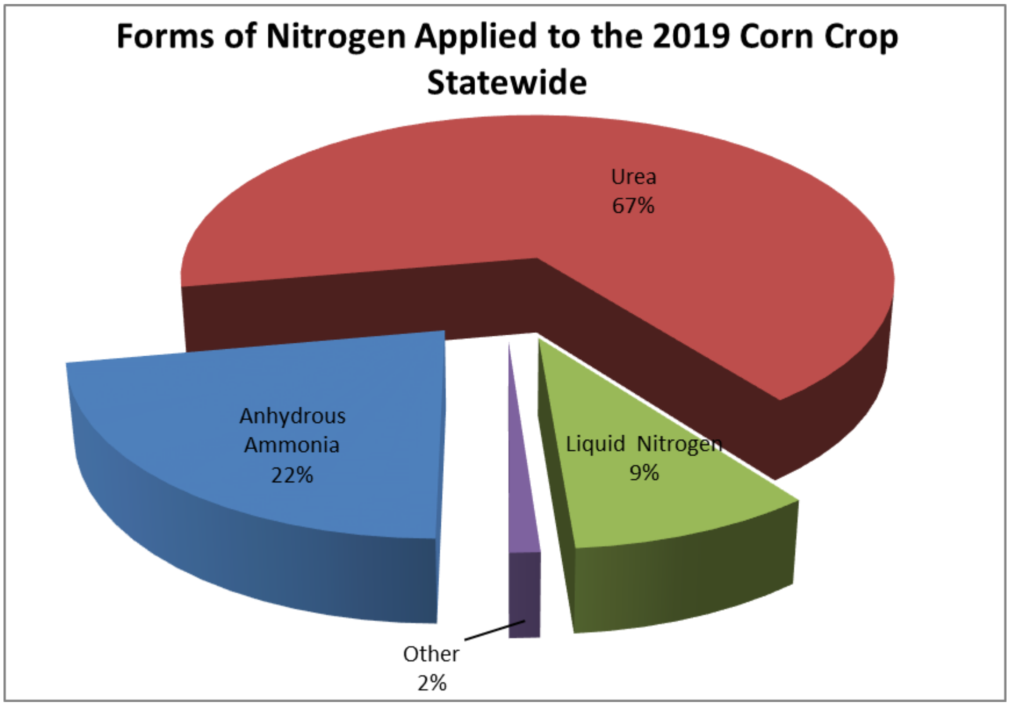

Figure 2. The form of the nitrogen applied to corn acres in state for the 2019 crop year for all fields applied with nitrogen fertilizer (Based on total pounds applied)

Figure 3 details the form of nitrogen that was applied to corn acres in the SW BMP region based on total pounds of nitrogen applied (CFQ-FERT TABLE).

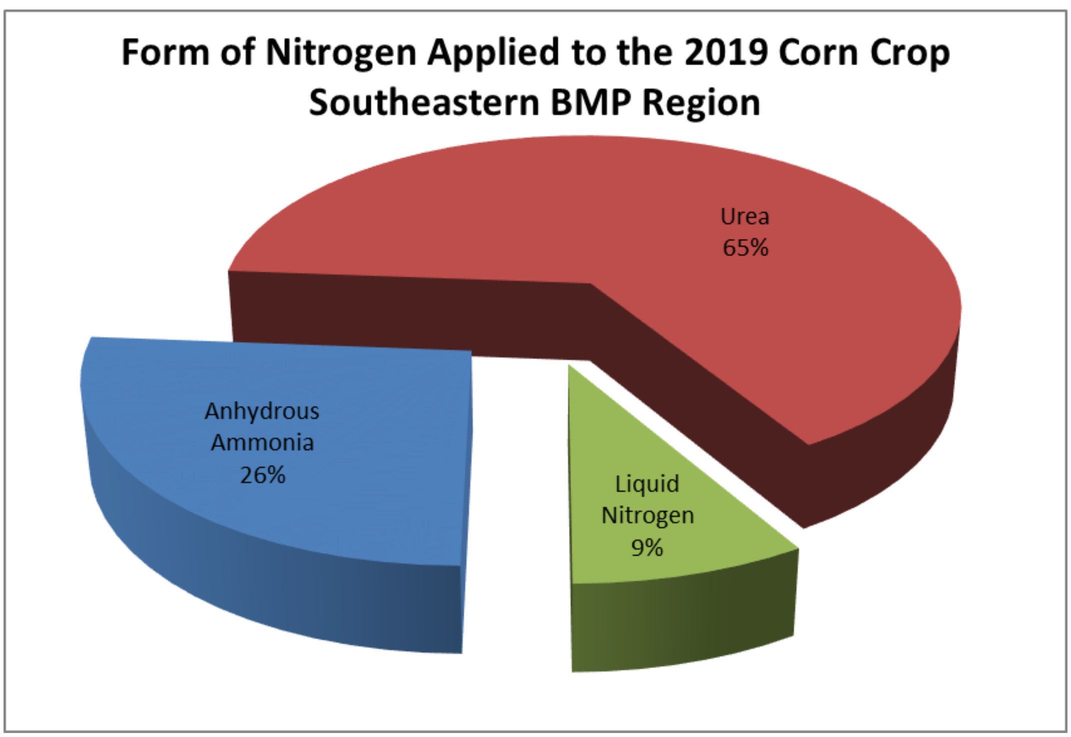

Figure 3. The form of the nitrogen applied to corn acres in the SE BMP region for the 2019 crop year for all fields applied with nitrogen fertilizer

Figure 4 details the form of nitrogen that was applied to corn acres in the SC BMP region based on total pounds of nitrogen applied (CFQ-FERT TABLE).

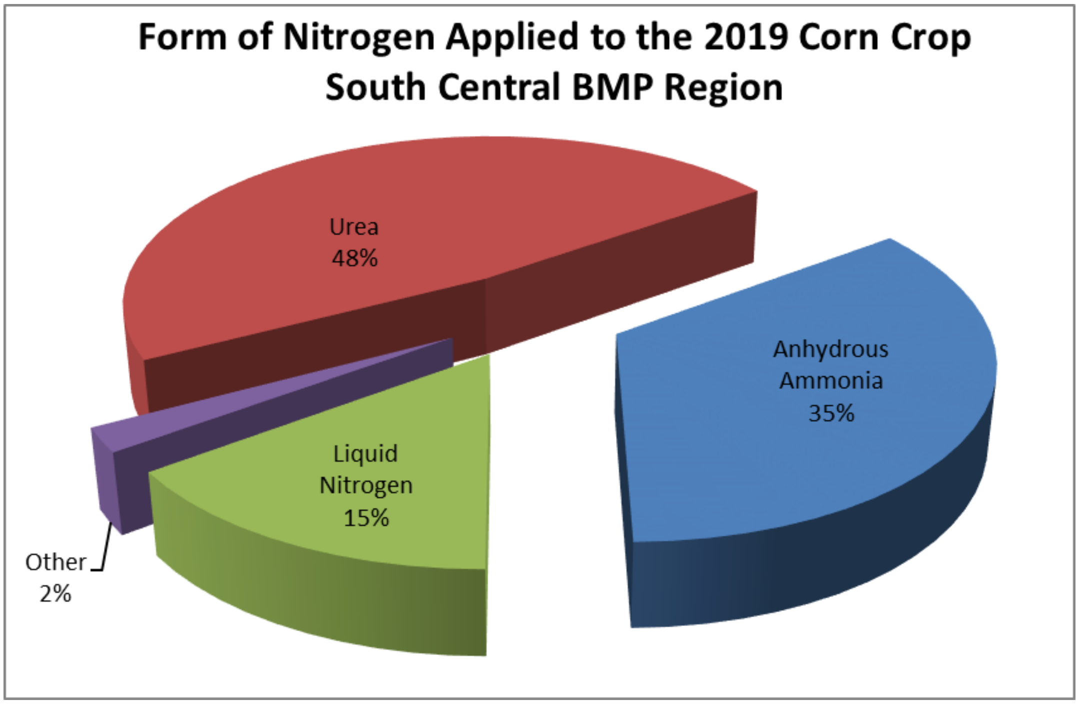

Figure 4. The form of the nitrogen applied to corn acres in the SC BMP region for the 2019 crop year for all fields applied with nitrogen fertilizer

Figure 5 details the form of nitrogen that was applied to corn acres in the SW BMP region based on total pounds of nitrogen applied (CFQ-FERT TABLE).

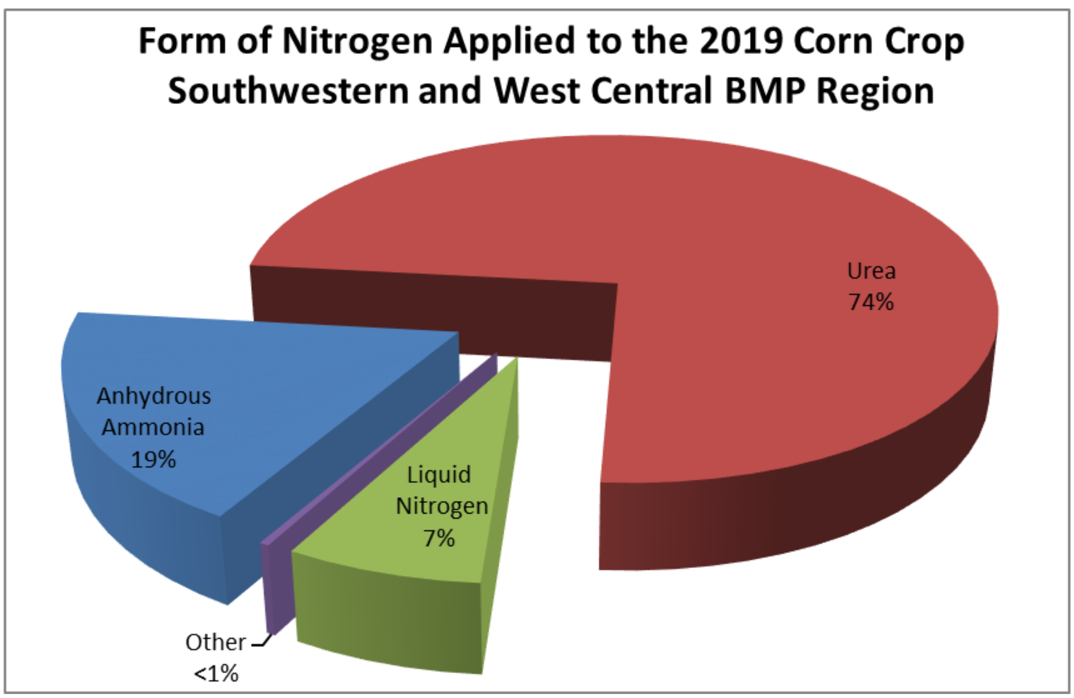

Figure 5. The form of the nitrogen applied to corn acres in the SW BMP region for the 2019 crop year for all fields applied with nitrogen fertilizer

Figure 6 details the form of nitrogen that was applied to corn acres in the NW BMP region based on total pounds of nitrogen applied (CFQ-FERT TABLE).

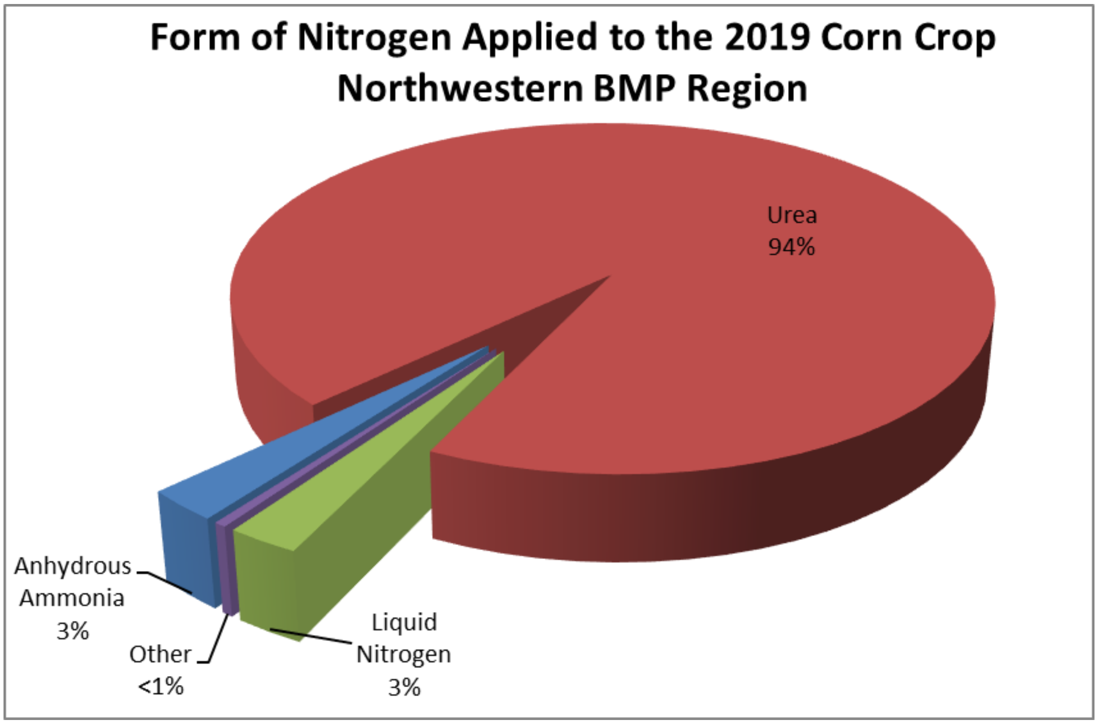

Figure 6. The form of the nitrogen applied to corn acres in the NW BMP region for the 2019 crop year for all fields applied with nitrogen fertilizer

Figure 7 details the form of nitrogen that was applied to corn acres in the IRR BMP region based on total pounds of nitrogen applied (CFQ-FERT TABLE).

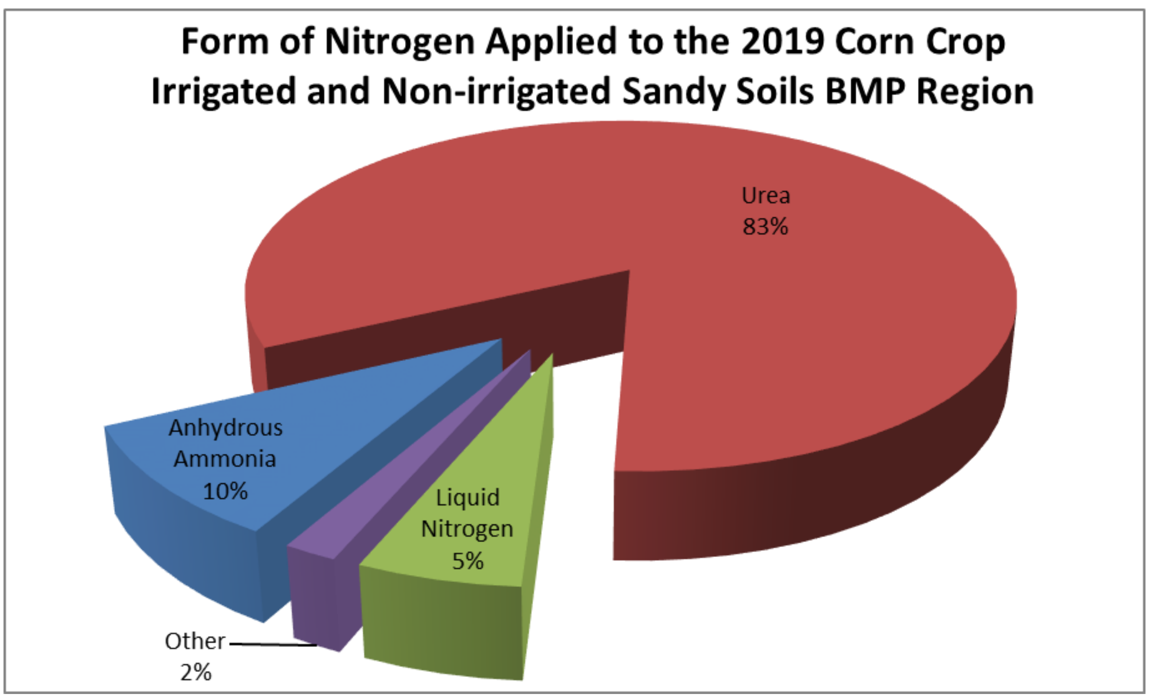

Figure 7. The form of the nitrogen applied to corn acres in the IRR BMP region for the 2019 crop year for all fields applied with nitrogen fertilizer

Figure 8 details the application timing of anhydrous ammonia on corn acres in Minnesota for the largest field by pounds of nitrogen applied (CFQ-FERT TABLE).

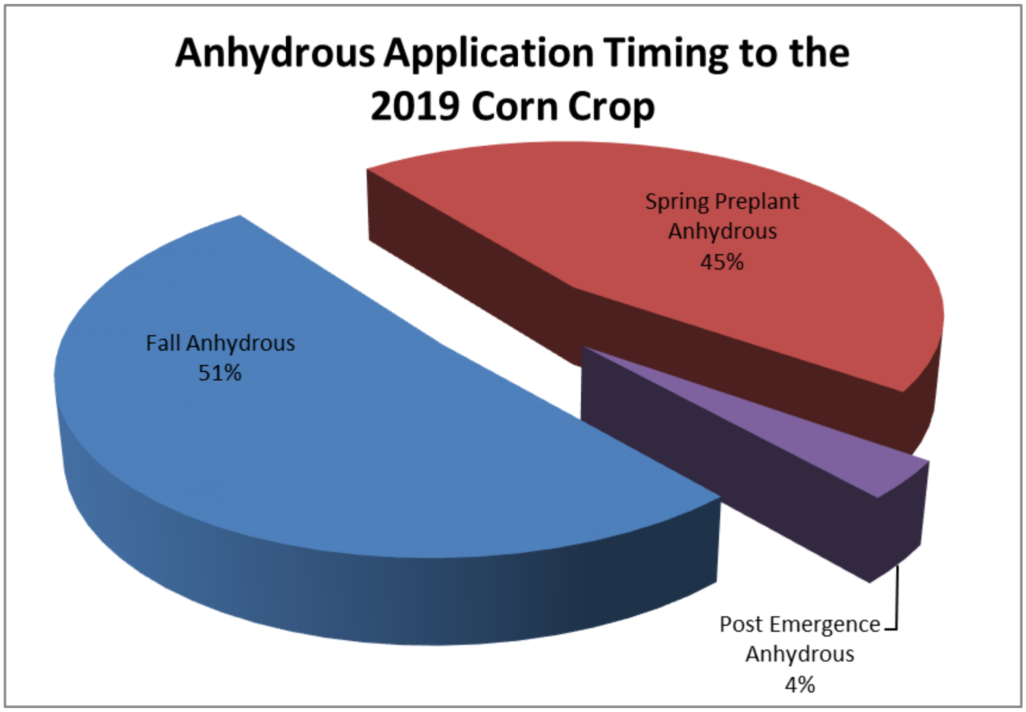

Figure 8. The application timing of anhydrous ammonia to corn acres in Minnesota by pounds of nitrogen applied in the 2019 crop year

Figure 9 details the application timing of urea on corn acres in Minnesota for the largest field by pounds of nitrogen applied (CFQ-FERT TABLE).

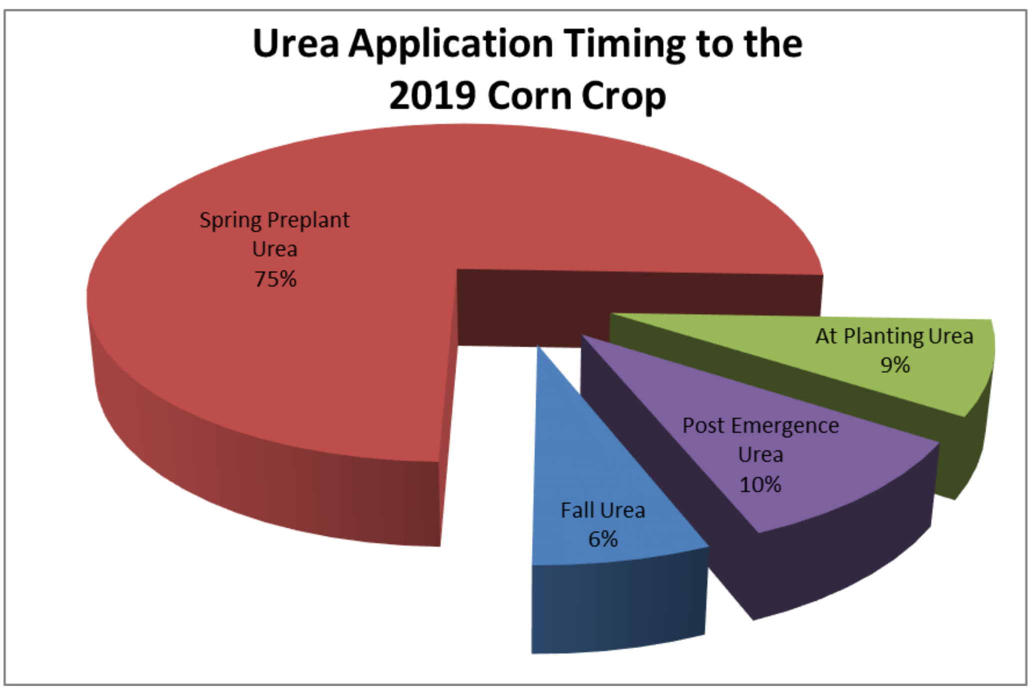

Figure 9. The application timing of urea to corn acres in Minnesota by pounds of nitrogen applied in the 2019 crop year

Figure 10 details the application timing of liquid nitrogen fertilizer on corn acres in Minnesota for the largest field by pounds of nitrogen applied (CFQ-FERT TABLE).

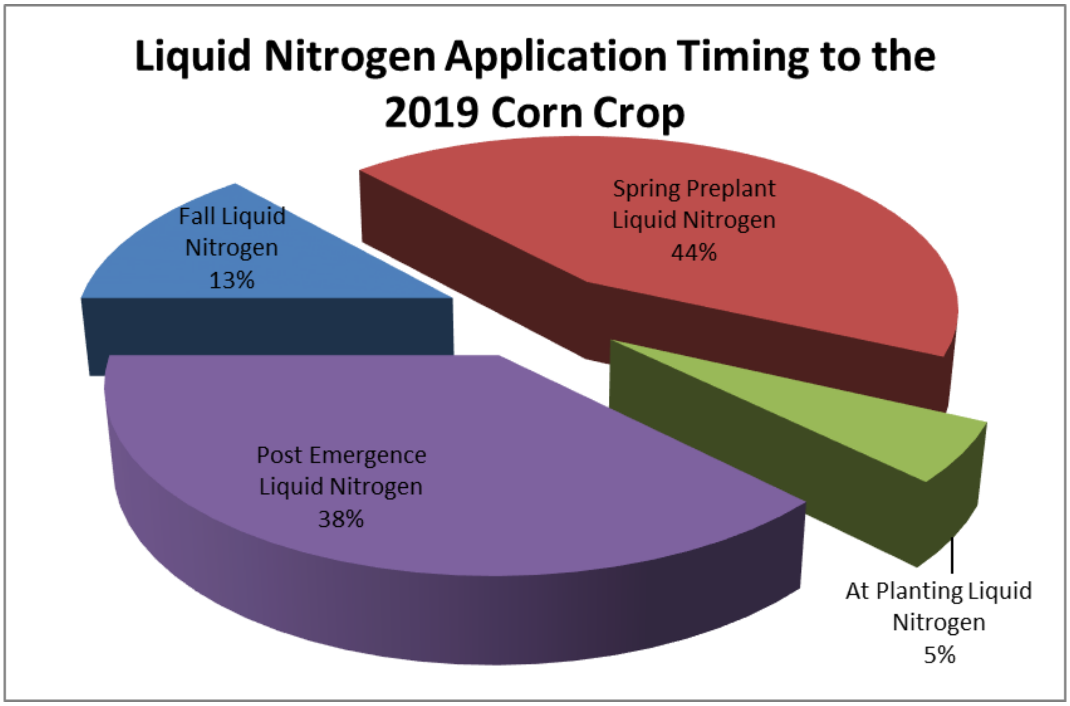

Figure 10. The application timing of liquid nitrogen fertilizer to corn acres in Minnesota by pounds of nitrogen applied in the 2019 crop year

Figure 11 details the application timing of other nitrogen sources on corn acres in Minnesota for the largest field by pounds of nitrogen applied (CFQ-FERT TABLE).

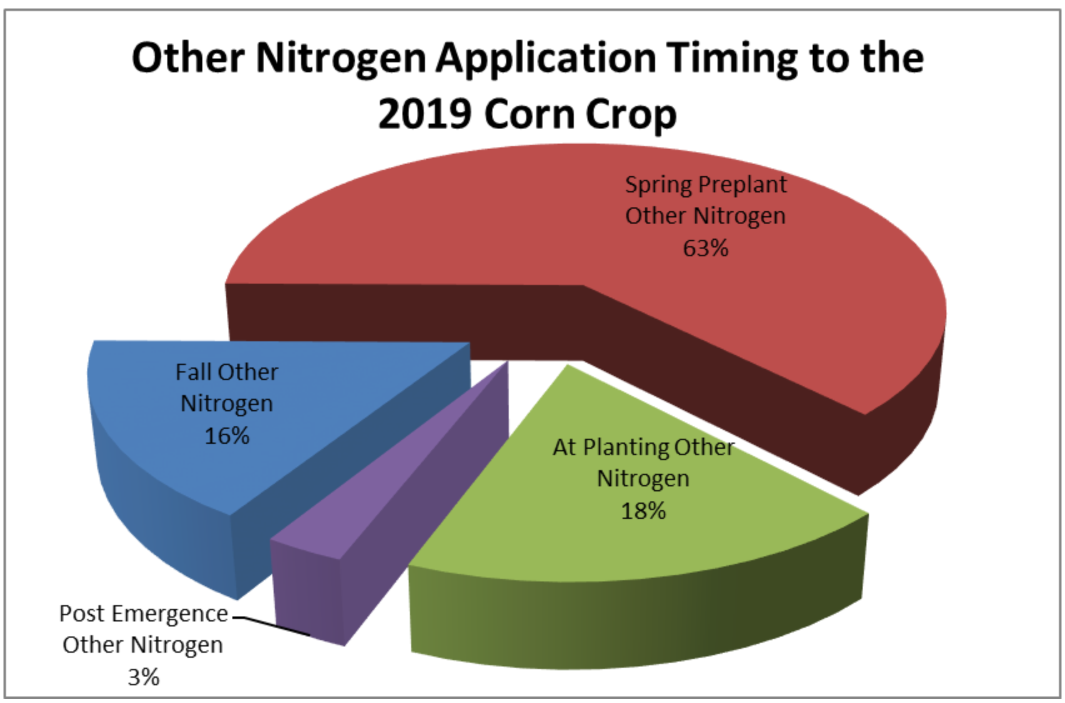

Figure 11. The application timing of other nitrogen sources to corn acres in Minnesota by pounds of nitrogen applied in the 2019 crop year

Figure 12 details the application timing of phosphorus on corn acres in Minnesota for the largest field by pounds of phosphorus applied (CFQ-FERT TABLE).

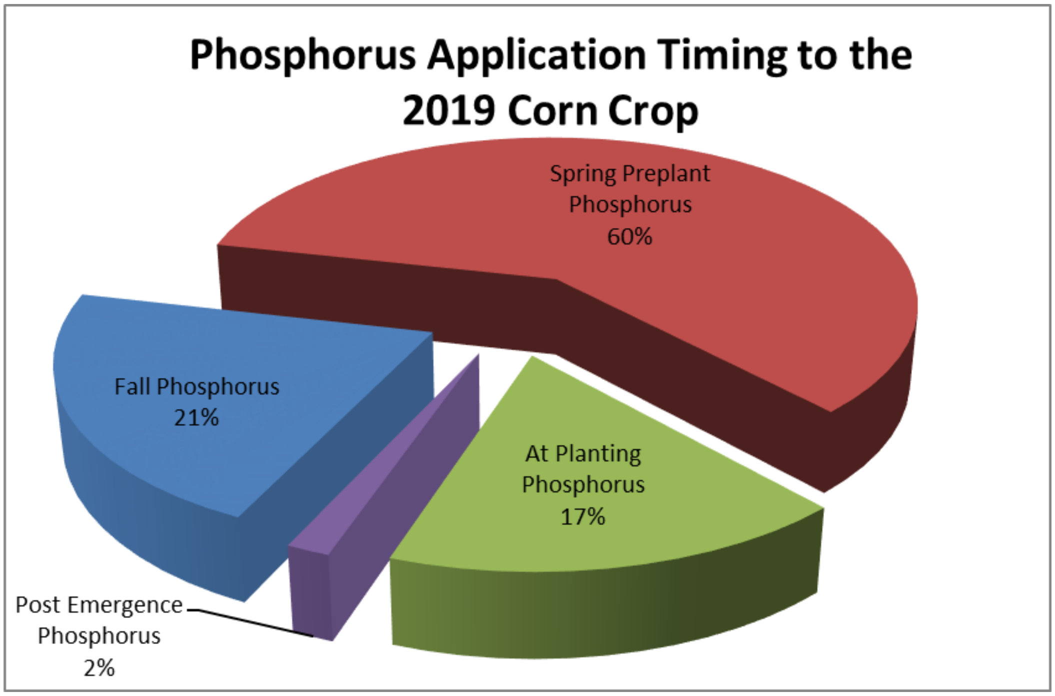

Figure 12. The application timing of phosphorus to corn acres in Minnesota by pounds of phosphorus applied in the 2019 crop year

Figure 13 details the application timing of potassium on corn acres in Minnesota for the largest field by pounds of potassium applied (CFQ-FERT TABLE).

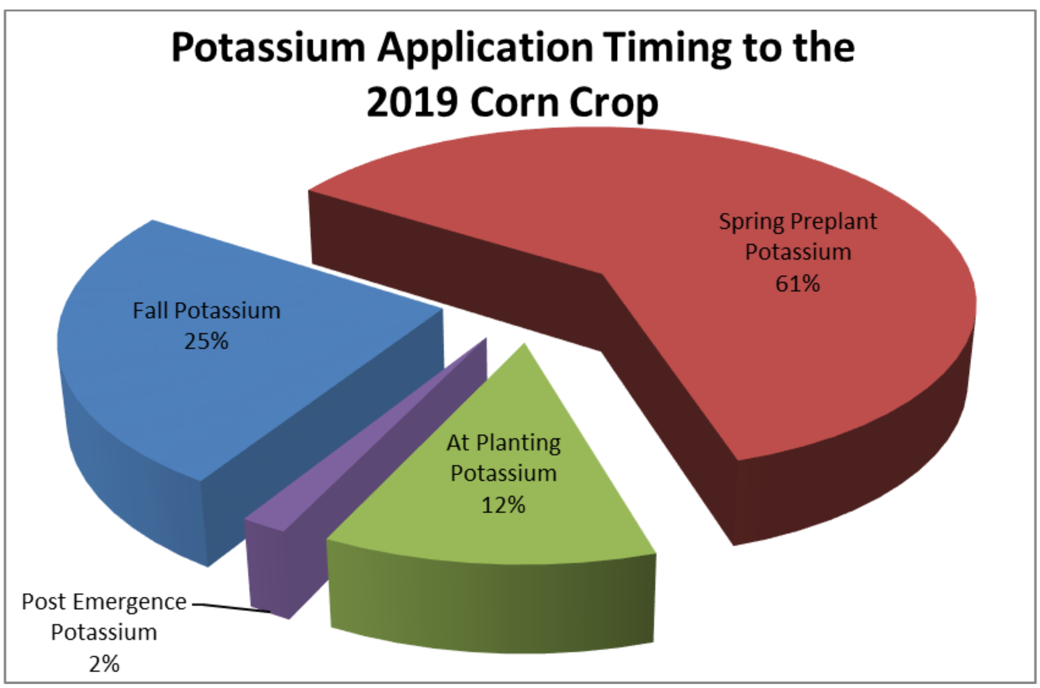

Figure 13. The application timing of potassium to corn acres in Minnesota by pounds of potassium applied in the 2019 crop year

Figure 14 details the application timing of sulfur on corn acres in Minnesota for the largest field by pounds of sulfur applied (CFQ-FERT TABLE).

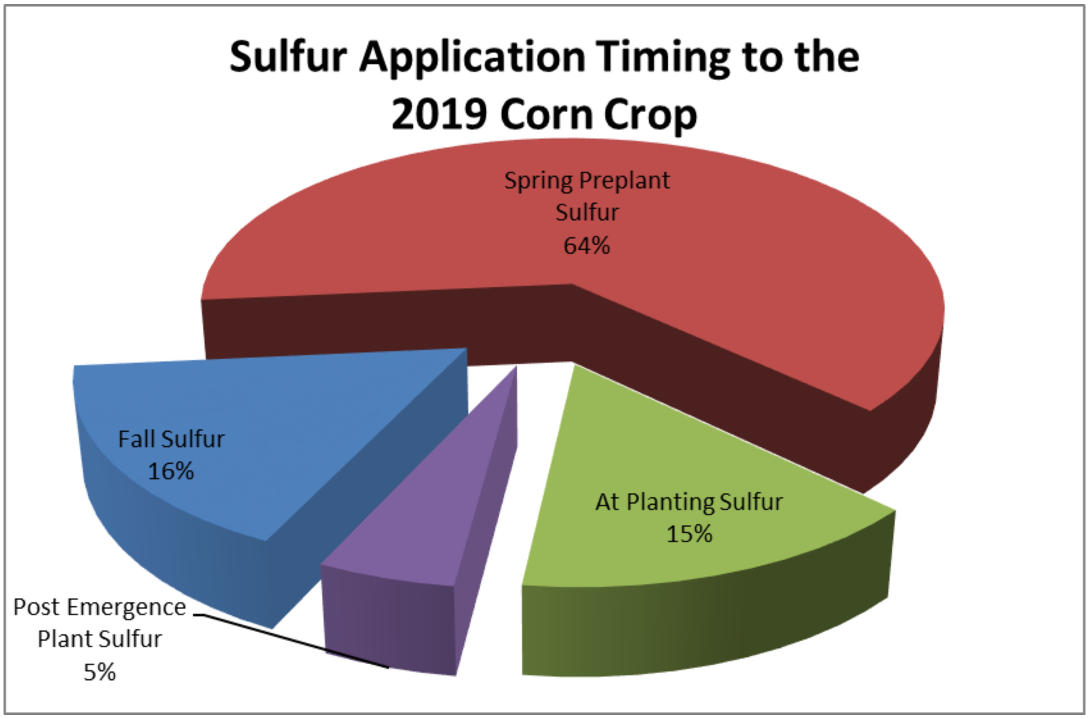

Figure 14. The application timing of sulfur to corn acres in Minnesota by pounds of sulfur applied in the 2019 crop year

Farmers were asked “Did you use a nitrogen inhibitor or stabilizer on this field?”

Table 64 details the percent of respondents that used a nitrogen inhibitor or stabilizer in the fall of 2018 or in 2019 for the 2019 corn crop on the farmer’s largest field (CFQ-6 and CFQ-10).

Table 64. Nitrogen inhibitor or stabilizer use for the 2019 corn crop

BMP Region	Nitrogen Inhibitor or Stabilizer Use	Percent of Respondents	Average Corn Yield Bushels per Acre
Northwestern	Yes	34	169
Northwestern	No	65	163
Northwestern	Don’t Know	**	**
Irrigated and Non-irrigated Sandy Soils	Yes	36	171
Irrigated and Non-irrigated Sandy Soils	No	63	158
Irrigated and Non-irrigated Sandy Soils	Don’t Know	1	123
Southwestern and West Central	Yes	40	185
Southwestern and West Central	No	58	180
Southwestern and West Central	Don’t Know	**	**
South Central	Yes	32	192
South Central	No	65	185
South Central	Don’t Know	3	166
Southeastern	Yes	32	198
Southeastern	No	67	185
Southeastern	Don’t Know	**	**
Statewide	Yes	**36**	**185**
Statewide	No	**62**	**177**
Statewide	Don’t Know	**2**	**160**

** Less than five responses

Application Method of Fertilizer on Corn

Fertilizer application practices are used by farmers to get nutrients to the corn crop's root system as efficiently as possible as well as to prevent nutrient losses. Only anhydrous ammonia applications are injected. Fertigation refers to applying fertilizer to the corn crop through irrigation pivots.

Table 65 details the application practices of any fertilizer applied in the fall of 2018 for the 2019 corn crop (CFQ-FERT TABLE). There were 5,178 corn fields represented in Minnesota.

Table 65. Application practices of any fertilizer applied in fall of 2018 for the 2019 corn crop

BMP Region	Application Practice of Any Fertilizer Applied in the Fall of 2018 for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	62
Northwest	Broadcast - Not Incorporated	15
Northwest	Injected	18
Northwest	Other	5
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	89
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	1
Irrigated and Non-Irrigated Sandy Soils	Injected	10
Southwestern and West Central	Broadcast - Incorporated	58
Southwestern and West Central	Broadcast - Not Incorporated	6
Southwestern and West Central	Injected	36
South Central	Broadcast - Incorporated	58
South Central	Broadcast - Not Incorporated	4
South Central	Injected	38
Southeastern	Broadcast - Incorporated	55
Southeastern	Broadcast - Not Incorporated	12
Southeastern	Injected	33
Statewide	**Broadcast - Incorporated**	**59**
Statewide	**Broadcast - Not Incorporated**	**6**
Statewide	**Injected**	**35**
Statewide	**Other**	**<1**

Table 66 details the application practices of urea applied in the fall of 2018 for the 2019 corn crop (CFQ-FERT TABLE). There were 2,064 corn fields represented in Minnesota.

Table 66. Application practices of urea applied in fall in the fall of 2018 for the 2019 corn crop

BMP Region	Application Practice of Urea Applied in the Fall of 2018 for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	67
Northwest	Broadcast - Not Incorporated	24
Northwest	Other	9
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	100
Southwestern and West Central	Broadcast - Incorporated	91
Southwestern and West Central	Broadcast - Not Incorporated	9
South Central	Broadcast - Incorporated	92
South Central	Broadcast - Not Incorporated	8
Southeastern	Broadcast - Incorporated	78
Southeastern	Broadcast - Not Incorporated	21
Statewide	**Broadcast - Incorporated**	**90**
Statewide	**Broadcast - Not Incorporated**	**10**
Statewide	**Other**	**<1**

Less than five responses reported application practices of:

- Liquid nitrogen (28% or 32%) in the fall of 2018 for the 2019 corn crop.
- Other sources of nitrogen in the fall of 2018 for the 2019 corn crop.

Table 67 details the application practices of fertilizers containing phosphorus, such as MAP or DAP, in the fall of 2018 for the 2019 corn crop (CFQ-FERT TABLE). There were 2,084 corn fields represented in Minnesota.

Table 67. Application practices of fertilizers containing phosphorus applied in the fall of 2018 for the 2019 corn crop

BMP Region	Application Practice of Phosphorus Applied in the Fall of 2018 for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	78
Northwest	Broadcast - Not Incorporated	22
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	98
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	2
Southwestern and West Central	Broadcast - Incorporated	93
Southwestern and West Central	Broadcast - Not Incorporated	7
South Central	Broadcast - Incorporated	97
South Central	Broadcast - Not Incorporated	3
Southeastern	Broadcast - Incorporated	82
Southeastern	Broadcast - Not Incorporated	18
Statewide	**Broadcast - Incorporated**	**90**
Statewide	**Broadcast - Not Incorporated**	**10**

Table 68 details the application practices of fertilizers containing potassium in the fall of 2018 for the 2019 corn crop (CFQ-FERT TABLE). There were 3,124 corn fields represented in Minnesota.

Table 68. Application practices of fertilizers containing potassium in the fall of 2018 for the 2019 corn crop

BMP Region	Application Practice of Potassium Applied in the Fall of 2018 for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	75
Northwest	Broadcast - Not Incorporated	25
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	99
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	1
Southwestern and West Central	Broadcast - Incorporated	90
Southwestern and West Central	Broadcast - Not Incorporated	10
South Central	Broadcast - Incorporated	96
South Central	Broadcast - Not Incorporated	4
Southeastern	Broadcast - Incorporated	81
Southeastern	Broadcast - Not Incorporated	19
Statewide	**Broadcast - Incorporated**	**92**
Statewide	**Broadcast - Not Incorporated**	**8**

Table 69 details the application practices of fertilizers containing sulfur, such as AMS, in the fall of 2018 for the 2019 corn crop (CFQ-FERT TABLE). There were corn 1,841 fields represented in Minnesota.

Table 69. Application practices of fertilizers containing sulfur in the fall of 2018 for the 2019 corn crop

BMP Region	Application Practice of Sulfur Applied in the Fall of 2018 for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	**
Northwest	Broadcast - Not Incorporated	**
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	97
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	3
Southwestern and West Central	Broadcast - Incorporated	90
Southwestern and West Central	Broadcast - Not Incorporated	10
South Central	Broadcast - Incorporated	95
South Central	Broadcast - Not Incorporated	5
Southeastern	Broadcast - Incorporated	73
Southeastern	Broadcast - Not Incorporated	27
Statewide	**Broadcast - Incorporated**	**92**
Statewide	**Broadcast - Not Incorporated**	**8**

** Less than five responses

Table 70 details the application practices of any fertilizer applied in the spring as a preplant for the 2019 corn crop (CFQ-FERT TABLE). Only anhydrous ammonia is injected. There were corn 16,112 fields represented in Minnesota.

Table 70. Application practices of any fertilizer applied in the spring as a preplant for the 2019 corn crop

BMP Region	Application Practice of Any Fertilizer Applied in the Spring as a Preplant for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	93
Northwest	Broadcast - Not Incorporated	4
Northwest	Injected	1
Northwest	Other	3
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	86
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	6
Irrigated and Non-Irrigated Sandy Soils	Injected	7
Irrigated and Non-Irrigated Sandy Soils	Other	1
Southwestern and West Central	Broadcast - Incorporated	90
Southwestern and West Central	Broadcast - Not Incorporated	6
Southwestern and West Central	Injected	3
Southwestern and West Central	Other	1
South Central	Broadcast - Incorporated	79
South Central	Broadcast - Not Incorporated	4
South Central	Injected	16
South Central	Other	1
Southeastern	Broadcast - Incorporated	78
Southeastern	Broadcast - Not Incorporated	9
Southeastern	Injected	13
Statewide	**Broadcast - Incorporated**	**84**
Statewide	**Broadcast - Not Incorporated**	**6**
Statewide	**Injected**	**9**
Statewide	**Other**	**1**

Table 71 details the application practices of urea applied in the spring as a preplant for the 2019 corn crop (CFQ-FERT TABLE). There were 11,604 corn fields represented in Minnesota.

Table 71. Application practices of urea applied as a preplant in the spring for the 2019 corn crop

BMP Region	Application Practice of Urea Applied in the Spring as a Preplant for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	93
Northwest	Broadcast - Not Incorporated	4
Northwest	Other	3
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	92
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	8
Southwestern and West Central	Broadcast - Incorporated	93
Southwestern and West Central	Broadcast - Not Incorporated	7
South Central	Broadcast - Incorporated	94
South Central	Broadcast - Not Incorporated	5
South Central	Other	1
Southeastern	Broadcast - Incorporated	88
Southeastern	Broadcast - Not Incorporated	12
Statewide	**Broadcast - Incorporated**	**92**
Statewide	**Broadcast - Not Incorporated**	**7**
Statewide	**Other**	**1**

Table 72 details the application practices of liquid nitrogen (28% or 32%) applied in the spring as a preplant for the 2019 corn crop (CFQ-FERT TABLE). There were 1,109 corn fields represented in Minnesota.

Table 72. Application practices of liquid nitrogen applied as a preplant in the spring for the 2019 corn crop

BMP Region	Application Practice of Liquid (28% or 32%) Applied in the Spring as a Preplant for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	**
Northwest	Broadcast - Not Incorporated	**
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	**
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	**
Southwestern and West Central	Broadcast - Incorporated	96
Southwestern and West Central	Other	4
South Central	Broadcast - Incorporated	89
South Central	Broadcast - Not Incorporated	11
Southeastern	Broadcast - Incorporated	66
Southeastern	Broadcast - Not Incorporated	34
Statewide	**Broadcast - Incorporated**	**88**
Statewide	**Broadcast - Not Incorporated**	**11**
Statewide	**Other**	**1**

** Less than five responses

Table 73 details the application practices of other sources of nitrogen applied in the spring as a preplant for the 2019 corn crop (CFQ-FERT TABLE). There were 179 corn fields represented in Minnesota.

Table 73. Application practices of other sources of nitrogen applied as a preplant in the spring for the 2019 corn crop

BMP Region	Application Practice of Other Sources of N Applied in the Spring as a Preplant for the 2019 Corn Crop	Percent of Respondents
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	100
Southwestern and West Central	Broadcast - Incorporated	**
South Central	Broadcast - Incorporated	**
Statewide	**Broadcast - Incorporated**	**100**

** Less than five responses

Table 74 details the application practices of fertilizers containing phosphorus, such as MAP or DAP, in the spring as a preplant for the 2019 corn crop (CFQ-FERT TABLE). There were 10,915 corn fields represented in Minnesota.

Table 74. Application practices of fertilizers containing phosphorus applied as a preplant in the spring for the 2019 corn crop

BMP Region	Application Practice of Phosphorus Applied in the Spring as a Preplant for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	93
Northwest	Broadcast - Not Incorporated	5
Northwest	Other	3
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	94
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	5
Irrigated and Non-Irrigated Sandy Soils	Other	1
Southwestern and West Central	Broadcast - Incorporated	94
Southwestern and West Central	Broadcast - Not Incorporated	6
Southwestern and West Central	Other	<1
South Central	Broadcast - Incorporated	95
South Central	Broadcast - Not Incorporated	5
South Central	Other	<1
Southeastern	Broadcast - Incorporated	89
Southeastern	Broadcast - Not Incorporated	11
Statewide	**Broadcast - Incorporated**	**93**
Statewide	**Broadcast - Not Incorporated**	**6**
Statewide	**Other**	**1**

Table 75 details the application practices of fertilizers containing potassium applied in the spring as a preplant for the 2019 corn crop (CFQ-FERT TABLE). There were 11,135 corn fields represented in Minnesota.

Table 75. Application practices of fertilizers containing potassium applied as a preplant in the spring for the 2019 corn crop

BMP Region	Application Practice of Potassium Applied in the Spring as a Preplant for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	92
Northwest	Broadcast - Not Incorporated	5
Northwest	Other	3
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	94
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	4
Irrigated and Non-Irrigated Sandy Soils	Other	1
Southwestern and West Central	Broadcast - Incorporated	94
Southwestern and West Central	Broadcast - Not Incorporated	6
South Central	Broadcast - Incorporated	96
South Central	Broadcast - Not Incorporated	3
South Central	Other	<1
Southeastern	Broadcast - Incorporated	89
Southeastern	Broadcast - Not Incorporated	11
Statewide	**Broadcast - Incorporated**	**94**
Statewide	**Broadcast - Not Incorporated**	**5**
Statewide	**Other**	**1**

Table 76 details the application practices of fertilizers containing sulfur applied in the spring as a preplant for the 2019 corn crop (CFQ-FERT TABLE). There were 7,776 corn fields represented in Minnesota.

Table 76. Application practices of fertilizers containing sulfur as a preplant in the spring for the 2019 corn crop

BMP Region	Application Practice of Sulfur Applied in the Spring as a Preplant for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	88
Northwest	Broadcast - Not Incorporated	7
Northwest	Other	5
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	96
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	2
Irrigated and Non-Irrigated Sandy Soils	Other	2
Southwestern and West Central	Broadcast - Incorporated	93
Southwestern and West Central	Broadcast - Not Incorporated	6
Southwestern and West Central	Other	1
South Central	Broadcast - Incorporated	93
South Central	Broadcast - Not Incorporated	7
Southeastern	Broadcast - Incorporated	81
Southeastern	Broadcast - Not Incorporated	19
Statewide	**Broadcast - Incorporated**	**92**
Statewide	**Broadcast - Not Incorporated**	**7**
Statewide	**Other**	**1**

Table 77 details the application practices of any fertilizer applied in the spring at planting for the 2019 corn crop (CFQ-FERT TABLE). There were 7,741 corn fields represented in Minnesota.

Table 77. Application practices of any fertilizer applied at planting for the 2019 corn crop

BMP Region	Application Practice of Any Fertilizer Applied in the Spring at Planting for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	9
Northwest	With planter	91
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	23
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	3
Irrigated and Non-Irrigated Sandy Soils	With planter	73
Irrigated and Non-Irrigated Sandy Soils	Other	1
Southwestern and West Central	Broadcast - Incorporated	15
Southwestern and West Central	Broadcast - Not Incorporated	4
Southwestern and West Central	With planter	81
South Central	Broadcast - Incorporated	13
South Central	With planter	87
Southeastern	Broadcast - Incorporated	18
Southeastern	Broadcast - Not Incorporated	3
Southeastern	With planter	79
Statewide	**Broadcast - Incorporated**	**16**
Statewide	**Broadcast - Not Incorporated**	**2**
Statewide	**With planter**	**81**
Statewide	**Other**	**1**

Table 78 details the application practices of urea applied in the spring at planting for the 2019 corn crop (CFQ-FERT TABLE). There were 5,086 corn fields represented in Minnesota.

Table 78. Application practices of urea applied at planting in the spring for the 2019 corn crop

BMP Region	Application Practice of Urea Applied in the Spring at Planting for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	10
Northwest	With planter	90
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	26
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	3
Irrigated and Non-Irrigated Sandy Soils	With planter	70
Irrigated and Non-Irrigated Sandy Soils	Other	1
Southwestern and West Central	Broadcast - Incorporated	18
Southwestern and West Central	Broadcast - Not Incorporated	3
Southwestern and West Central	With planter	79
South Central	Broadcast - Incorporated	29
South Central	With planter	71
Southeastern	Broadcast - Incorporated	25
Southeastern	With planter	75
Statewide	**Broadcast - Incorporated**	**23**
Statewide	**Broadcast - Not Incorporated**	**2**
Statewide	**With planter**	**75**
Statewide	**Other**	**<1**

Table 79 details the application practices of liquid nitrogen (28% or 32%) in the spring at planting for the 2019 corn crop (CFQ-FERT TABLE). There were 784 corn fields represented in Minnesota.

Table 79. Application practices of liquid nitrogen (28% or 32%) applied at planting in the spring for the 2019 corn crop

BMP Region	Application Practice of Liquid (28% or 32%) Applied in the Spring at Planting for the 2019 Corn Crop	Percent of Respondents
Northwest	With planter	**
Irrigated and Non-Irrigated Sandy Soils	With planter	100
Southwestern and West Central	Broadcast - Incorporated	38
Southwestern and West Central	Broadcast - Not Incorporated	27
Southwestern and West Central	With planter	35
South Central	Broadcast - Incorporated	5
South Central	Broadcast - Not Incorporated	95
Southeastern	Broadcast - Incorporated	**
Southeastern	With planter	**
Statewide	**Broadcast - Incorporated**	**12**
Statewide	**Broadcast - Not Incorporated**	**4**
Statewide	**With planter**	**84**

** Less than five responses

Table 80 details the application practices of other sources of nitrogen applied in the spring at planting for the 2019 corn crop (CFQ-FERT TABLE). There were 179 corn fields represented in Minnesota.

Table 80. Application practices of other sources of nitrogen applied at planting in the spring for the 2019 corn crop

BMP Region	Application Practice of Other Sources of N Applied in the Spring at Planting for the 2019 Corn Crop	Percent of Respondents
Northwest	With planter	**
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	27
Irrigated and Non-Irrigated Sandy Soils	With planter	73
South Central	With planter	**
Statewide	**Broadcast - Incorporated**	**12**
Statewide	**With planter**	**88**

** Less than five responses

Table 81 details the application practices of fertilizers containing phosphorus, such as MAP or DAP, in the spring at planting for the 2019 corn crop (CFQ-FERT TABLE). There were 7,061 corn fields represented in Minnesota.

Table 81. Application practices of fertilizers containing phosphorus at planting in the spring for the 2019 corn crop

BMP Region	Application Practice of Phosphorus Applied in the Spring at Planting for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	5
Northwest	With planter	95
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	18
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	3
Irrigated and Non-Irrigated Sandy Soils	With planter	79
Irrigated and Non-Irrigated Sandy Soils	Other	<1
Southwestern and West Central	Broadcast - Incorporated	15
Southwestern and West Central	Broadcast - Not Incorporated	2
Southwestern and West Central	With planter	83
South Central	Broadcast - Incorporated	12
South Central	With planter	88
Southeastern	Broadcast - Incorporated	19
Southeastern	With planter	81
Statewide	**Broadcast - Incorporated**	**15**
Statewide	**Broadcast - Not Incorporated**	**1**
Statewide	**With planter**	**84**
Statewide	**Other**	**<1**

Table 82 details the application practices of fertilizers containing potassium in the in the spring at planting for the 2019 corn crop (CFQ-FERT TABLE). There were 4,526 corn fields represented in Minnesota.

Table 82. Application practices of fertilizers containing potassium at planting in the spring for the 2019 corn crop

BMP Region	Application Practice of Potassium Applied in the Spring at Planting for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	5
Northwest	With planter	95
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	24
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	2
Irrigated and Non-Irrigated Sandy Soils	With planter	72
Irrigated and Non-Irrigated Sandy Soils	Other	1
Southwestern and West Central	Broadcast - Incorporated	24
Southwestern and West Central	Broadcast - Not Incorporated	4
Southwestern and West Central	With planter	72
South Central	Broadcast - Incorporated	24
South Central	With planter	76
Southeastern	Broadcast - Incorporated	18
Southeastern	With planter	82
Statewide	**Broadcast - Incorporated**	**22**
Statewide	**Broadcast - Not Incorporated**	**1**
Statewide	**With planter**	**77**
Statewide	**Other**	**<1**

Table 83 details the application practices of fertilizers containing sulfur, such as AMS, in the in the spring at planting for the 2019 corn crop (CFQ-FERT TABLE). There were 2,416 corn fields represented in Minnesota.

Table 83. Application practices of fertilizers containing sulfur at planting in the spring for the 2019 corn crop

BMP Region	Application Practice of Sulfur Applied in the Spring at Planting for the 2019 Corn Crop	Percent of Respondents
Northwest	Broadcast - Incorporated	16
Northwest	With planter	84
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	34
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	4
Irrigated and Non-Irrigated Sandy Soils	With planter	60
Irrigated and Non-Irrigated Sandy Soils	Other	2
Southwestern and West Central	Broadcast - Incorporated	39
Southwestern and West Central	Broadcast - Not Incorporated	9
Southwestern and West Central	With planter	52
South Central	Broadcast - Incorporated	38
South Central	With planter	62
Southeastern	Broadcast - Incorporated	35
Southeastern	Broadcast - Not Incorporated	10
Southeastern	With planter	55
Statewide	**Broadcast - Incorporated**	**35**
Statewide	**Broadcast - Not Incorporated**	**4**
Statewide	**With planter**	**60**
Statewide	**Other**	**1**

Table 84 details the application practices of any fertilizer applied as a sidedress, top dress, or through irrigation for the 2019 corn crop (CFQ-FERT TABLE). There were 5,079 corn fields represented in Minnesota.

Table 84. Application practices of any fertilizer applied as a sidedress, injected, top dress, or through irrigation (fertigation) for the 2019 corn crop

BMP Region	Application Practice of Any Fertilizer Applied as a Sidedress, Top Dress, or Through Irrigation for the 2019 Corn Crop	Percent of Respondents
Northwest	Sidedress	96
Northwest	Top Dress	4
Irrigated and Non-Irrigated Sandy Soils	Sidedress	68
Irrigated and Non-Irrigated Sandy Soils	Top Dress	16
Irrigated and Non-Irrigated Sandy Soils	Irrigation	16
Southwestern and West Central	Sidedress	82
Southwestern and West Central	Top Dress	17
Southwestern and West Central	Irrigation	1
South Central	Sidedress	92
South Central	Top Dress	8
Southeastern	Sidedress	86
Southeastern	Top Dress	14
Statewide	**Sidedress**	**82**
Statewide	**Top Dress**	**13**
Statewide	**Irrigation**	**5**

Table 85 details the application practices of urea applied as a sidedress or a top dress for the 2019 corn crop (CFQ-FERT TABLE). There were 2,874 corn fields represented in Minnesota.

Table 85. Application practices of urea applied as a sidedress or top dress for the 2019 corn crop

BMP Region	Application Practice of Urea Applied as a Sidedress or Top Dress for the 2019 Corn Crop	Percent of Respondents
Northwest	Sidedress	95
Northwest	Top Dress	5
Irrigated and Non-Irrigated Sandy Soils	Sidedress	78
Irrigated and Non-Irrigated Sandy Soils	Top Dress	22
Southwestern and West Central	Sidedress	82
Southwestern and West Central	Top Dress	18
South Central	Sidedress	93
South Central	Top Dress	7
Southeastern	Sidedress	82
Southeastern	Top Dress	18
Statewide	**Sidedress**	**83**
Statewide	**Top Dress**	**17**

Table 86 details the application practices of liquid nitrogen (28% or 32%) applied as a sidedress, top dress, or through irrigation for the 2019 corn crop (CFQ-FERT TABLE). There were 1,314 corn fields represented in Minnesota.

Table 86. Application practices of liquid nitrogen applied as a sidedress, top dress, or through irrigation for the 2019 corn crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Sidedress	**
Irrigated and Non-Irrigated Sandy Soils	Sidedress	51
Irrigated and Non-Irrigated Sandy Soils	Irrigation	49
Southwestern and West Central	Sidedress	75
Southwestern and West Central	Top Dress	25
South Central	Sidedress	89
South Central	Top Dress	11
Southeastern	Sidedress	**
Statewide	**Sidedress**	**81**
Statewide	**Top Dress**	**11**
Statewide	**Irrigation**	**8**

** Less than five responses

Less than five responses reported application practices of other sources of nitrogen as a sidedress or top dress for the 2019 corn crop.

Table 87 details the application practices of fertilizers containing phosphorus, such as MAP or DAP, as a sidedress or top dress for the 2019 corn crop. There were 483 corn fields represented in Minnesota.

Table 87. Application practices of fertilizers containing phosphorus as a sidedress or top dress for the 2019 corn crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Sidedress	**
Irrigated and Non-Irrigated Sandy Soils	Sidedress	85
Irrigated and Non-Irrigated Sandy Soils	Top Dress	15
Southwestern and West Central	Sidedress	87
Southwestern and West Central	Top Dress	13
South Central	Sidedress	100
Southeastern	Sidedress	**
Statewide	**Sidedress**	**90**
Statewide	**Top Dress**	**10**

** Less than five responses

Table 88 details the application practices of fertilizers containing potassium as a sidedress or top dress for the 2019 corn crop. There were 512 corn fields represented in Minnesota.

Table 88. Application practices of fertilizers containing potassium as a sidedress or top dress for the 2019 corn crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Sidedress	**
Irrigated and Non-Irrigated Sandy Soils	Sidedress	73
Irrigated and Non-Irrigated Sandy Soils	Top Dress	27
Southwestern and West Central	Sidedress	82
Southwestern and West Central	Top Dress	18
South Central	Sidedress	100
Statewide	**Sidedress**	**90**
Statewide	**Top Dress**	**10**

** Less than five responses

Table 89 details the application practices of fertilizers containing sulfur, such as AMS, as a sidedress or top dress for the 2019 corn crop. There were 749 corn fields represented in Minnesota.

Table 89. Application practices applications of fertilizers containing sulfur as a sidedress or top dress in the spring for the 2019 corn crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Sidedress	**
Irrigated and Non-Irrigated Sandy Soils	Sidedress	80
Irrigated and Non-Irrigated Sandy Soils	Top Dress	20
Southwestern and West Central	Sidedress	81
Southwestern and West Central	Top Dress	19
South Central	Sidedress	91
South Central	Top Dress	9
Southeastern	Sidedress	**
Statewide	**Sidedress**	**84**
Statewide	**Top Dress**	**16**

** Less than five responses

The following tables and figures in the remaining corn section represent the 21,261 statistically weighted respondents that reported on their largest corn field including fertilizer rate, timing, and previous crop planted. Fertilizer rates are based on the rate for each nutrient applied (nitrogen rate for fields fertilized with nitrogen, phosphorus rate for fields fertilized with phosphorus, potassium rate for fields fertilized with potassium, and sulfur rate for fields fertilized with sulfur). Nutrient rates are only published if there are more than five responses.

Statewide: Corn Following Soybeans

Statewide, seventy-seven percent of the represented fields reported were corn following soybeans. Figure 15 details the BMP regions where farmers reported on fields with corn following soybeans. There were 16,446 fields represented in Minnesota.[18]

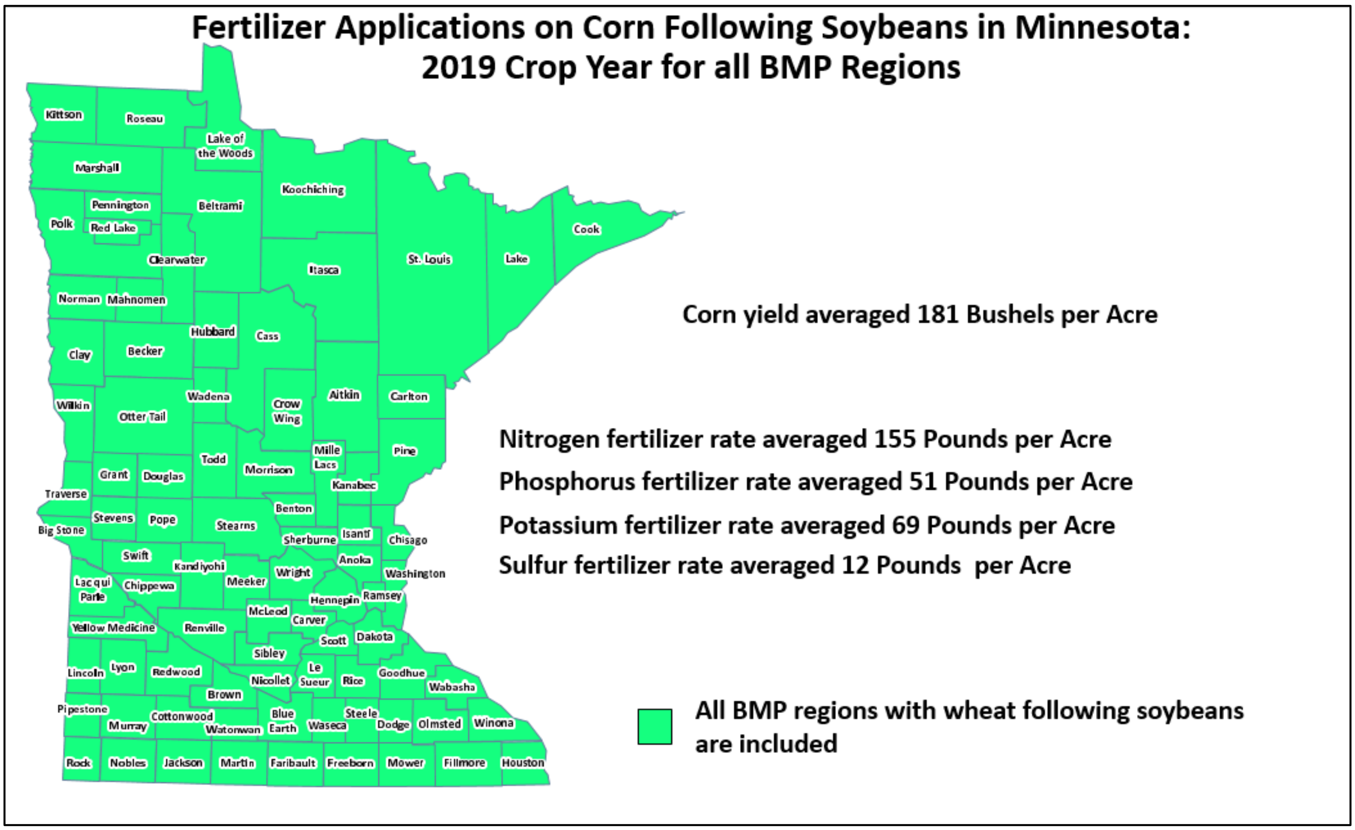

Figure 15. The average corn yield and average fertilizer rate for corn following soybeans in Minnesota

[18] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2018 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 93% applied phosphorus, 90% applied potassium, and 63% applied sulfur on fields with corn following soybeans.

Figure 16 provides the distribution of average nitrogen fertilizer rate in Minnesota for corn following soybeans; the corresponding corn yield is detailed in red. Nitrogen rates are only from commercial fertilizer.

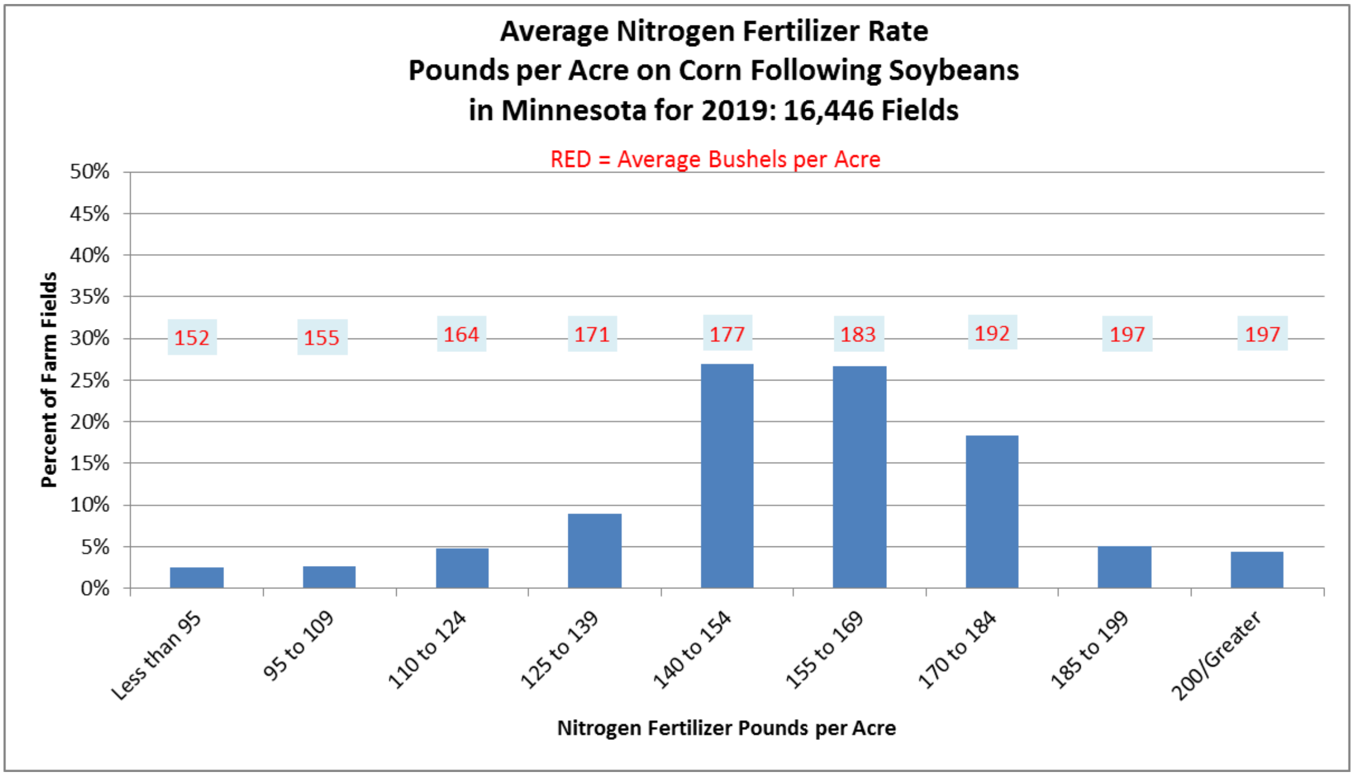

Figure 16. Average nitrogen fertilizer rate and yield on corn following soybeans in Minnesota for 2019: 16,446 fields

In Minnesota, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following soybeans are shown in Table 90.

Table 90. Average fertilizer rate and yield on fertilized corn fields in Minnesota for corn following soybeans

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient[19] Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields[20] Pounds per Acre
Nitrogen	100	155	181	155
Phosphorus	93	51	181	47
Potassium	90	69	181	62
Sulfur	63	12	182	7

[19] Represents the average rate of a nutrient on fields receiving the same nutrient. For example, 51 pounds per acre of phosphorus was applied on fields receiving phosphorus. Fields not receiving phosphorus were not included.

[20] Represents the average rate of a nutrient on all fields receiving fertilizer. For example, 47 pounds per acre of phosphorus was applied on fields receiving fertilizer. This could include MAP, DAP, urea, anhydrous ammonia, etc.

Southeastern BMP Region: Corn Following Soybeans

There were 1,609 fields that were represented in the SE BMP region for the corn following soybeans analysis. Figure 17 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for corn following soybeans in the SE BMP region.[21]

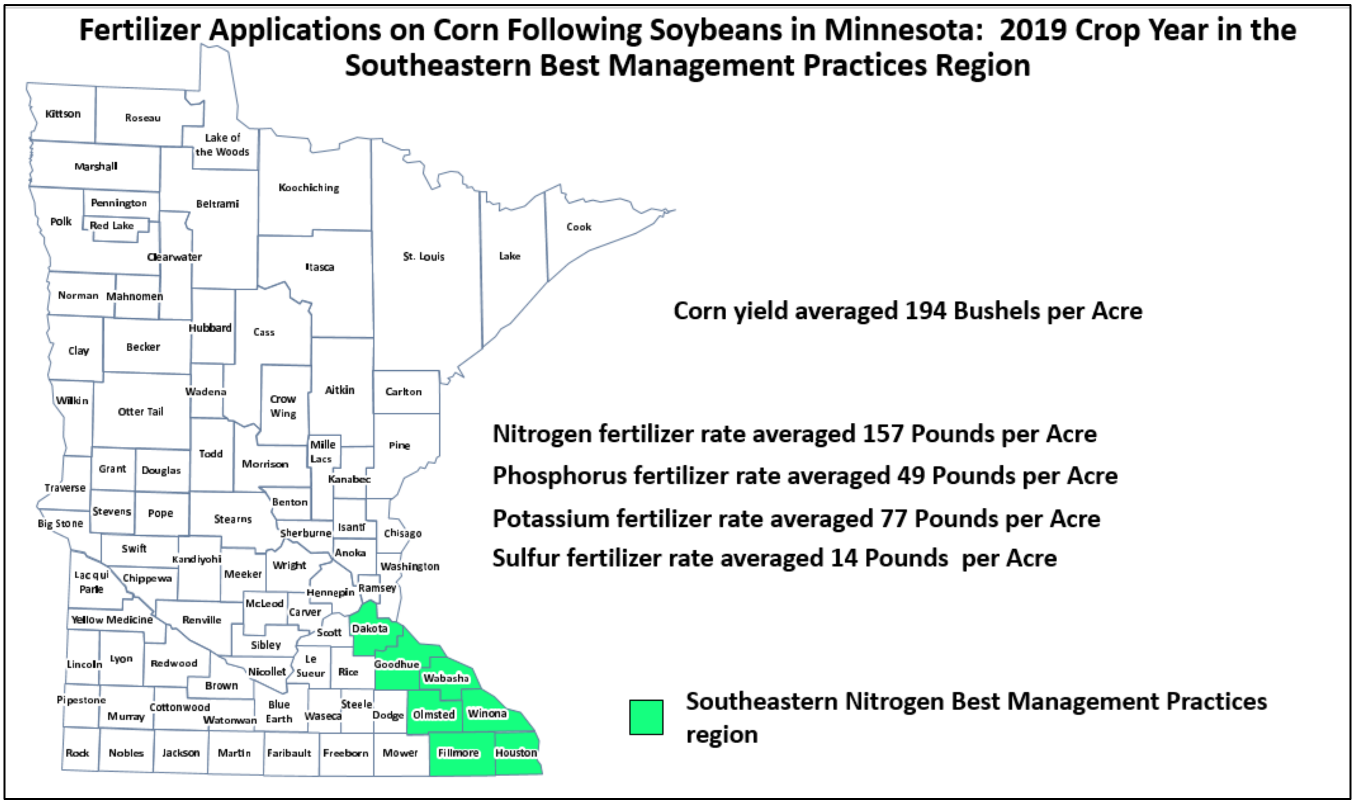

Figure 17. The average corn yield and average fertilizer rate for corn following soybeans in the SE BMP region

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[21] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 97% applied phosphorus, 99% applied potassium, and 64% applied sulfur on fields with corn following soybeans.

Figure 18 provides the distribution of nitrogen fertilizer rate in the SE BMP region for corn following soybeans; the corresponding corn yield are detailed in red.[22] Nitrogen rates are only from commercial fertilizer.

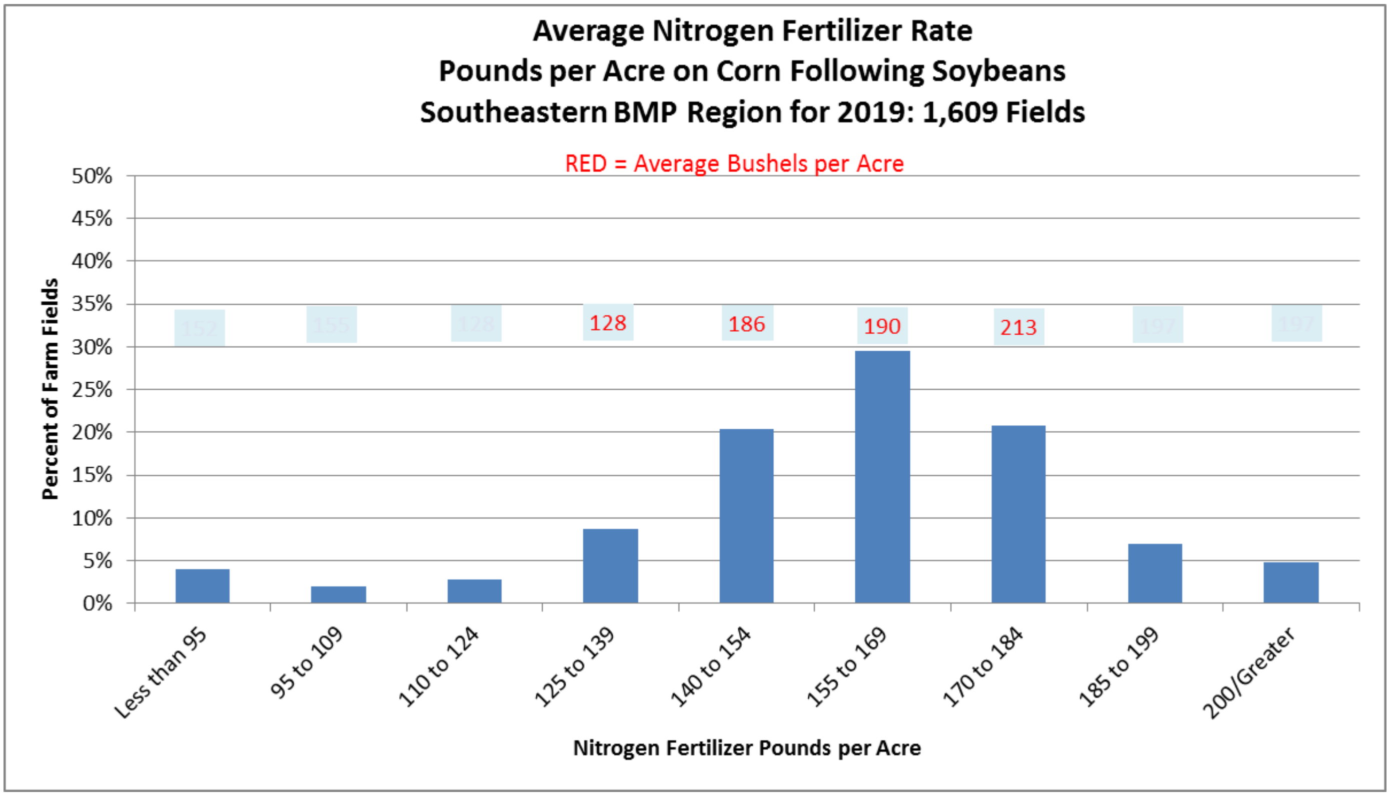

Figure 18. Average nitrogen fertilizer rate and yield on corn following soybeans in the SE BMP region for 2019: 1,609 fields

In the SE BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following soybeans are shown in Table 91.

Table 91. Average fertilizer rate and yield in the SE BMP region for corn following soybeans

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	157	194	157
Phosphorus	97	49	194	47
Potassium	99	77	194	76
Sulfur	64	14	194	9

[22] Yields are not published if there are less than five responses.

South Central BMP Region: Corn Following Soybeans

There were 5,685 fields that were represented in the SC BMP region for the corn following soybeans analysis. Figure 19 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for corn following soybeans in the SC BMP region.[23]

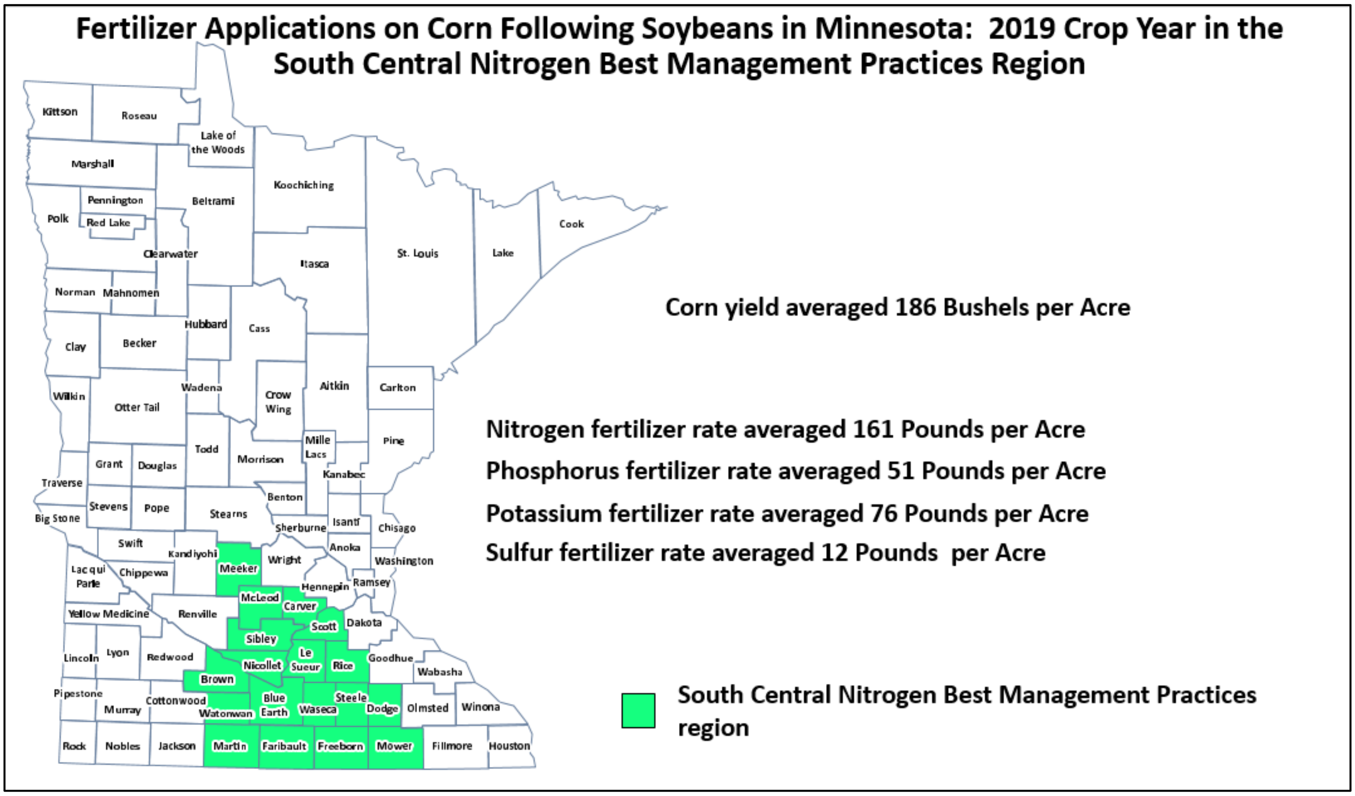

Figure 19. The average corn yield and average fertilizer rate for corn following soybeans in the SC BMP region

[23] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 92% applied phosphorus, 89% applied potassium, and 63% applied sulfur on fields with corn following soybeans.

Figure 20 provides the distribution of nitrogen fertilizer rate in the SC BMP region for corn following soybeans; the corresponding corn yield are detailed in red.[24] Nitrogen rates are only from commercial fertilizer.

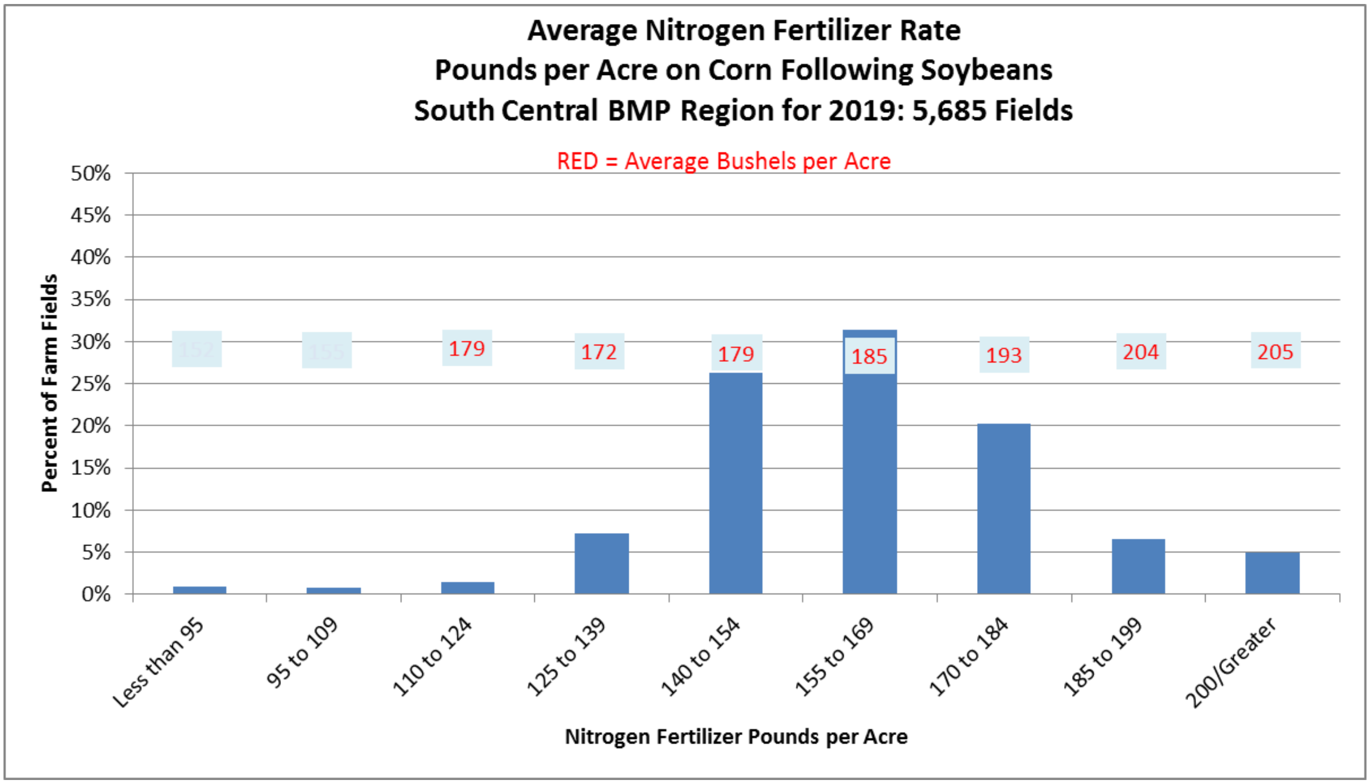

Figure 20. Average nitrogen fertilizer rate and yield on corn following soybeans in the SC BMP region for 2019: 5,685 fields

In the SC BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following soybeans are shown in Table 92.

Table 92. Average fertilizer rate and yield in the SC BMP region for corn following soybeans

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	161	186	161
Phosphorus	92	51	187	47
Potassium	89	76	187	68
Sulfur	63	12	188	8

[24] Yields are not published if there are less than five responses.

Southwestern and West Central BMP Region: Corn Following Soybeans

There were 5,909 fields that were represented in the SW BMP region for the corn following soybeans analysis. Figure 21 details the location, average rate of nitrogen, phosphorus, potassium, and sulfur fertilizer and average yield for corn following soybeans in the SW BMP region.[25]

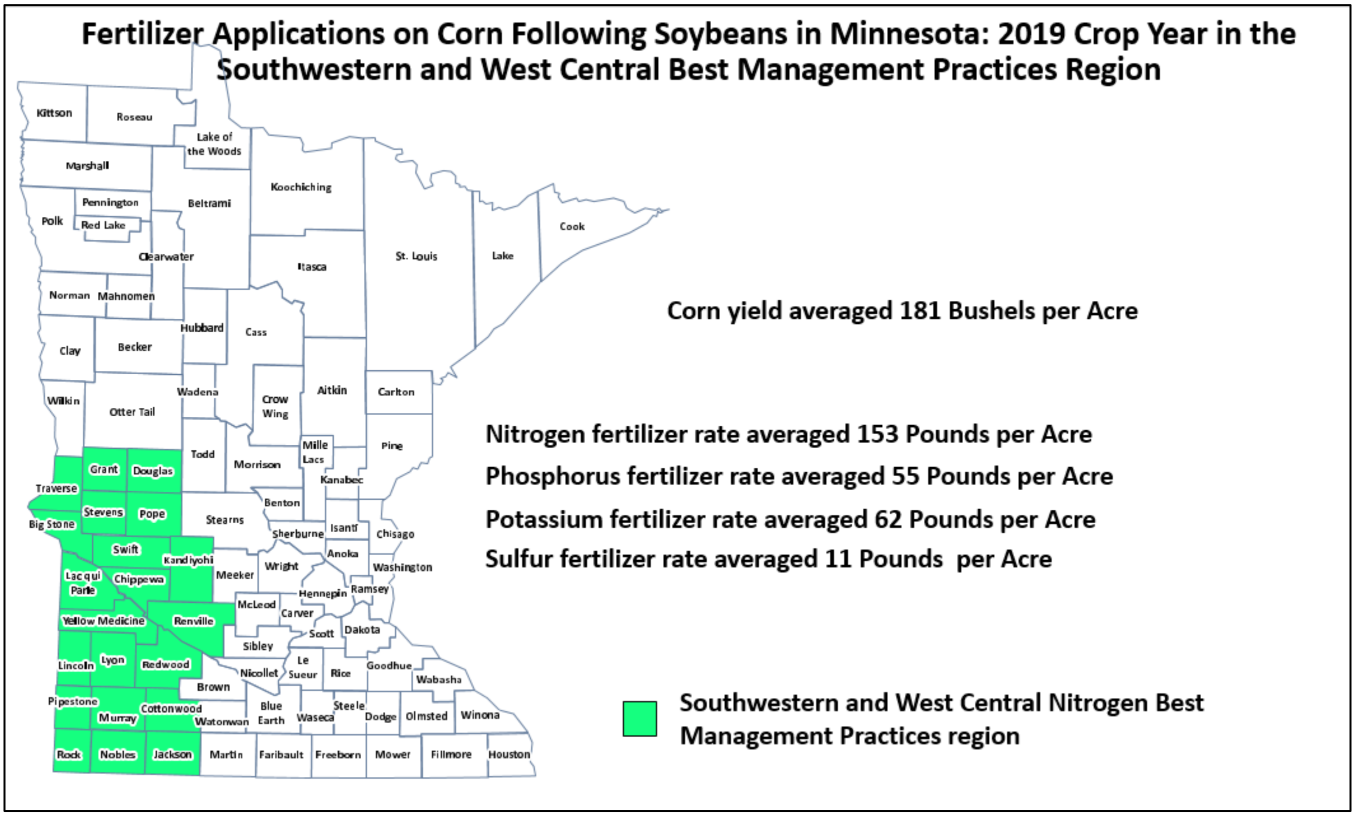

Figure 21. The average corn yield and average fertilizer rate for corn following soybeans in the SW BMP region

[25] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 92% applied phosphorus, 89% applied potassium, and 59% applied sulfur on fields with corn following soybeans.

Figure 22 provides the distribution of nitrogen fertilizer rate in the SW BMP region for corn following soybeans; the corresponding corn yield is detailed in red. Nitrogen rates are only from commercial fertilizer.

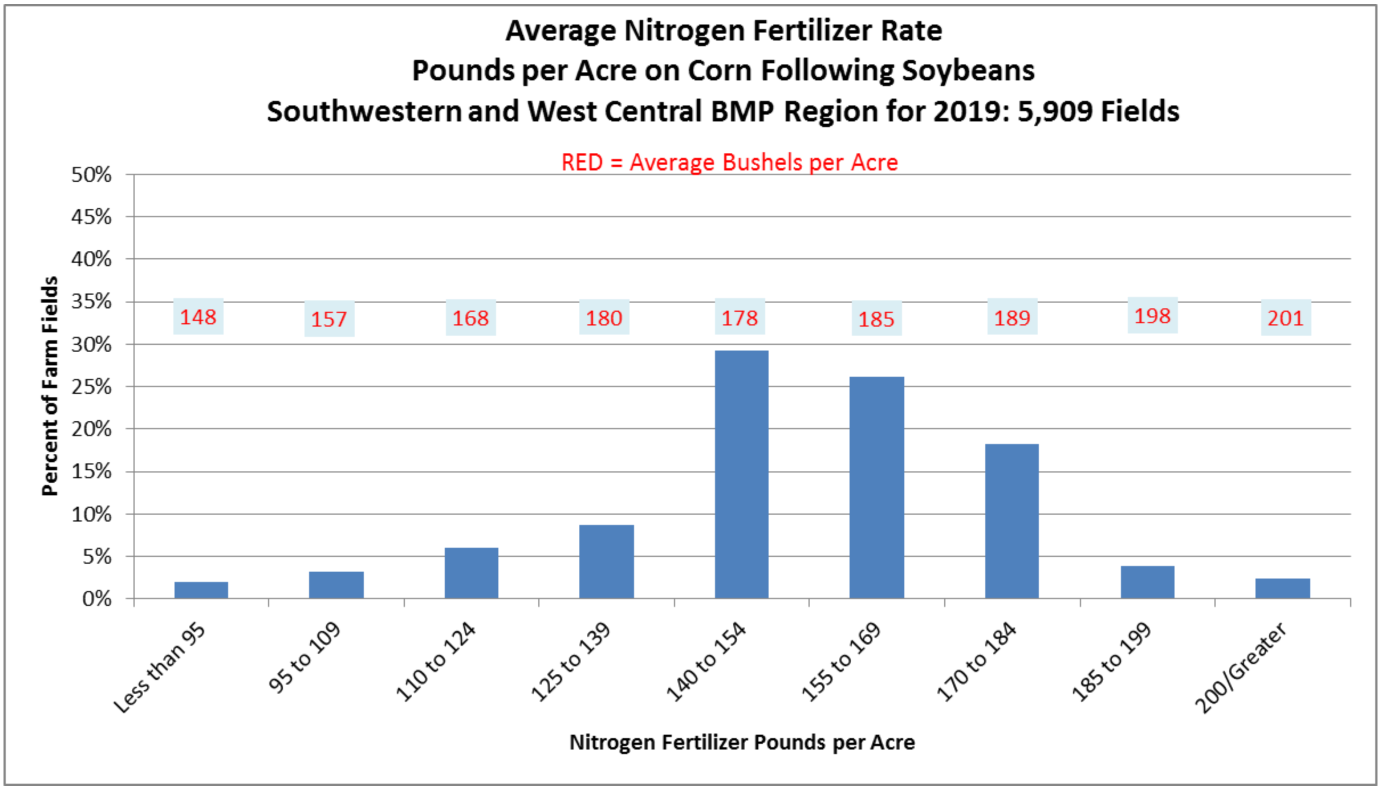

Figure 22. Average nitrogen fertilizer rate and yield on corn following soybeans in the SW BMP region for 2019: 5,909 fields

In the SW BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following soybeans are shown in Table 93.

Table 93. Average fertilizer rate and corn yield in the SW BMP region for corn following soybeans

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	153	181	153
Phosphorus	92	55	181	50
Potassium	89	62	180	55
Sulfur	59	11	181	7

Northwestern BMP Region: Corn Following Soybeans

There were 709 fields that were represented in the NW BMP region for the corn following soybean analysis. Figure 23 details the location, average rate of nitrogen, phosphorus, potassium, and sulfur fertilizer and average yield for corn following soybeans in the NW BMP region.[26]

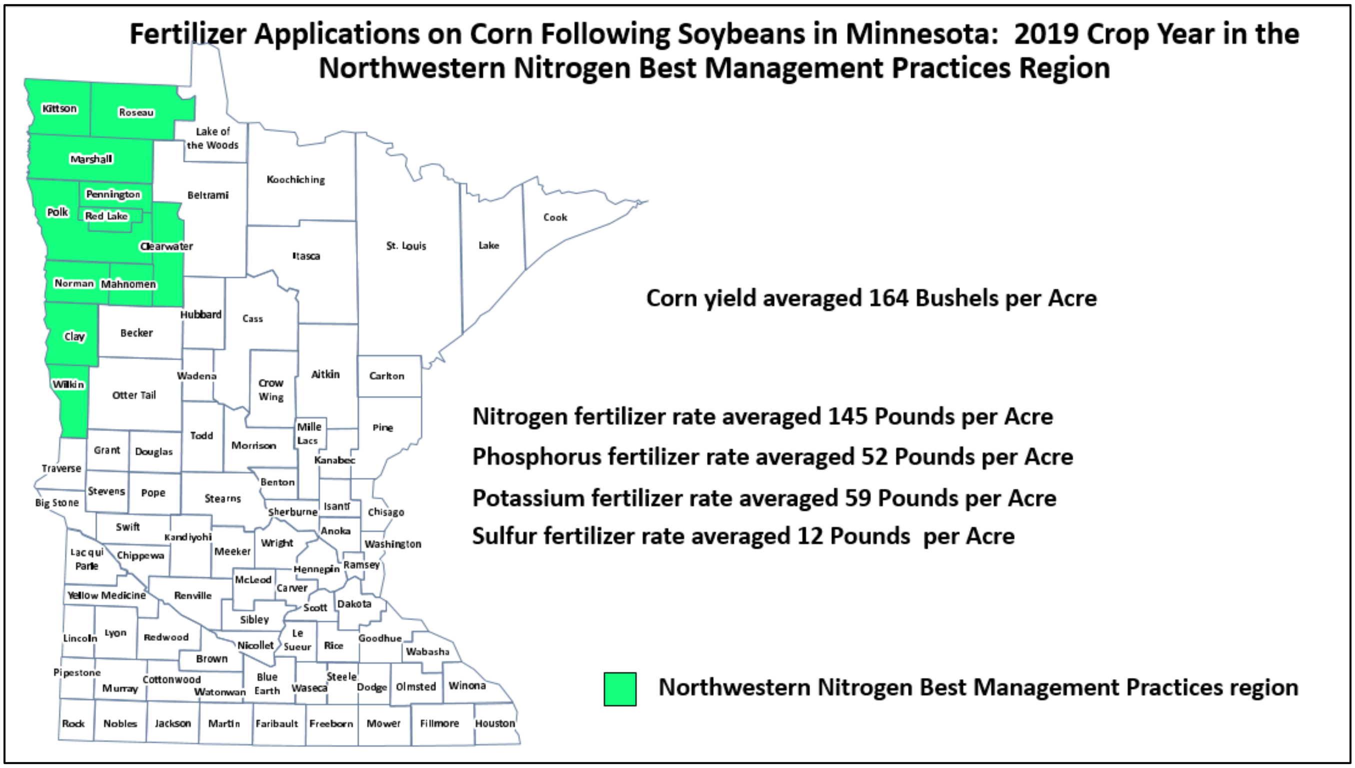

Figure 23. The average corn yield and average fertilizer rate for corn following soybeans in the NW BMP region

[26] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2018 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 99% applied phosphorus, 89% applied potassium, and 63% applied sulfur on fields with corn following soybeans.

Figure 24 provides the distribution of nitrogen fertilizer rate in the NW BMP region for corn following soybeans; the corresponding corn yield is detailed in red[27]. Nitrogen rates are only from commercial fertilizer.

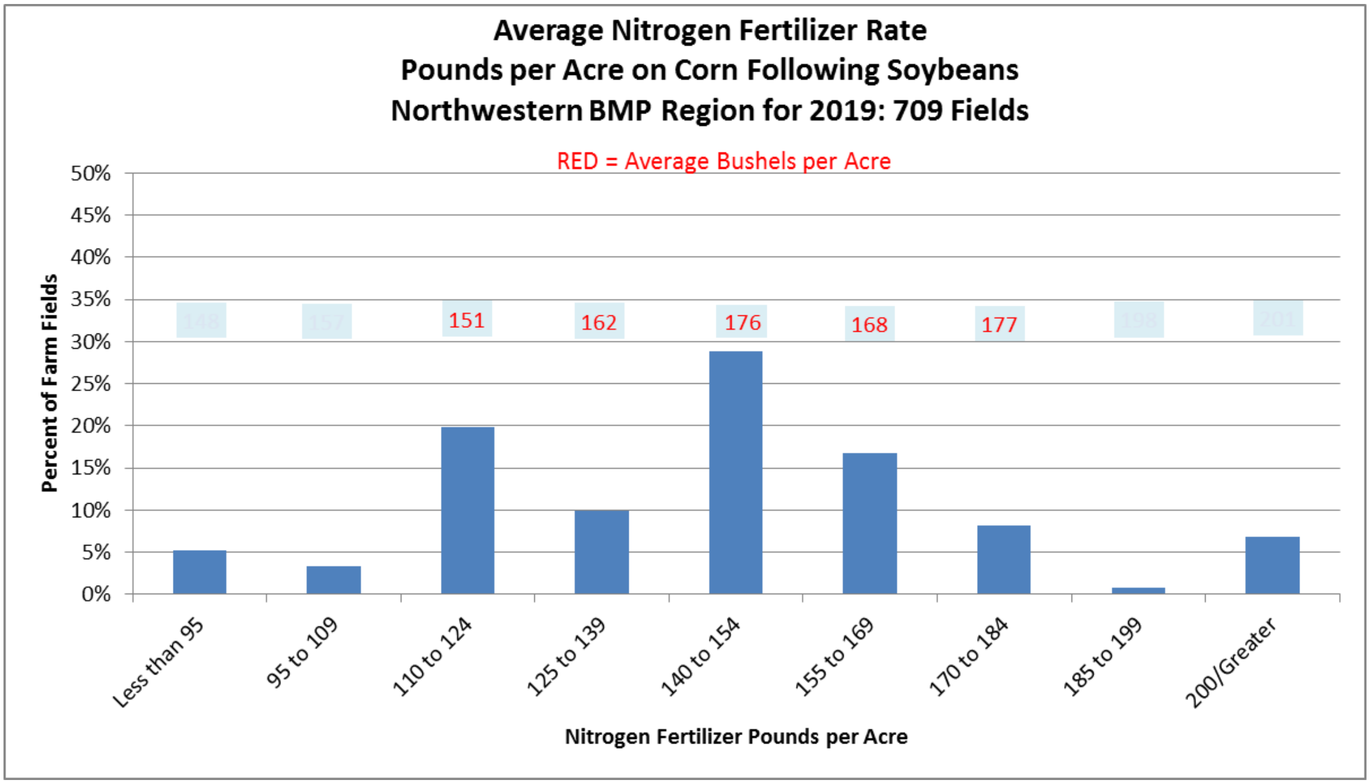

Figure 24. Average nitrogen fertilizer rate and yield on corn following soybeans in the NW BMP region for 2019: 709 fields

In the NW BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur, pounds per acre of actual nutrients, corresponding yield, and the average nutrient rate across all fertilized fields of corn following soybeans are shown in Table 94.

Table 94. Average fertilizer rate and corn yield in the NW BMP region for corn following soybeans

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	145	164	145
Phosphorus	99	52	165	52
Potassium	89	59	165	52
Sulfur	63	12	171	7

[27] Yields are not published if there are less than five responses.

Irrigated and Non-irrigated Sandy Soils BMP Region: Corn Following Soybeans

There were 2,534 fields that were represented in the IRR BMP region for the corn following soybean analysis. Figure 25 details the location, average rate of nitrogen, phosphorus, potassium, and sulfur fertilizer and average yield for corn following soybeans in the IRR BMP region.[28]

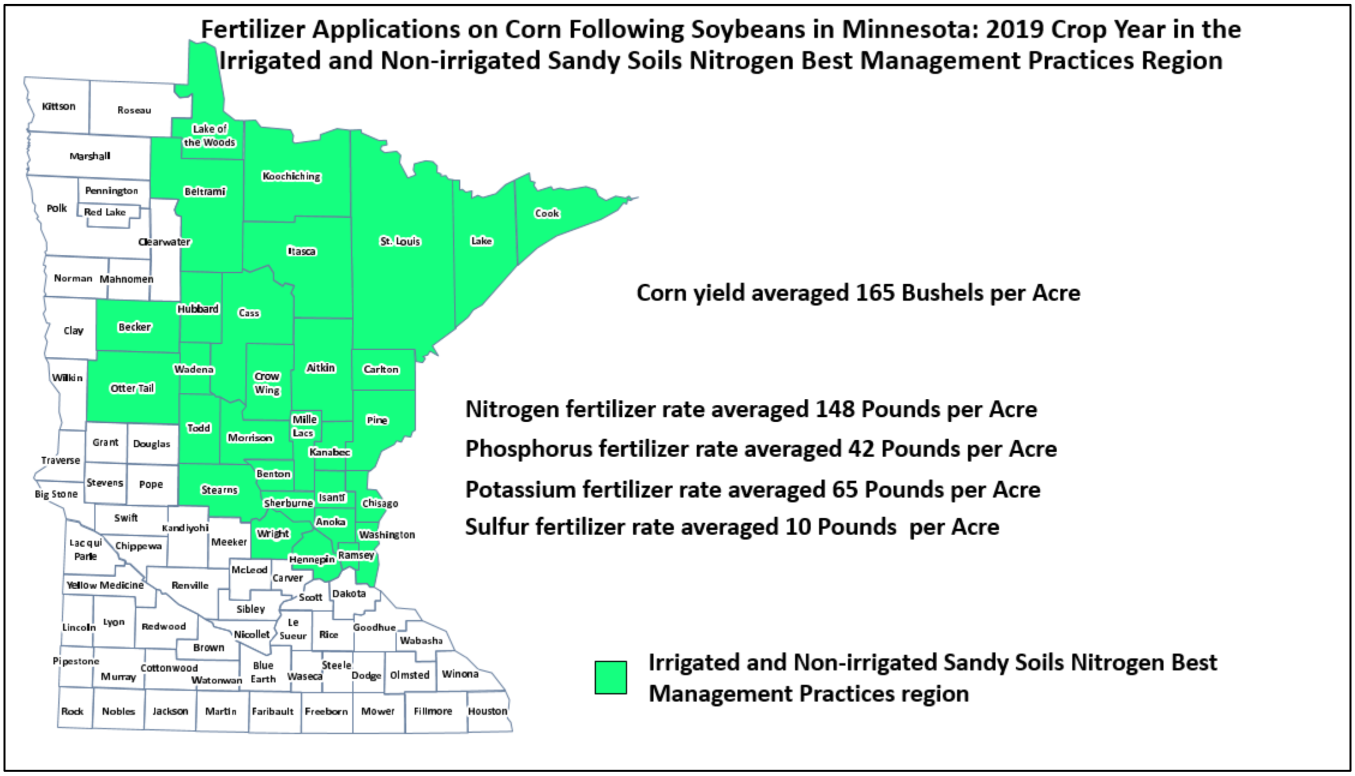

Figure 25. The average corn yield and average fertilizer rate for corn following soybeans in the IRR BMP region

[28] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 90% applied phosphorus, 90% applied potassium, and 69% applied sulfur on fields with corn following soybeans.

Figure 26 provides the distribution of nitrogen fertilizer rate in the IRR BMP region for corn following soybeans; the corresponding corn yield is detailed in red. Nitrogen rates are only from commercial fertilizer.

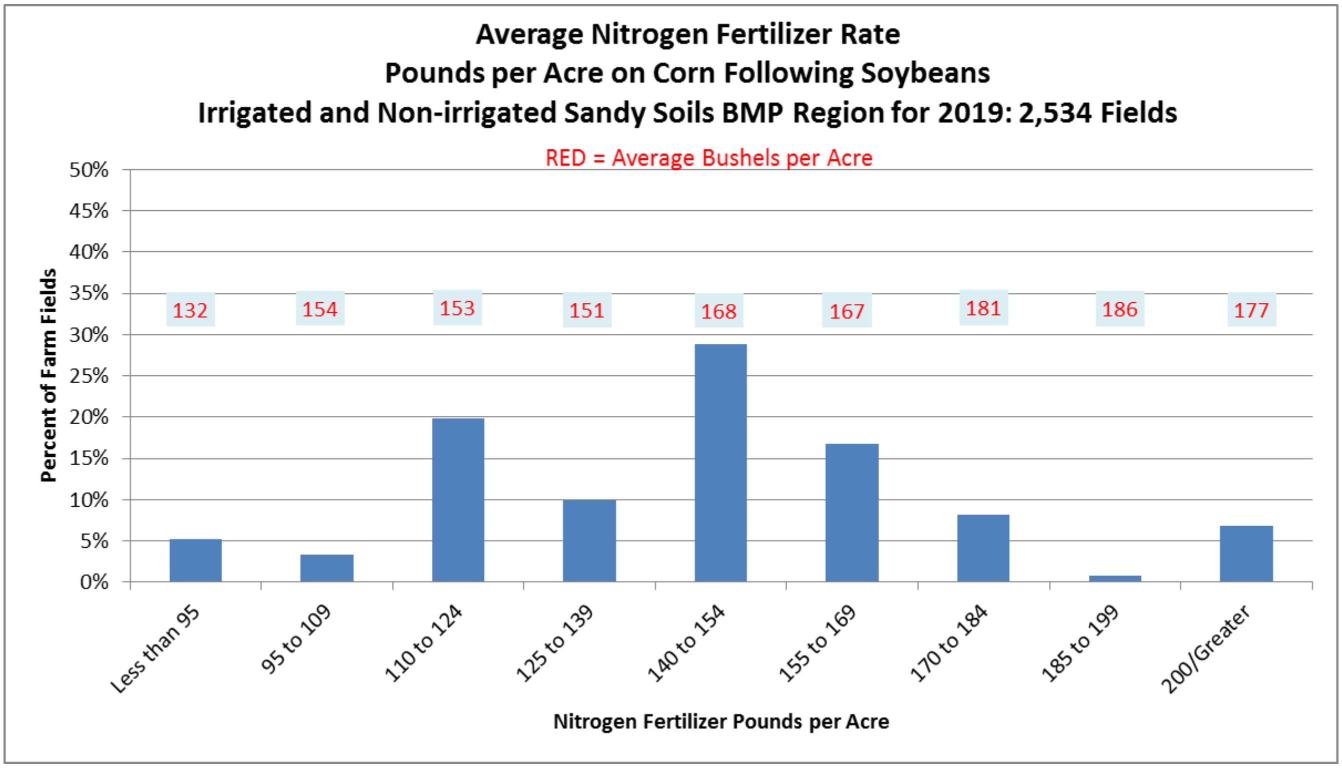

Figure 26. Average nitrogen fertilizer rate and yield on corn following soybeans in the IRR BMP region for 2019: 2,534 fields

In the IRR BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following soybeans are shown in Table 95.

Table 95. Average fertilizer rate and corn yield in the IRR BMP region for corn following soybeans

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	148	165	148
Phosphorus	90	42	166	38
Potassium	90	65	166	58
Sulfur	69	10	166	7

Statewide: Corn Following Corn

Statewide, fourteen percent of the fields reported were corn following corn. Figure 27 details the BMP region where farmers reported on fields with corn following corn. There were 3,092 fields represented in Minnesota.[29]

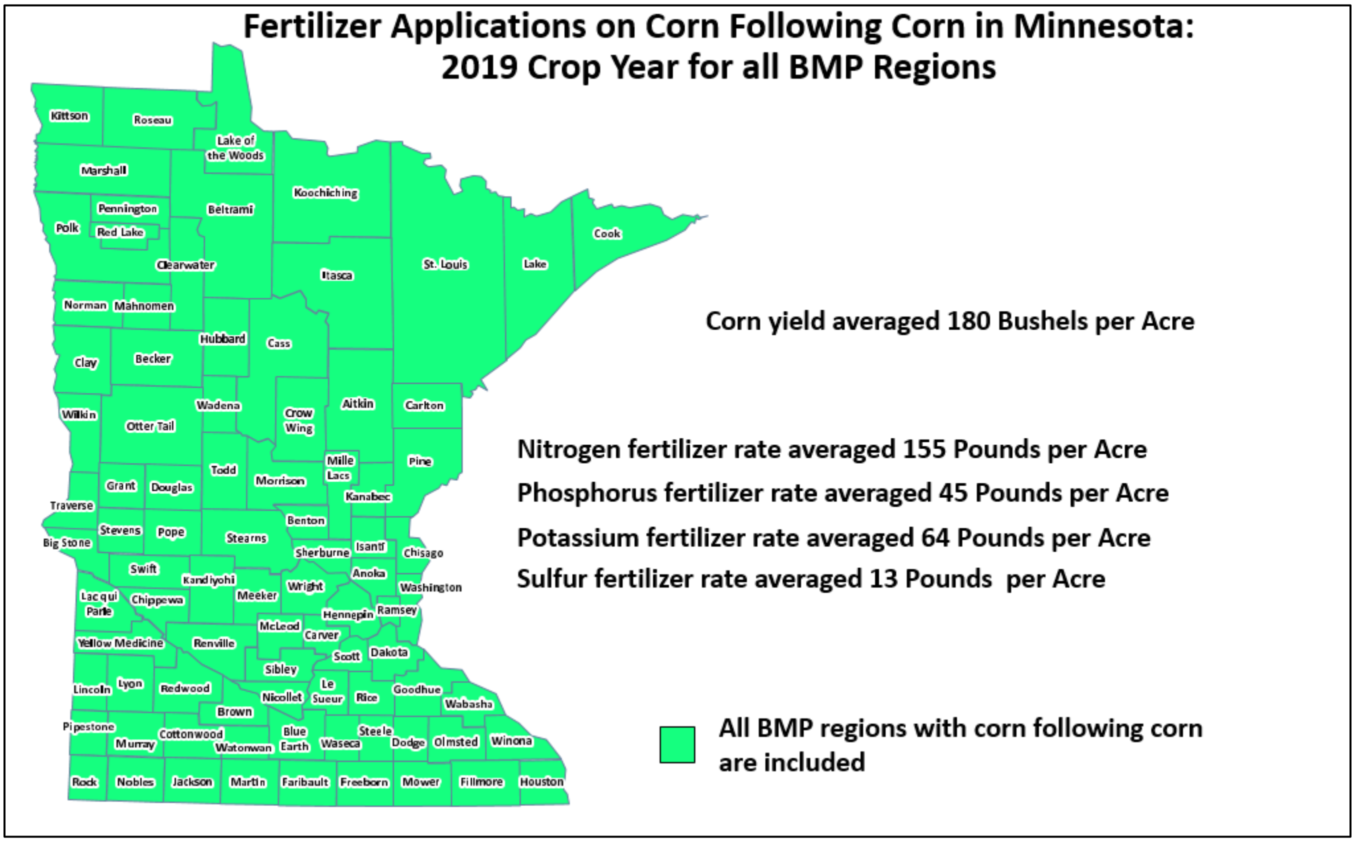

Figure 27. The average corn yield and average fertilizer rate for corn following corn in Minnesota

[29] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 89% applied phosphorus, 79% applied potassium, and 55% applied sulfur on fields with corn following corn.

Figure 28 provides the distribution of average nitrogen fertilizer rate in Minnesota for corn following corn; the corresponding corn yield is detailed in red.[30] Nitrogen rates are only from commercial fertilizer.

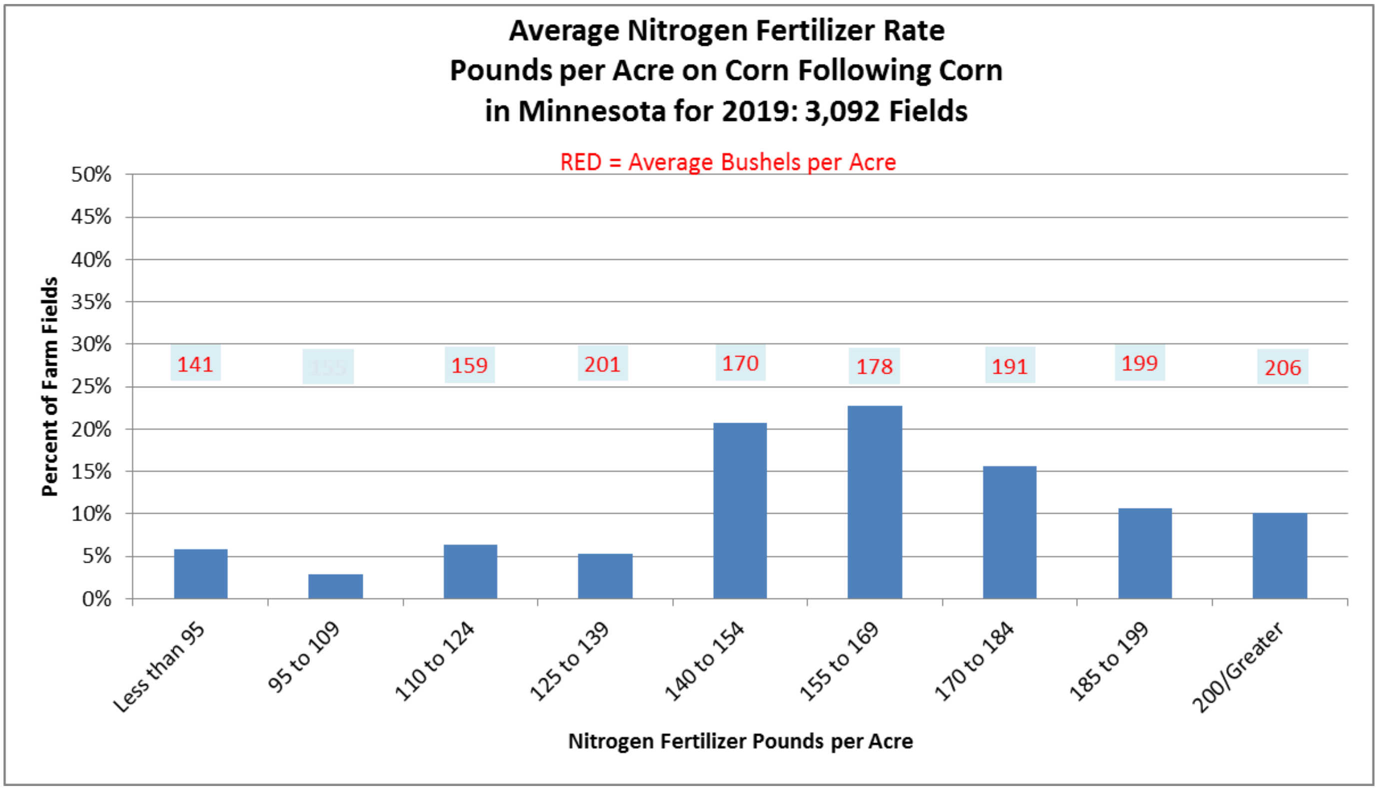

Figure 28. Average nitrogen fertilizer rate and yield on corn following corn in Minnesota for 2019: 3,092 fields

In Minnesota, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following corn are shown in Table 96.

Table 96. Average fertilizer rate and corn yield in Minnesota for corn following corn

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	155	180	155
Phosphorus	89	45	182	40
Potassium	79	64	181	50
Sulfur	55	13	182	7

** Less than five responses

[30] Yields are not published if there are less than five responses.

Southeastern BMP Region: Corn Following Corn

There were 538 fields that were represented in the SE BMP region for the corn following corn analysis. Figure 29 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for corn following corn in the SE BMP region.[31]

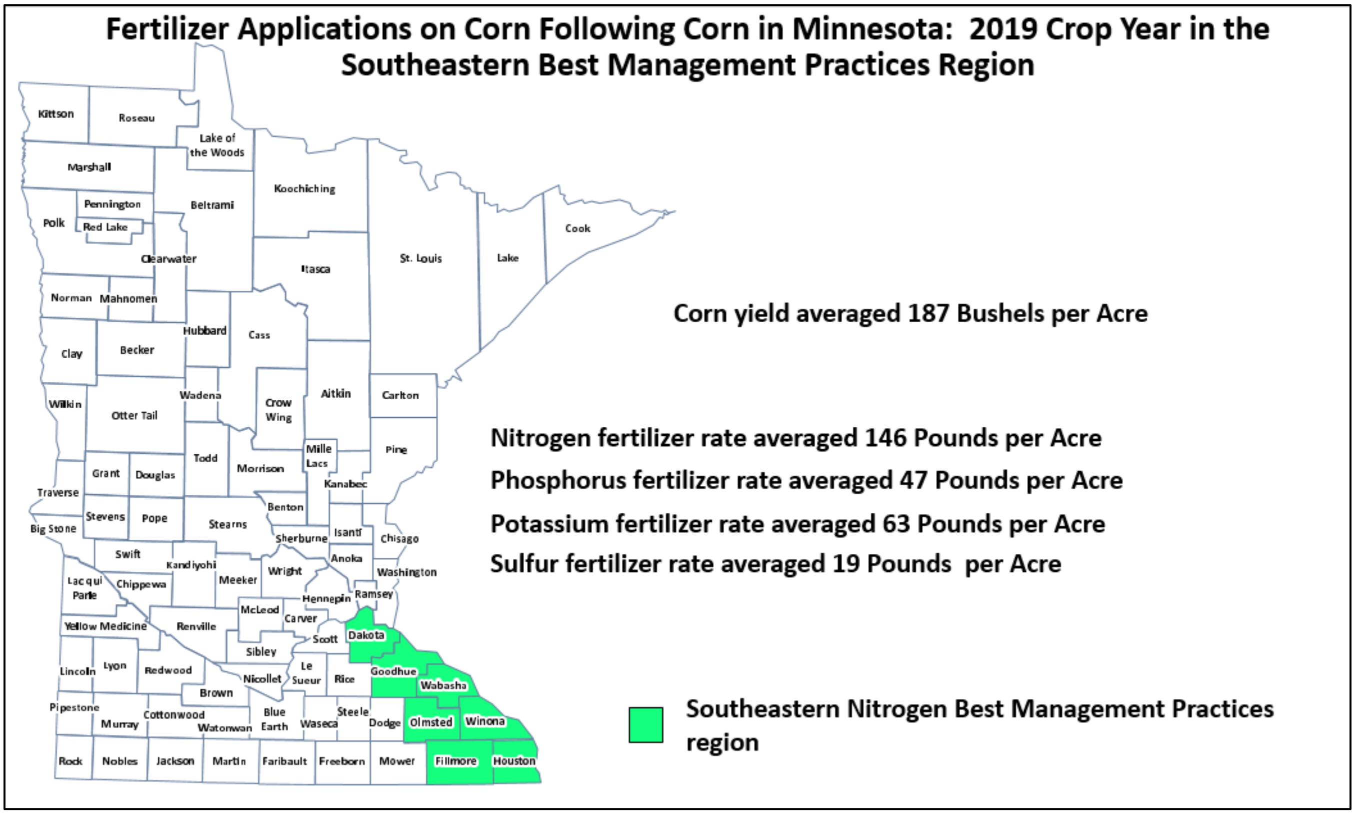

Figure 29. The average corn yield and average fertilizer rate for corn following corn in the SE BMP region

[31] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 89% applied phosphorus, 77% applied potassium, and 60% applied sulfur on fields with corn following corn.

Figure 30 provides the distribution of nitrogen fertilizer rate in the SE BMP region for corn following corn; the corresponding corn yield are detailed in red.[32] Nitrogen rates are only from commercial fertilizer.

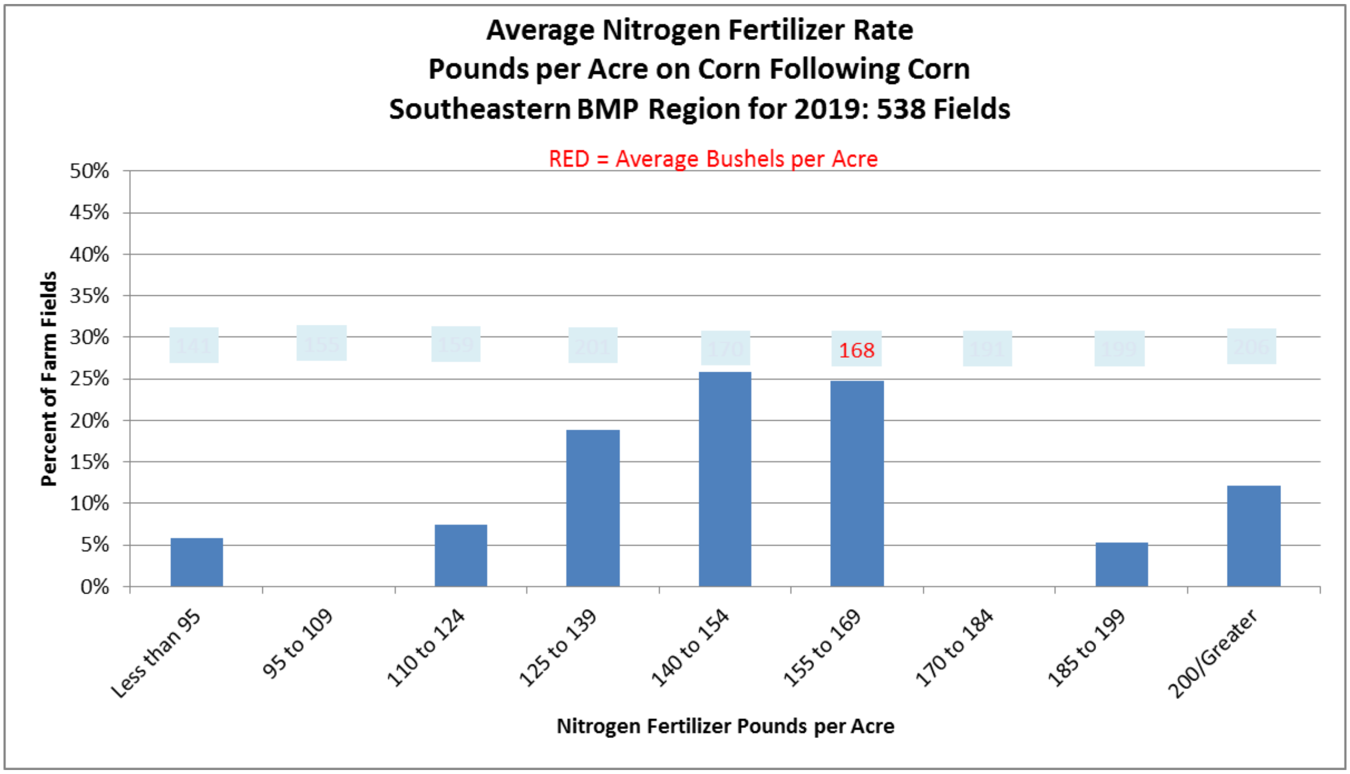

Figure 30. Average nitrogen fertilizer rate and yield on corn following corn in the SE BMP region for 2019: 538 fields

In the SE BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following corn are shown in Table 97.

Table 97. Average fertilizer rate and yield in the SE BMP region for corn following corn

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	146	187	146
Phosphorus	89	47	188	42
Potassium	77	63	189	48
Sulfur	60	19	190	11

[32] Yields are not published if there are less than five responses.

South Central BMP Region: Corn Following Corn

There were 598 fields that were represented in the SC BMP region for the corn following corn analysis. Figure 31 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for corn following corn in the SC BMP region.[33]

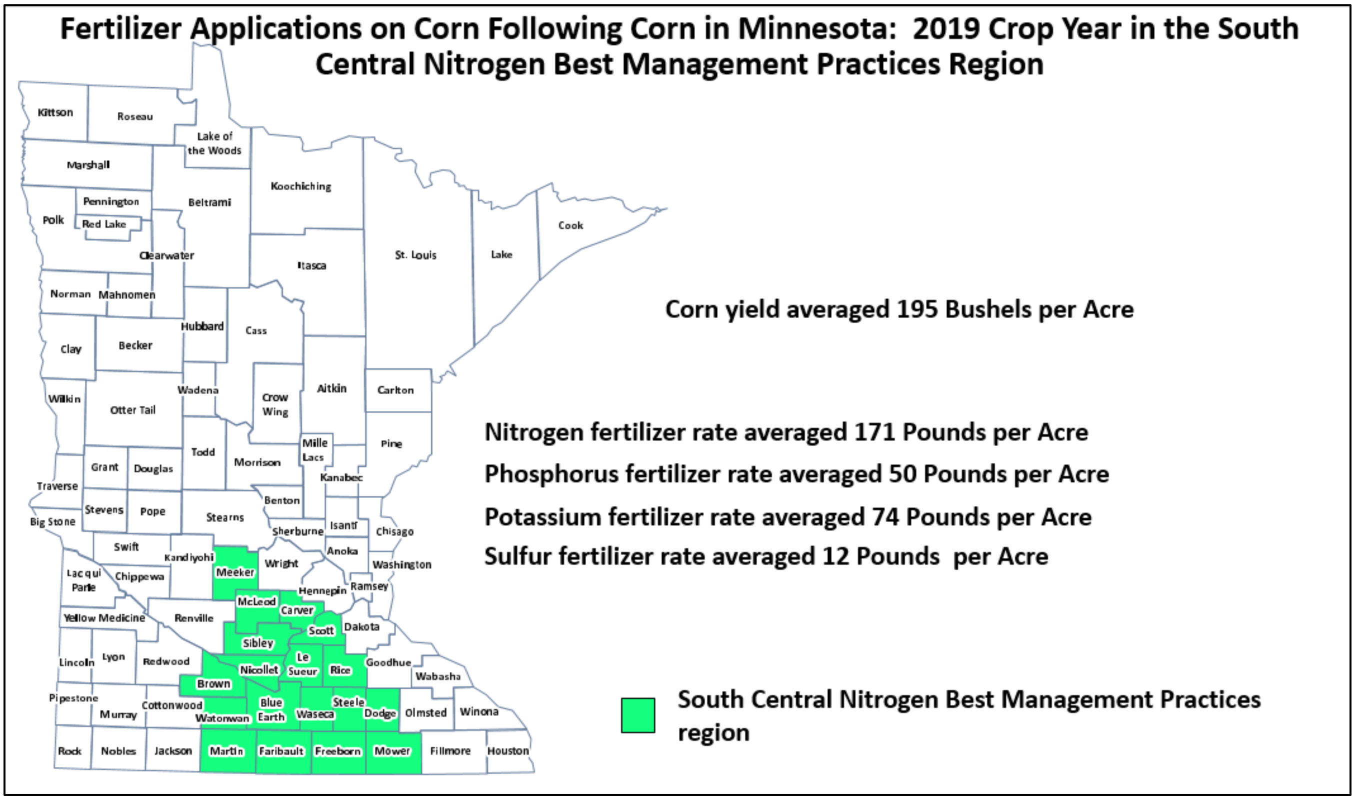

Figure 31. The average corn yield and average fertilizer rate for corn following corn in the SC BMP region

[33] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 97% applied phosphorus, 85% applied potassium, and 58% applied sulfur on fields with corn following corn.

Figure 32 provides the distribution of nitrogen fertilizer rate in the SC BMP region for corn following corn; the corresponding corn yield are detailed in red.[34] Nitrogen rates are only from commercial fertilizer.

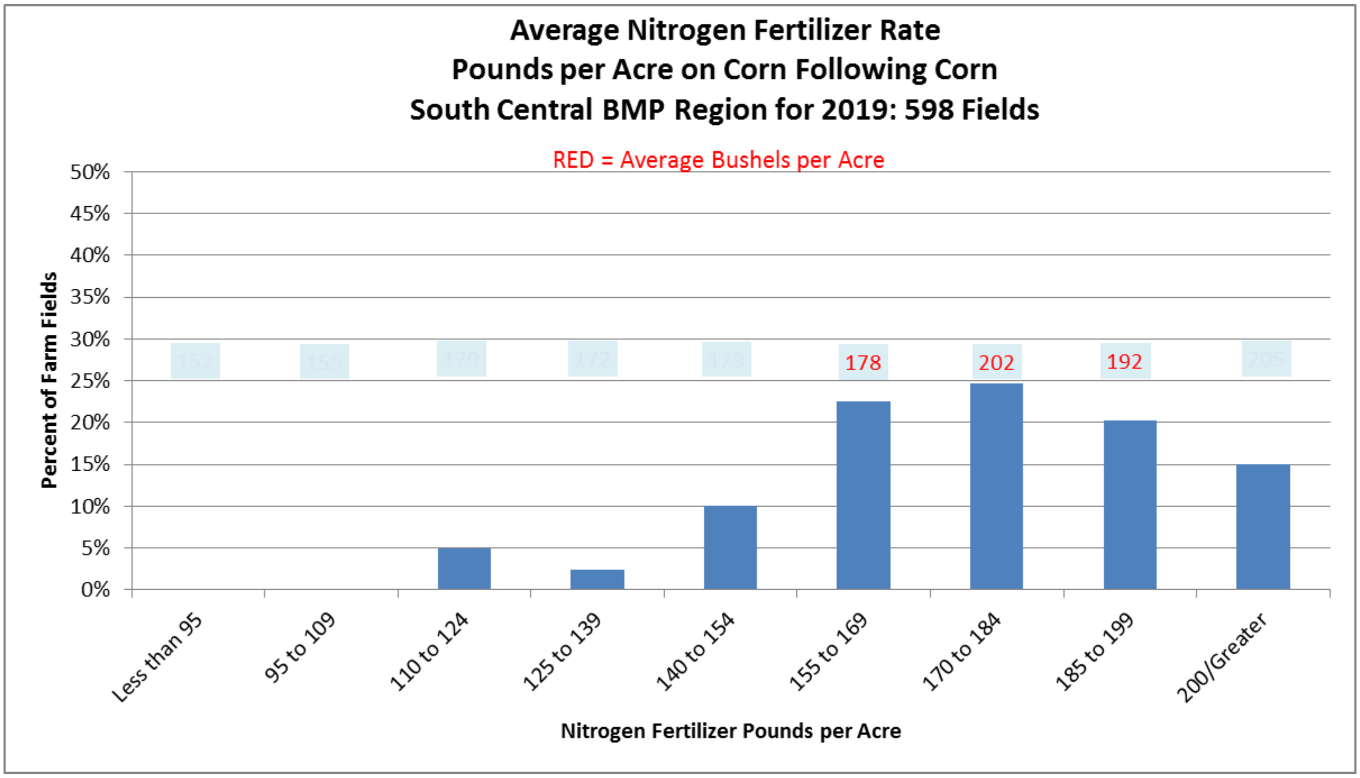

Figure 32. Average nitrogen fertilizer rate and yield on corn following corn in the SC BMP region for 2019: 598 fields

In the SC BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following corn are shown in Table 98.

Table 98. Average fertilizer rate and yield in the SC BMP region for corn following corn

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	171	195	171
Phosphorus	97	50	195	48
Potassium	85	74	196	63
Sulfur	58	12	199	7

[34] Yields are not published if there are less than five responses.

Southwestern and West Central BMP Region: Corn Following Corn

There were 1,020 fields that were represented in the SW BMP region for the corn following corn analysis. Figure 33 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for corn following corn in the SW BMP region.[35]

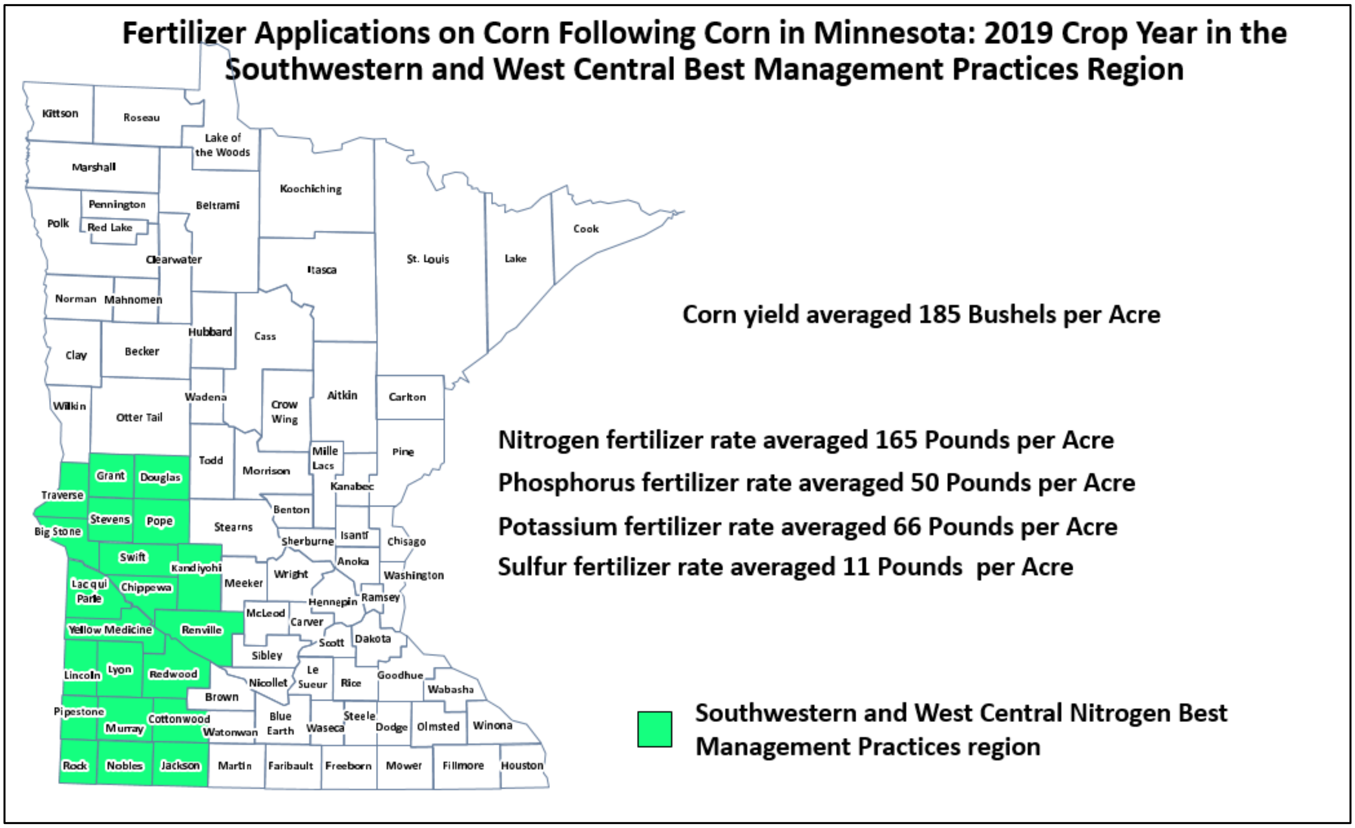

Figure 33. The average corn yield and average fertilizer rate for corn following corn in the SW BMP region

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[35] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 85% applied phosphorus, 71% applied potassium, and 41% applied sulfur on fields with corn following corn.

Figure 34 provides the distribution of nitrogen fertilizer rate in the SW BMP region for corn following corn; the corresponding corn yield are detailed in red.[36] Nitrogen rates are only from commercial fertilizer.

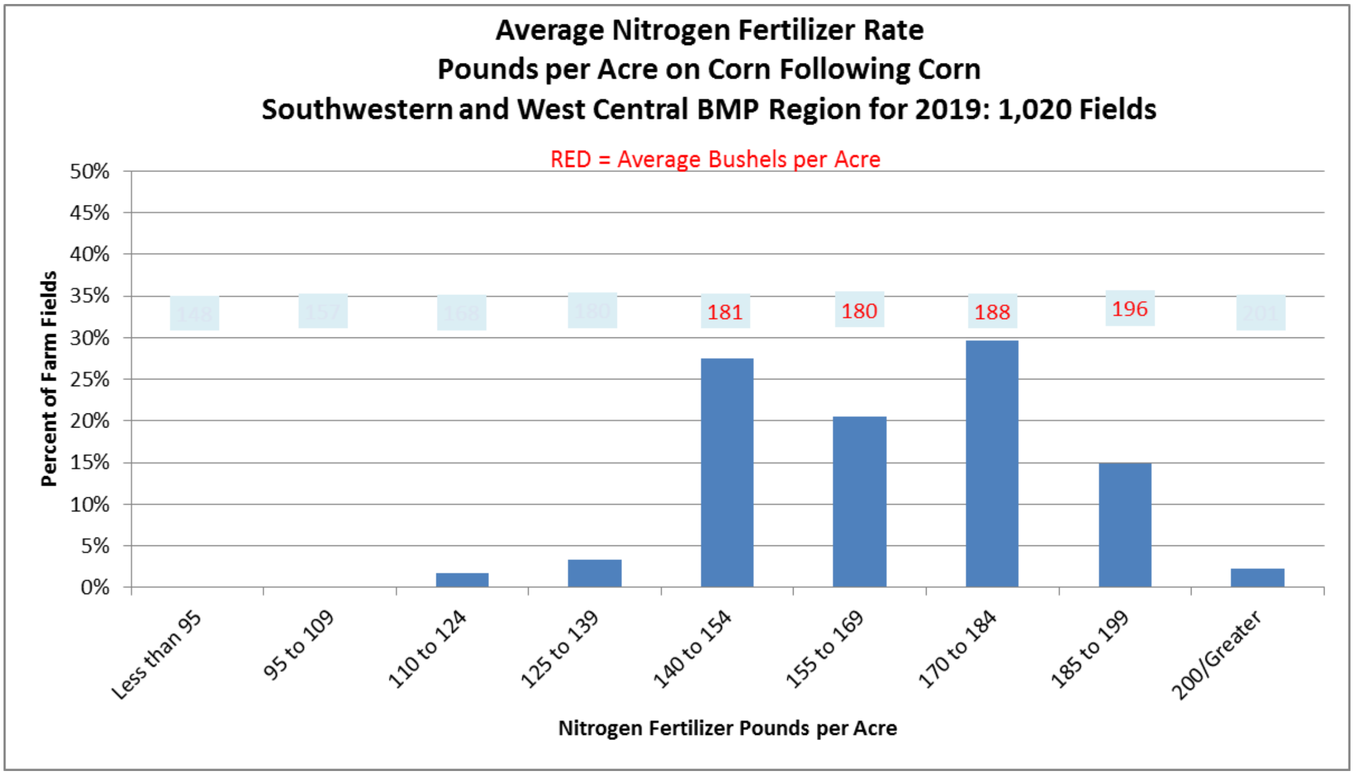

Figure 34. Average nitrogen fertilizer rate and yield on corn following corn in the SW BMP region for 2019: 1,020 fields

In the SW BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following corn are shown in Table 99.

Table 99. Average fertilizer rate and yield in the SW BMP region for corn following corn

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	165	185	165
Phosphorus	85	50	188	42
Potassium	71	66	186	47
Sulfur	41	11	188	4

[36] Yields are not published if there are less than five responses.

Northwestern BMP Region: Corn Following Corn

There were 116 fields that were represented in the NW BMP region for the corn following corn analysis. Figure 35 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for corn following corn in the NW BMP region.[37]

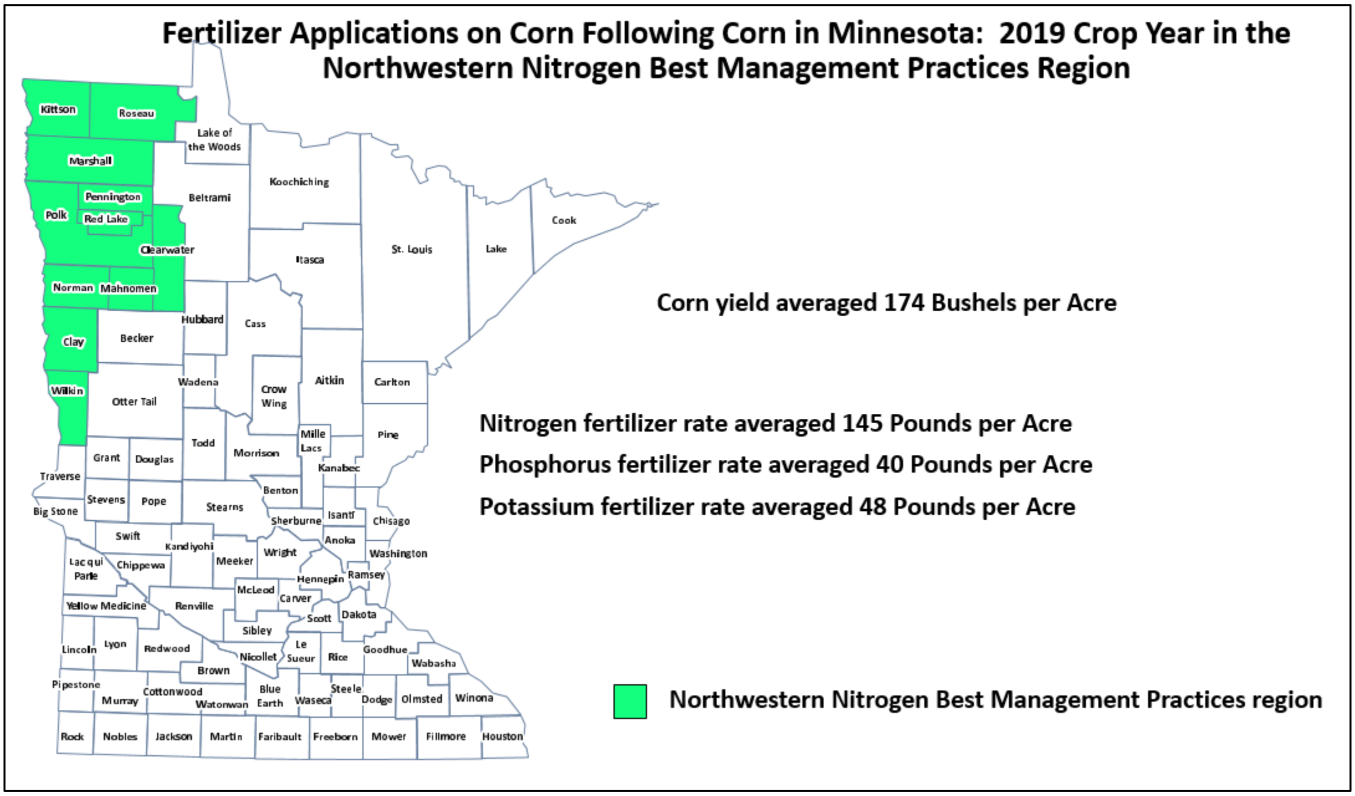

Figure 35. The average corn yield and average fertilizer rate for corn following corn in the NW BMP region

[37] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 82% applied phosphorus, and 53% applied potassium on fields with corn following corn. Less than five responses reported applying sulfur.

Figure 36 provides the distribution of nitrogen fertilizer rate in the NW BMP region for corn following corn; the corresponding corn yield are detailed in red.[38] Nitrogen rates are only from commercial fertilizer.

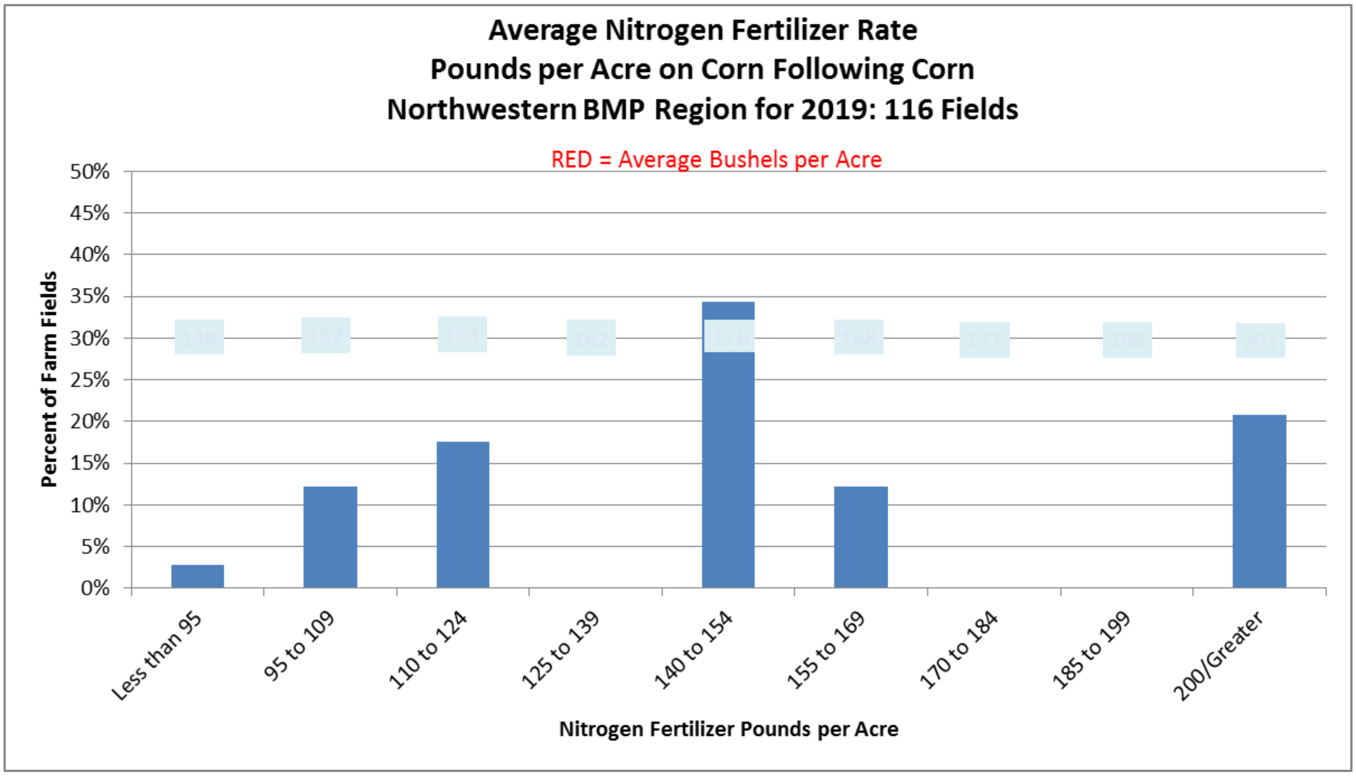

Figure 36. Average nitrogen fertilizer rate and yield on corn following corn in the NW BMP region for 2019: 116 fields

In the NW BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following corn are shown in Table 100.

Table 100. Average fertilizer rate and yield in the NW BMP region for corn following corn

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	145	174	145
Phosphorus	82	40	177	33
Potassium	53	48	175	26
Sulfur	**	**	**	**

** Less than five responses

[38] Yields are not published if there are less than five responses.

Irrigated and Non-irrigated Sandy Soils BMP Region: Corn Following Corn

There were 820 fields that were represented in the IRR BMP region for the corn following corn analysis. Figure 37 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for corn following corn in the IRR BMP region.[39]

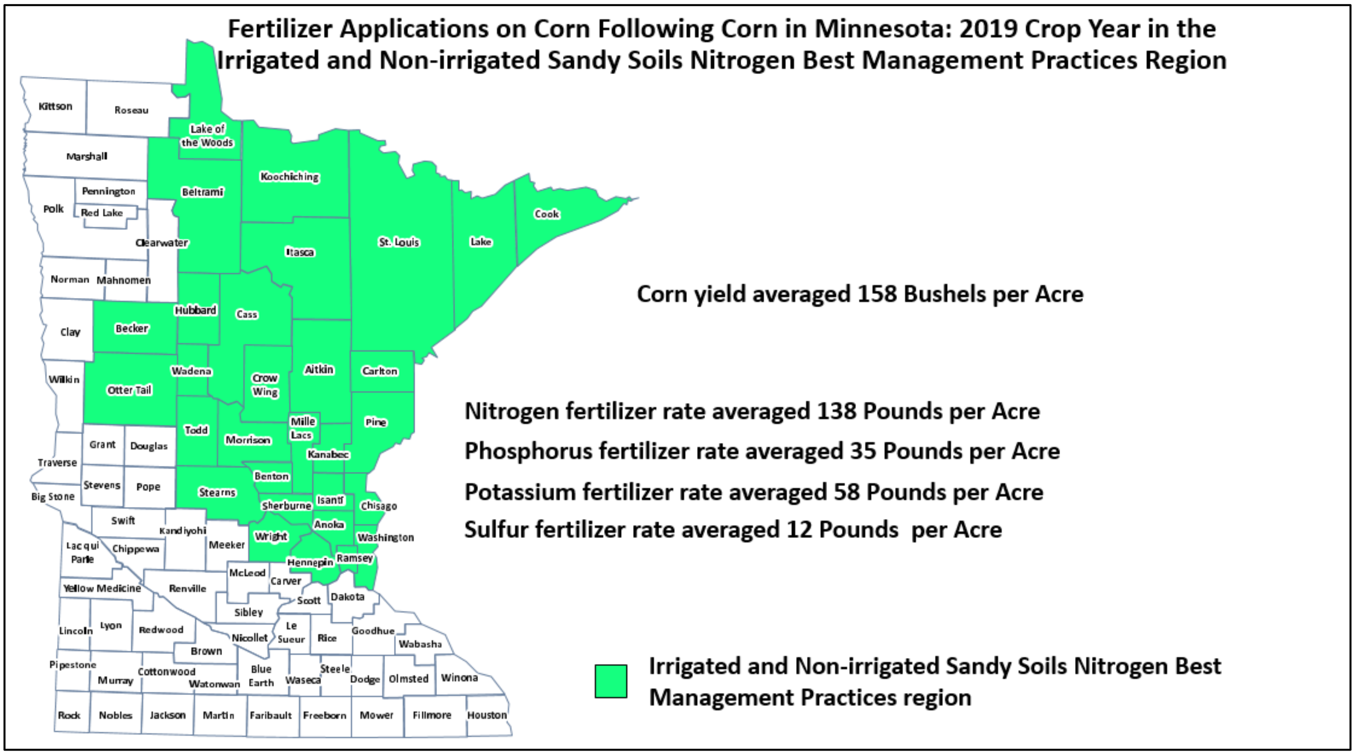

Figure 37. The average corn yield and average fertilizer rate for corn following corn in the IRR BMP region

[39] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 89% applied phosphorus, 88% applied potassium, and 69% applied sulfur on fields with corn following corn.

Figure 38 provides the distribution of nitrogen fertilizer rate in the IRR BMP region for corn following corn; the corresponding corn yield are detailed in red.[40] Nitrogen rates are only from commercial fertilizer.

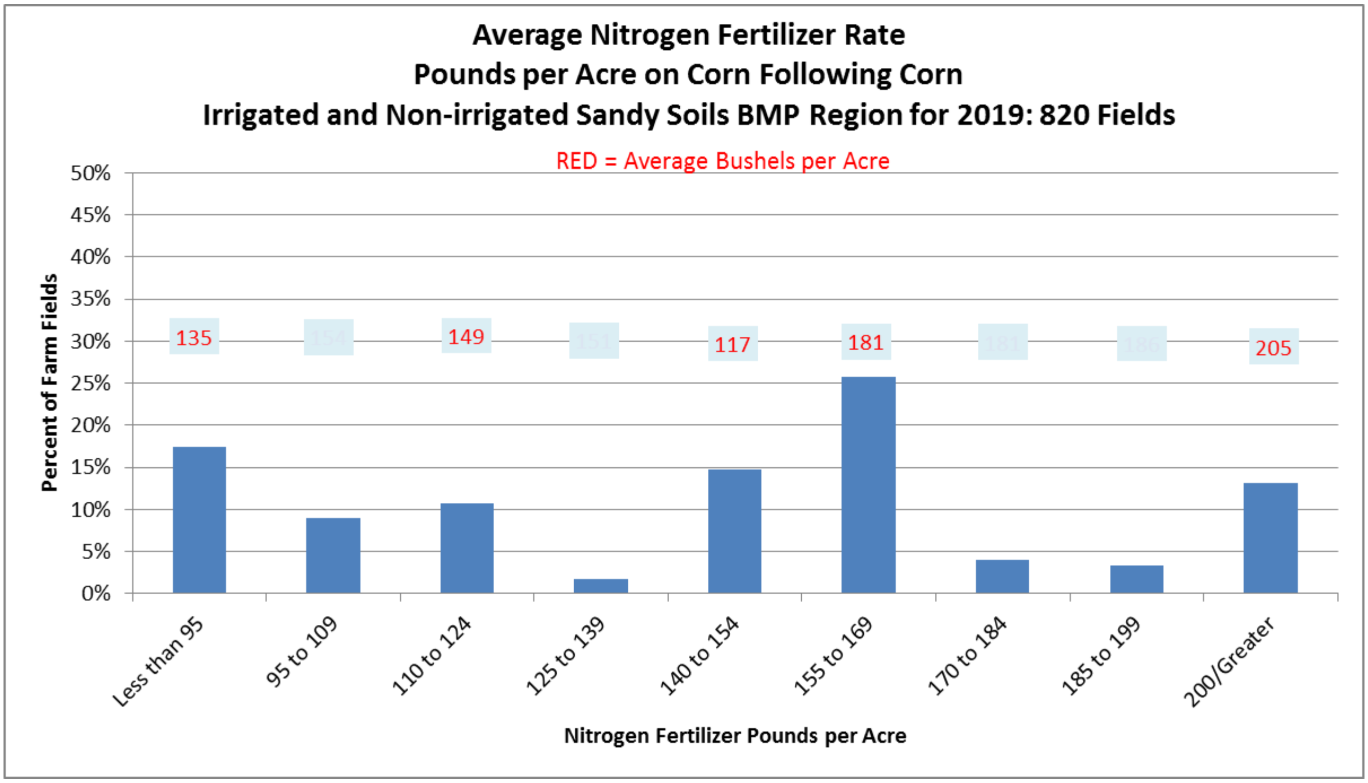

Figure 38. Average nitrogen fertilizer rate and yield on corn following corn in the IRR BMP region for 2019: 820 fields

In the IRR BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following corn are shown in Table 101.

Table 101. Average fertilizer rate and yield in the IRR BMP region for corn following corn

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	138	158	138
Phosphorus	89	35	162	31
Potassium	88	58	160	51
Sulfur	69	12	162	8

[40] Yields are not published if there are less than five responses.

Statewide: Corn Following Corn Following Alfalfa

Statewide, one percent of the fields reported were corn following corn following alfalfa. Figure 39 details the BMP regions where farmers reported on fields with corn following corn following alfalfa. There were 197 fields represented in Minnesota.[41]

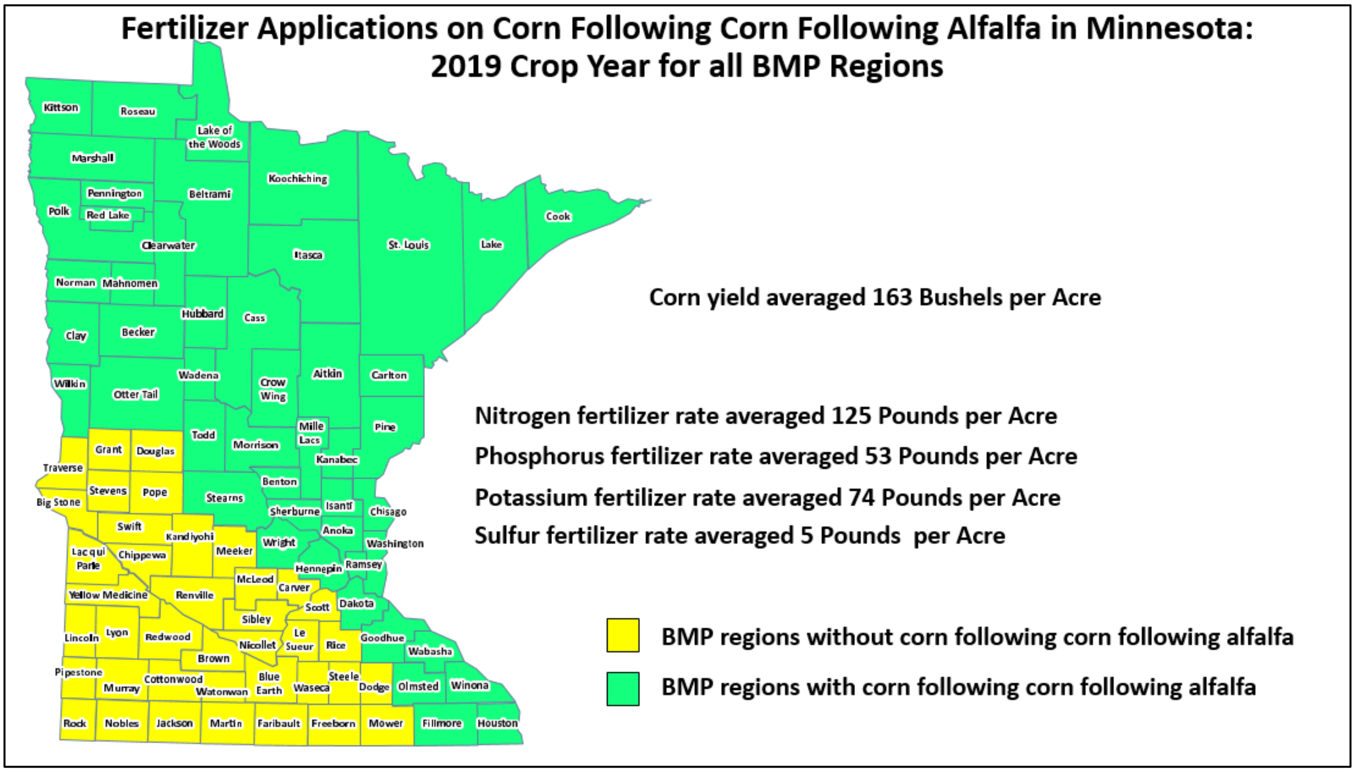

Figure 39. The average corn yield and average fertilizer rate for corn following corn following alfalfa in Minnesota

[41] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 98% applied phosphorus, 98% applied potassium, and 38% applied sulfur on fields with corn following corn following alfalfa.

Figure 40 provides the distribution of average nitrogen fertilizer rate in Minnesota for corn following corn following alfalfa; the corresponding corn yield is detailed in red.[42] Nitrogen rates are only from commercial fertilizer.

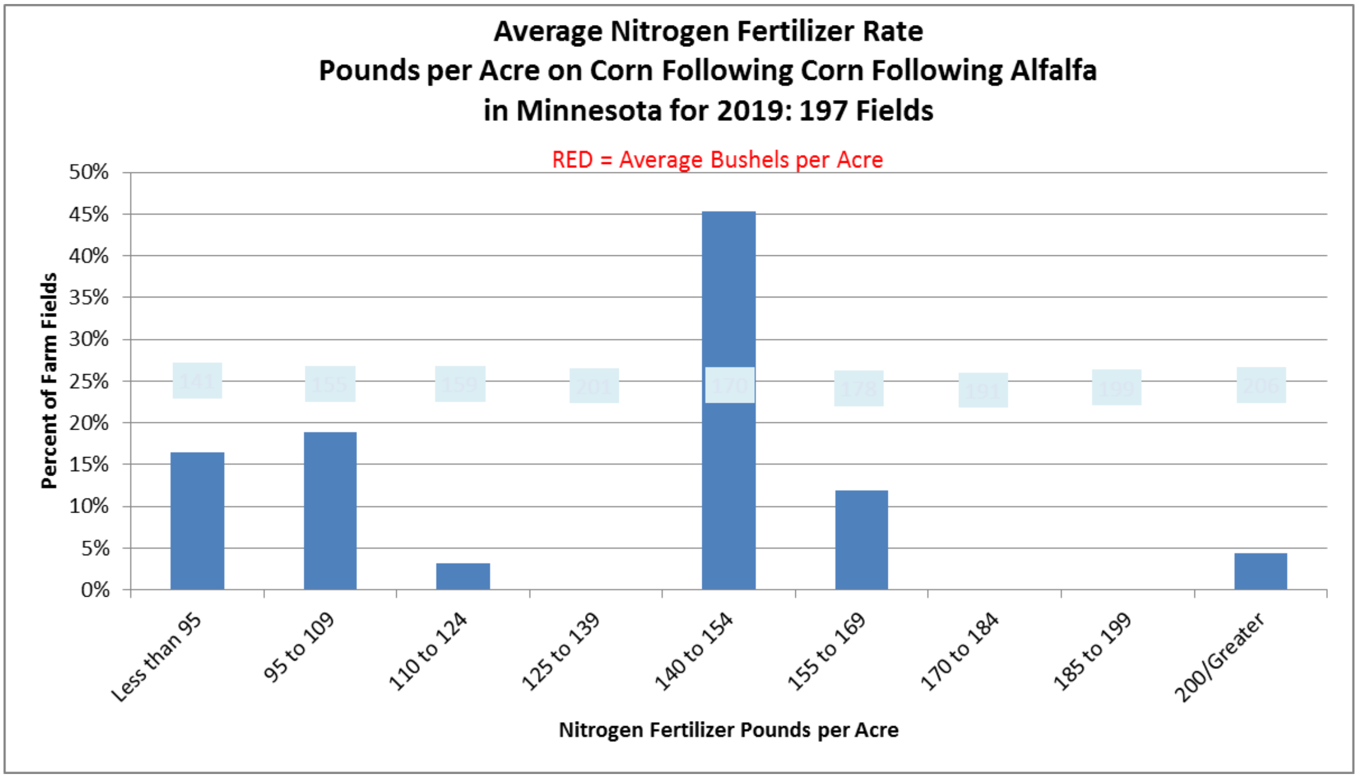

Figure 40. Average nitrogen fertilizer rate and yield on corn following corn following alfalfa in Minnesota for 2019: 197 fields

In Minnesota, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following corn following alfalfa are shown in Table 100.

Table 102. Average fertilizer rate and corn yield in Minnesota for corn following corn following alfalfa

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	125	163	125
Phosphorus	98	53	164	52
Potassium	98	74	164	73
Sulfur	38	5	185	2

[42] Yields are not published if there are less than five responses.

Southeastern BMP Region: Corn Following Corn Following Alfalfa

Less than five responses reported corn following corn following alfalfa in the SE BMP region.

South Central BMP Region: Corn Following Corn Following Alfalfa

No responses reported corn following corn following alfalfa in the SC BMP region.

Southwestern and West Central BMP Region: Corn Following Corn Following Alfalfa

No responses reported corn following corn following alfalfa in the SW BMP region.

Northwestern BMP Region: Corn Following Corn Following Alfalfa

Less than five responses reported corn following corn following alfalfa in the NW BMP region.

Irrigated and Non-irrigated Sandy Soils BMP Region: Corn Following Corn Following Alfalfa

There were 110 fields that were represented in the IRR BMP region for the corn following corn following alfalfa analysis. Figure 41 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for corn following corn following alfalfa in the IRR BMP region.[43]

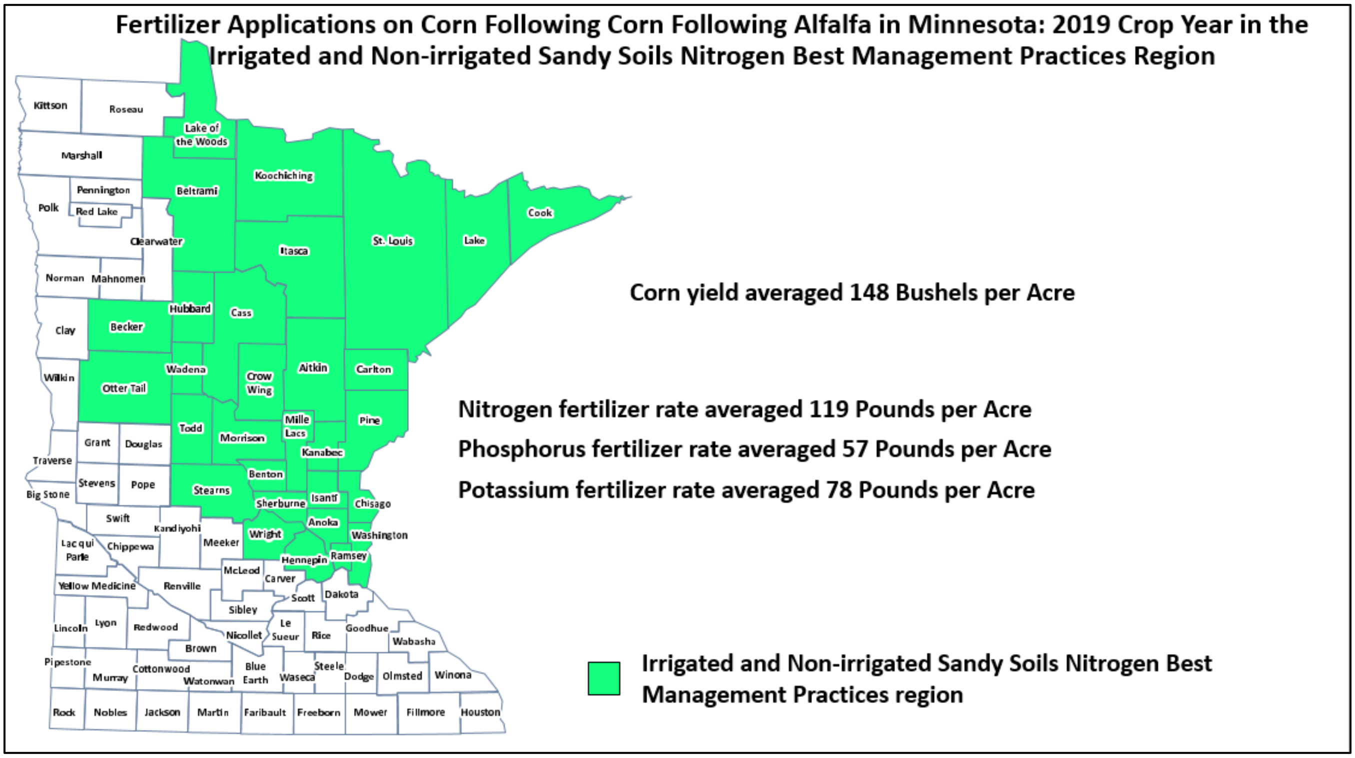

Figure 41. The average corn yield and average fertilizer rate for corn following corn following alfalfa in the IRR BMP region

[43] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 100% applied phosphorus, and 100% applied potassium on fields with corn following corn following alfalfa. Less than five responses reported applying sulfur.

Figure 42 provides the distribution of nitrogen fertilizer rate in the IRR BMP region for corn following corn following alfalfa; the corresponding corn yield are detailed in red.[44] Nitrogen rates are only from commercial fertilizer.

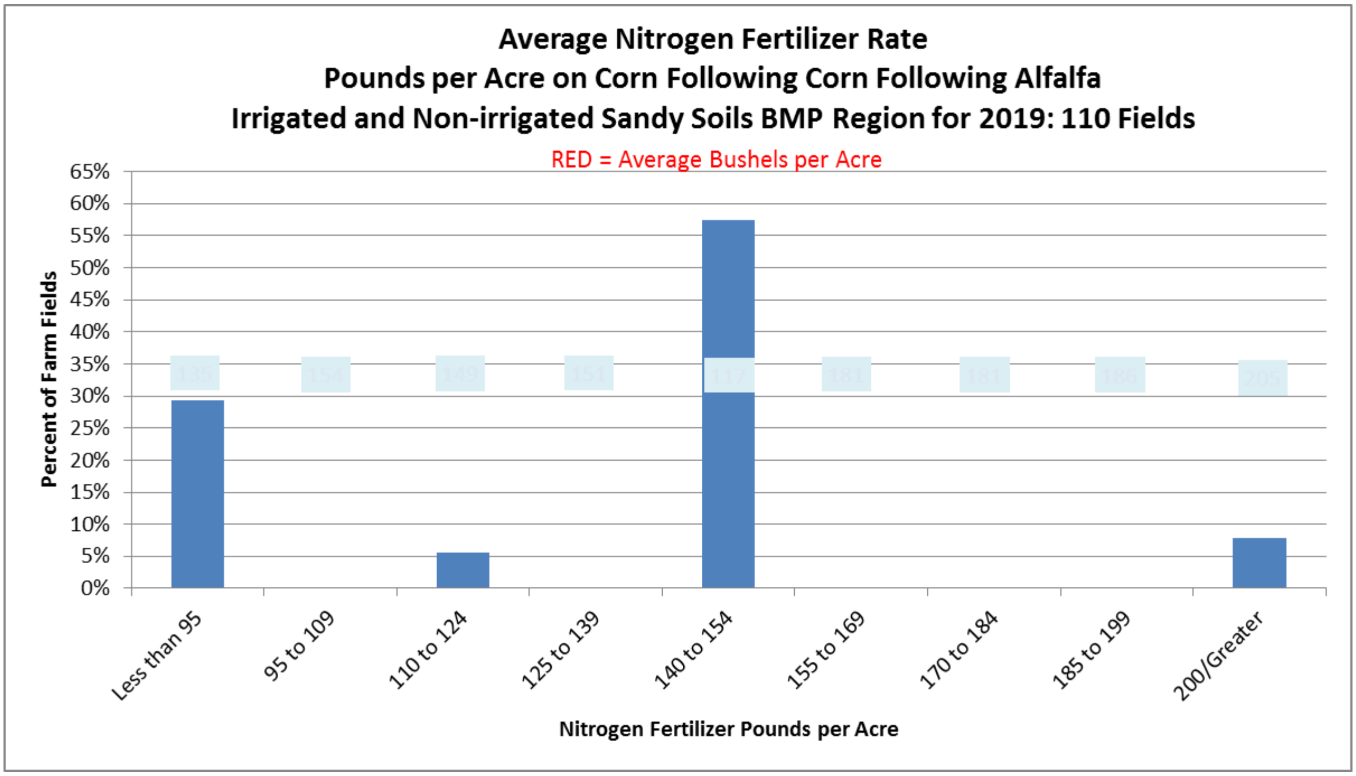

Figure 42. Average nitrogen fertilizer rate and yield on corn following corn following alfalfa in the IRR BMP region for 2019: 110 fields

In the IRR BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following corn following alfalfa are shown in Table 103.

Table 103. Average fertilizer rate and yield in the IRR BMP region for corn following corn following alfalfa

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	119	148	119
Phosphorus	100	57	148	57
Potassium	100	78	148	78
Sulfur	**	**	**	**

** Less than five responses

[44] Yields are not published if there are less than five responses.

Statewide: Corn Following Alfalfa

Statewide, two percent of the fields reported were corn following alfalfa. Figure 43 details the BMP regions where farmers reported on fields with corn following alfalfa. There were 364 fields represented in Minnesota.[45]

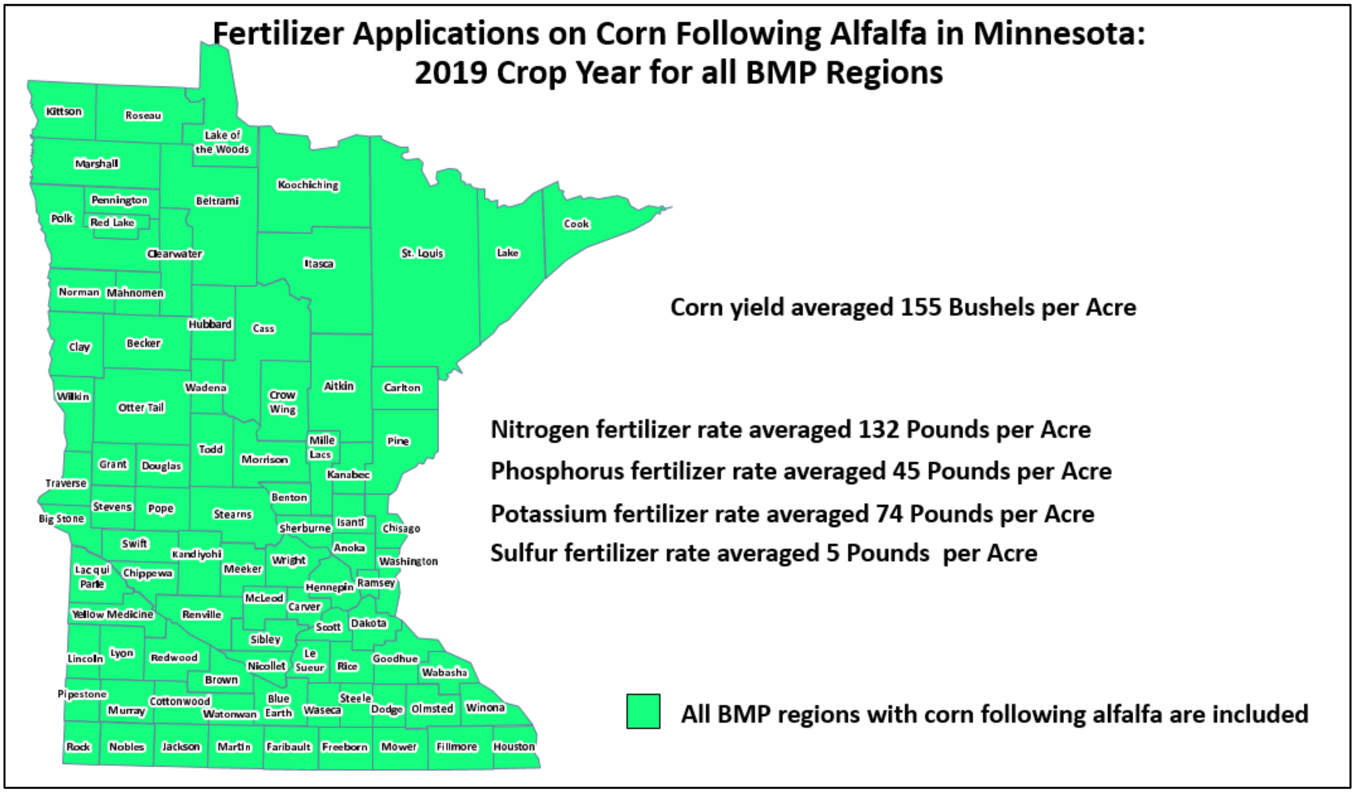

Figure 43. The average corn yield and average fertilizer rate for corn following alfalfa in Minnesota

[45] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 88% applied phosphorus, 53% applied potassium, and 21% applied sulfur on fields with corn following alfalfa.

Figure 44 provides the distribution of average nitrogen fertilizer rate in Minnesota for corn following alfalfa; the corresponding corn yield is detailed in red.[46] Nitrogen rates are only from commercial fertilizer.

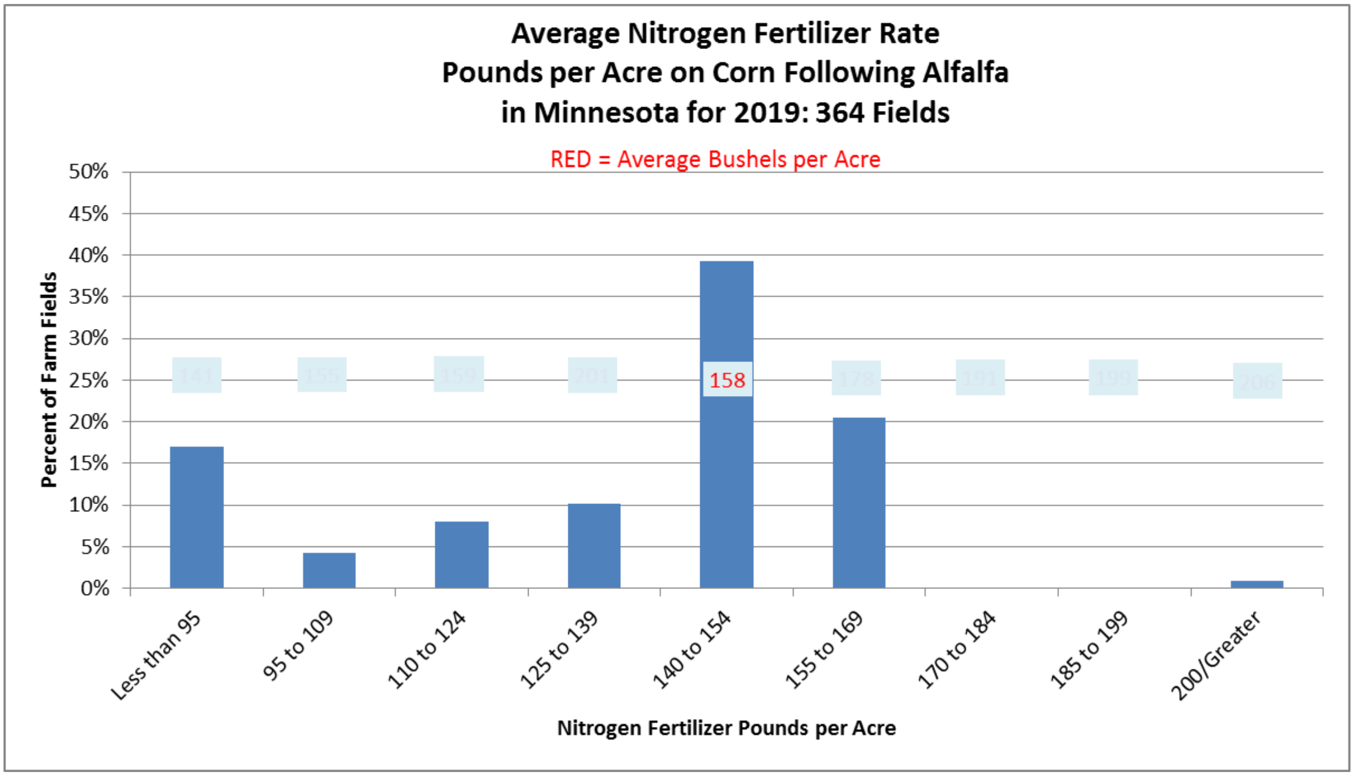

Figure 44. Average nitrogen fertilizer rate and yield on corn following alfalfa in Minnesota for 2019: 364 fields

In Minnesota, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following alfalfa are shown in Table 104.

Table 104. Average fertilizer rate and corn yield in Minnesota for corn following alfalfa

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	132	155	132
Phosphorus	88	45	155	40
Potassium	53	74	164	39
Sulfur	21	5	185	1

[46] Yields are not published if there are less than five responses.

Southeastern BMP Region: Corn Following Alfalfa

Less than five responses reported corn following alfalfa in the SE BMP region.

South Central BMP Region: Corn Following Alfalfa

Less than five responses reported corn following alfalfa in the SC BMP region.

Southwestern and West Central BMP Region: Corn Following Alfalfa

Less than five responses reported corn following alfalfa in the SW BMP region.

Northwestern BMP Region: Corn Following Alfalfa

Less than five responses reported corn following alfalfa in the NW BMP region.

Irrigated and Non-irrigated Sandy Soils BMP Region: Corn Following Alfalfa

There were 129 fields that were represented in the IRR BMP region for the corn following alfalfa analysis. Figure 45 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield corn following alfalfa in the IRR BMP region.[47]

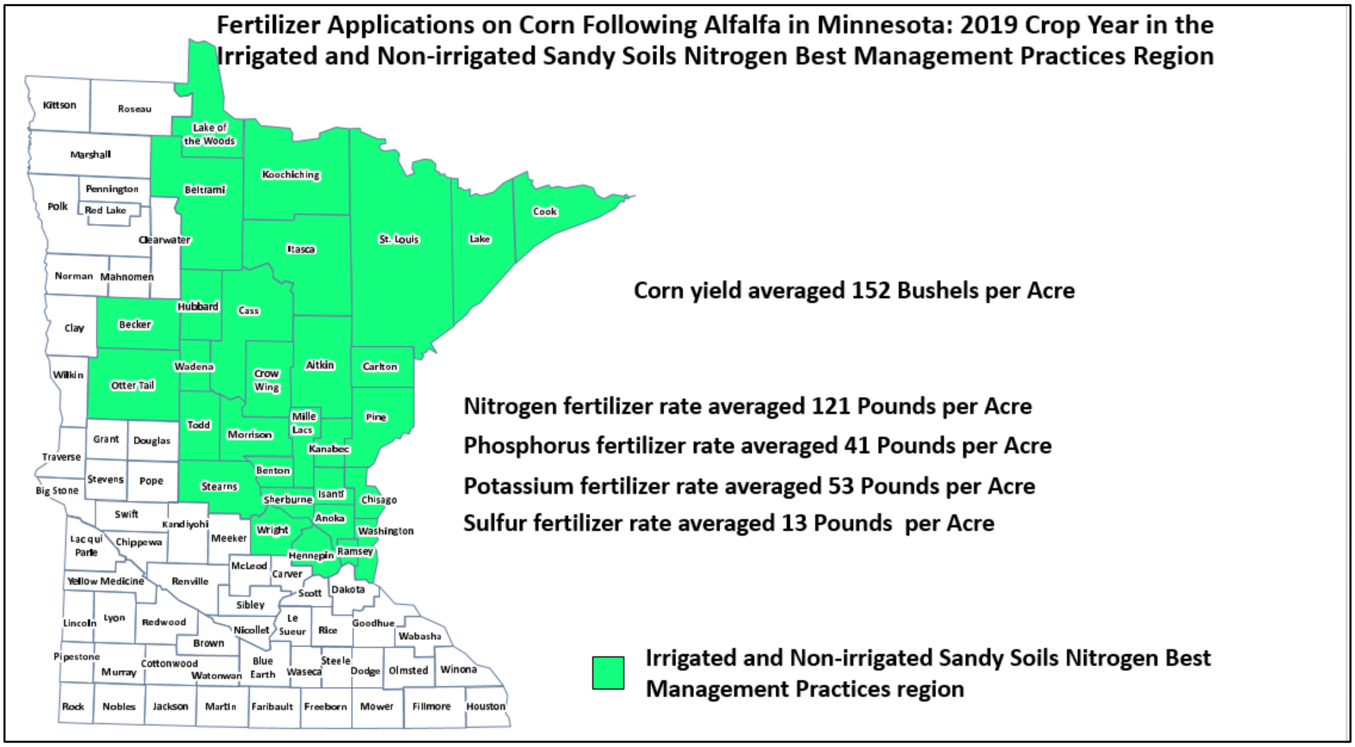

Figure 45. The average corn yield and average fertilizer rate for corn following alfalfa in the IRR BMP region

[47] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 90% applied phosphorus, 92% applied potassium, and 80% applied sulfur on fields with corn following alfalfa.

Figure 46 provides the distribution of nitrogen fertilizer rate in the IRR BMP region for corn following alfalfa; the corresponding corn yield are detailed in red.[48] Nitrogen rates are only from commercial fertilizer.

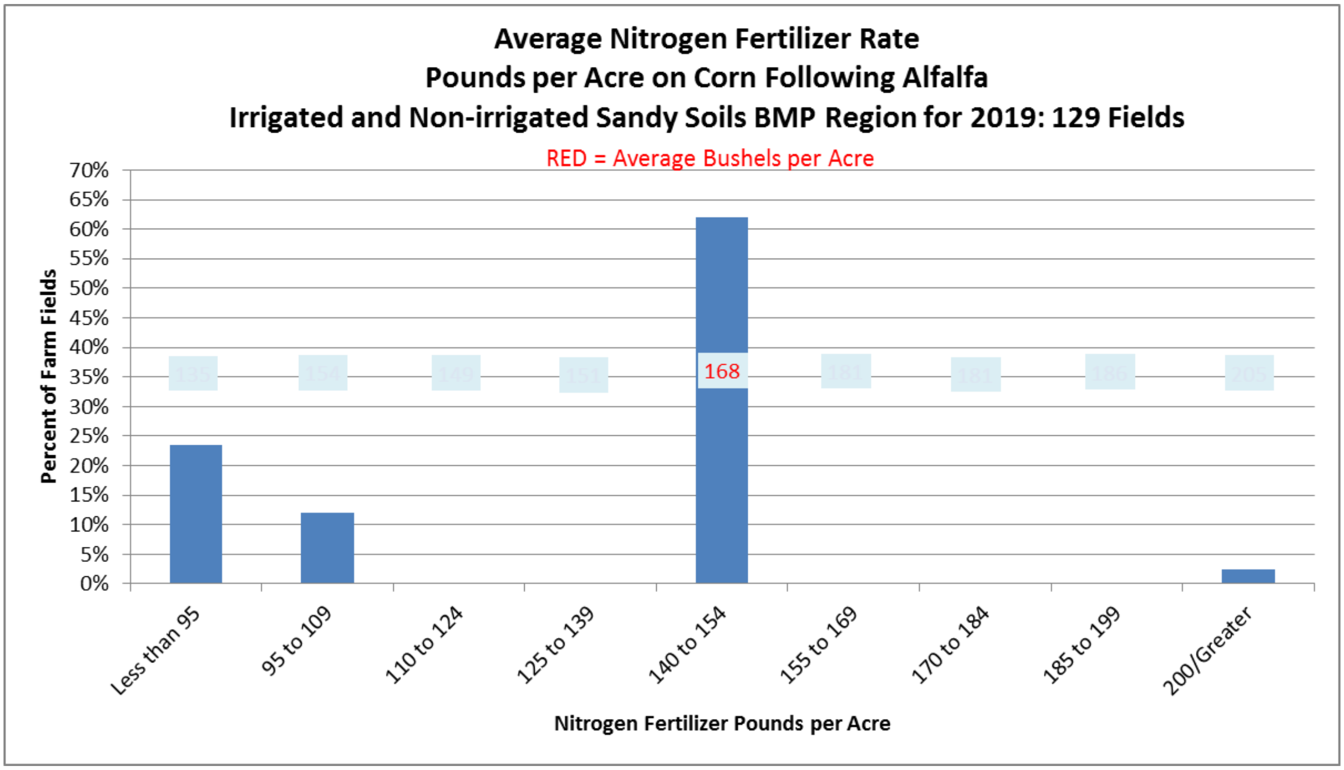

Figure 46. Average nitrogen fertilizer rate and yield on corn following alfalfa in the IRR BMP region for 2019: 129 fields

In the IRR BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following alfalfa are shown in Table 105.

Table 105. Average fertilizer rate and yield in the IRR BMP region for corn following alfalfa

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	121	152	121
Phosphorus	90	41	155	37
Potassium	92	53	152	49
Sulfur	80	13	152	10

[48] Yields are not published if there are less than five responses.

Statewide: Corn Following Small Grains

Statewide, three percent of the fields reported were corn following small grains. Figure 47 details the BMP regions where farmers reported on fields with corn following small grains. There were 618 fields represented in Minnesota.[49]

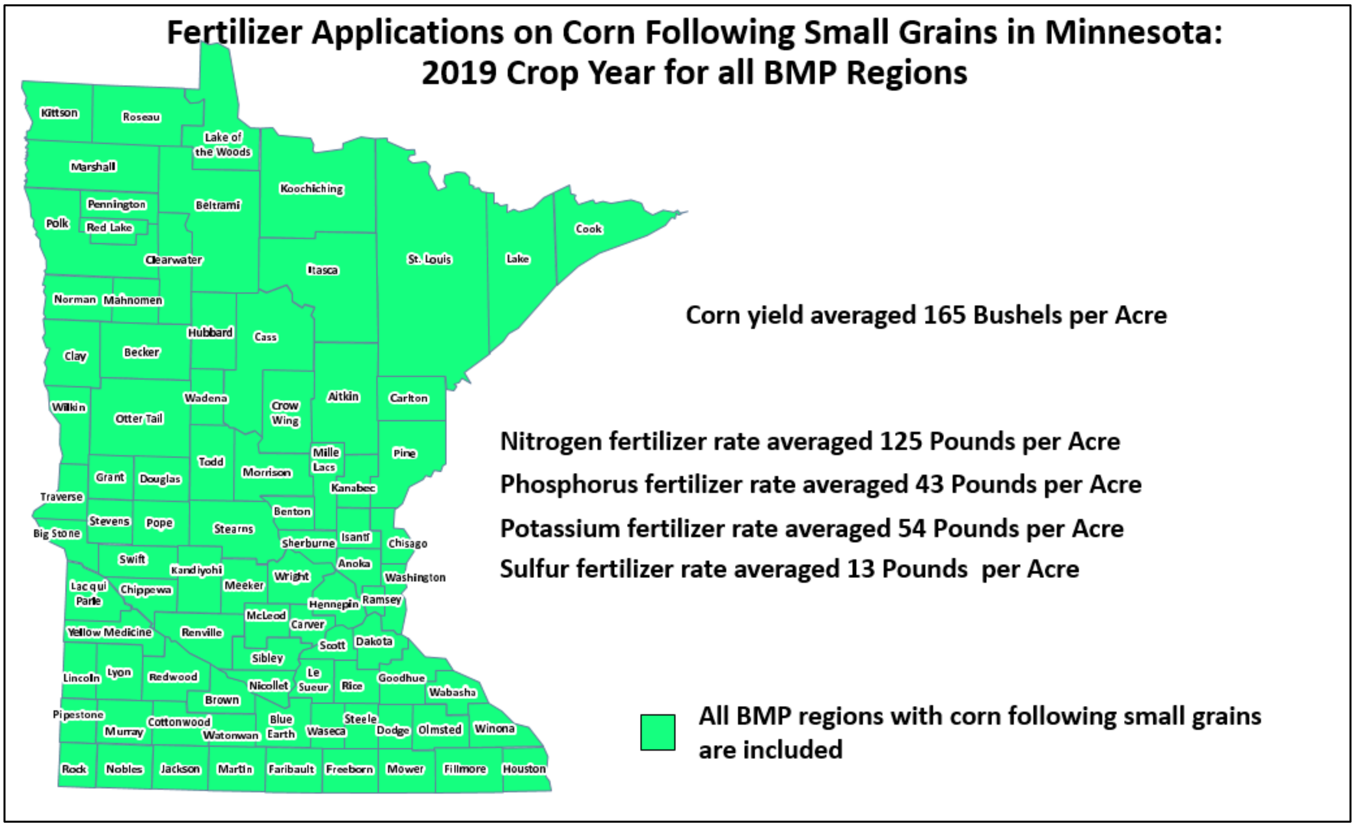

Figure 47. The average corn yield and average fertilizer rate for corn following small grains in Minnesota

[49] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 83% applied phosphorus, 74% applied potassium, and 55% applied sulfur on fields with corn following small grains.

Figure 48 provides the distribution of average nitrogen fertilizer rate in Minnesota for corn following small grains; the corresponding corn yield is detailed in red.[50] Nitrogen rates are only from commercial fertilizer.

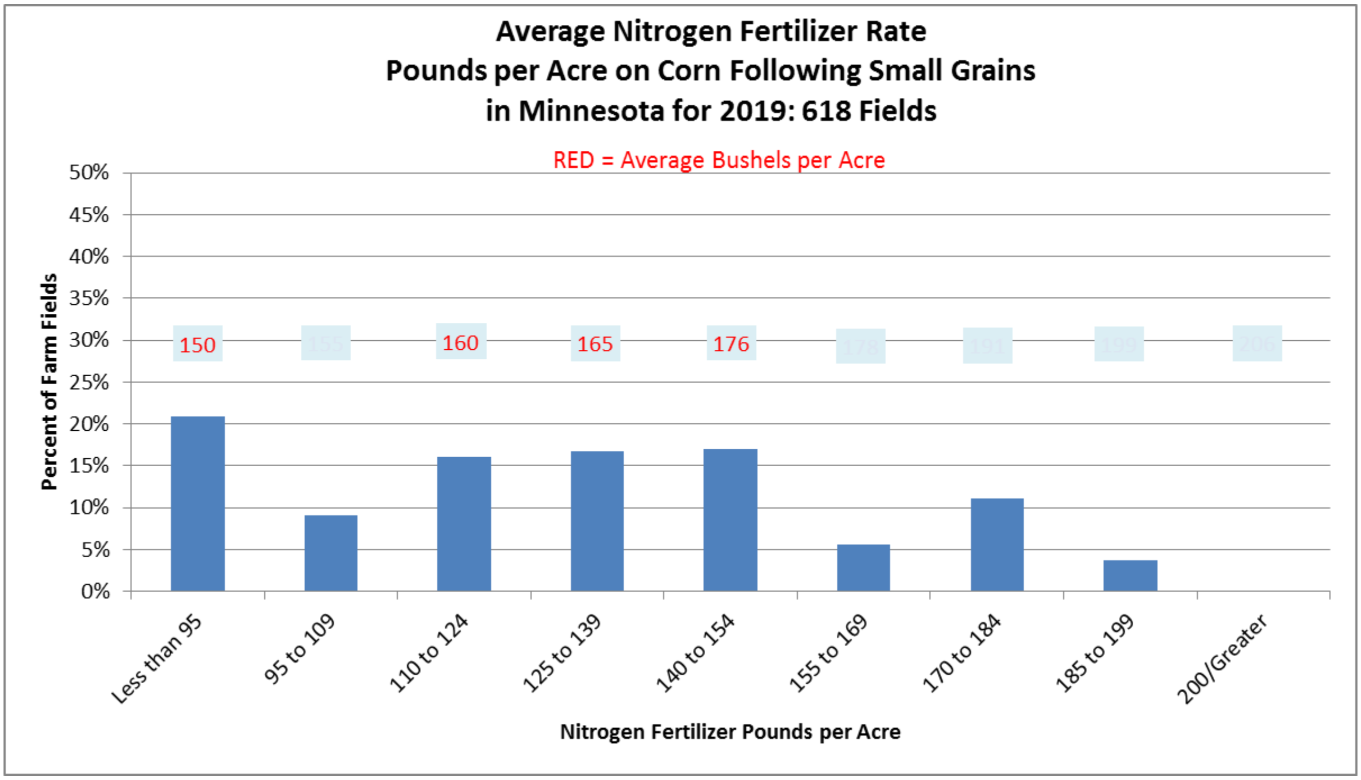

Figure 48. Average nitrogen fertilizer rate and yield on corn following small grains in Minnesota for 2019: 618 fields

In Minnesota, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following small grains are shown in Table 106.

Table 106. Average fertilizer rate and corn yield in Minnesota for corn following small grains

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	125	165	125
Phosphorus	83	43	164	36
Potassium	74	54	158	40
Sulfur	55	13	160	7

[50] Yields are not published if there are less than five responses.

Southeastern BMP Region: Corn Following Small Grains

Less than five responses reported corn following small grains in the SE BMP region.

South Central BMP Region: Corn Following Small Grains

Less than five responses reported corn following small grains in the SC BMP region.

Southwestern and West Central BMP Region: Corn Following Small Grains

There were 184 fields that were represented in the SW BMP region for the corn following small grains analysis. Figure 49 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for corn following small grains in the SW BMP region.[51]

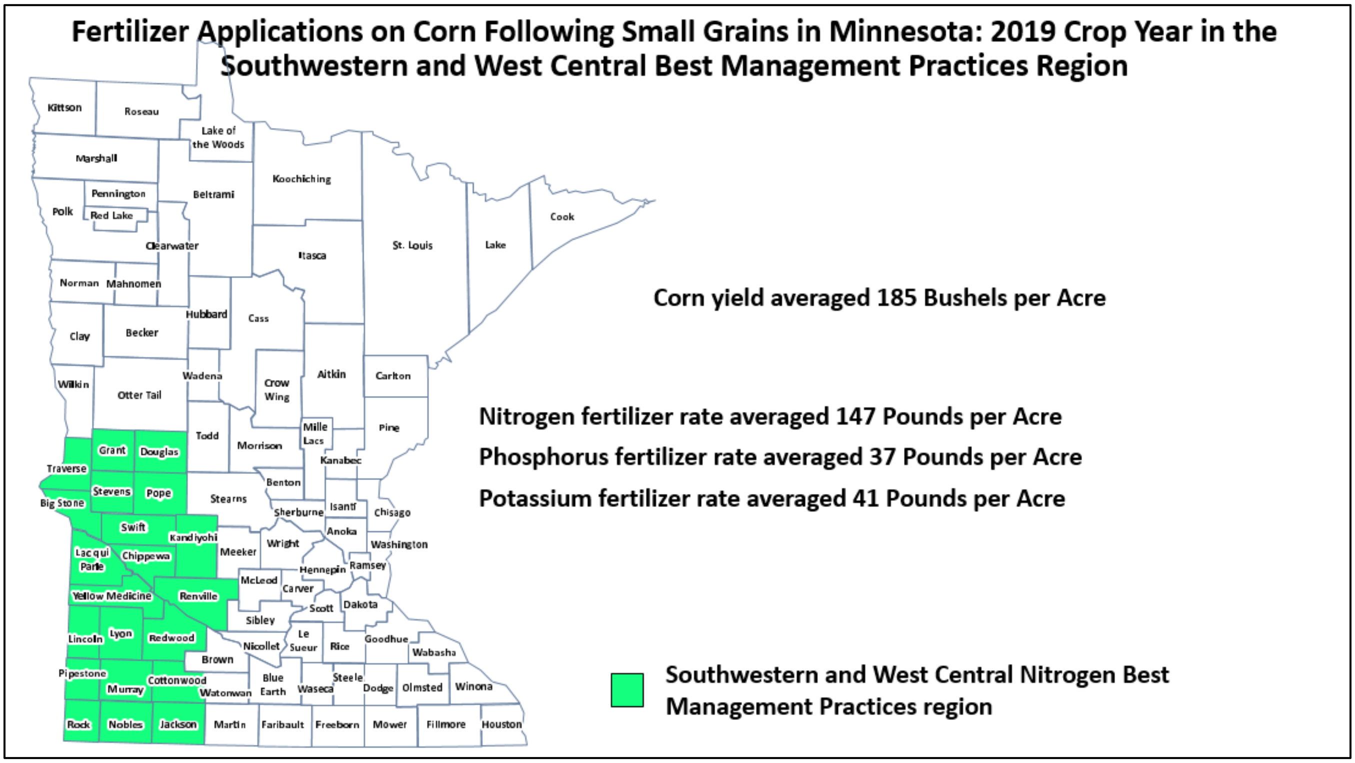

Figure 49. The average corn yield and average fertilizer rate for corn following small grains in the SW BMP region

[51] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 72% applied phosphorus, and 40% applied potassium on fields with corn following small grains. Less than five respondents reported applying sulfur.

Figure 50 provides the distribution of nitrogen fertilizer rate in the SW BMP region for corn following small grains; the corresponding corn yield are detailed in red.[52] Nitrogen rates are only from commercial fertilizer.

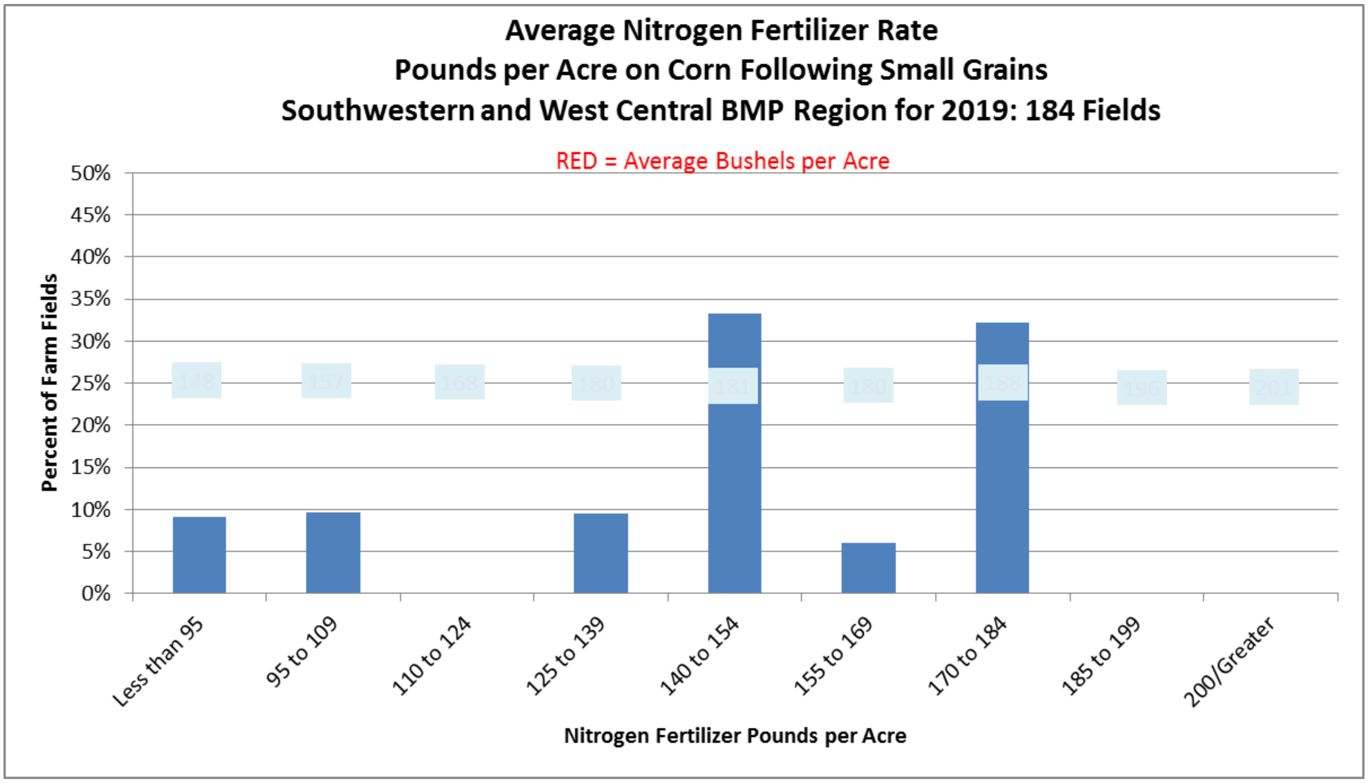

Figure 50. Average nitrogen fertilizer rate and yield on corn following small grains in the SW BMP region for 2019: 184 fields

In the SW BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following small grains are shown in Table 107.

Table 107. Average fertilizer rate and yield in the SW BMP region for corn following small grains

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	147	185	147
Phosphorus	72	37	179	27
Potassium	40	41	163	16
Sulfur	**	**	**	**

** Less than five responses

[52] Yields are not published if there are less than five responses.

Northwestern BMP Region: Corn Following Small Grains

There were 218 fields that were represented in the NW BMP region for the corn following small grains analysis. Figure 51 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for corn following small grains in the NW BMP region.[53]

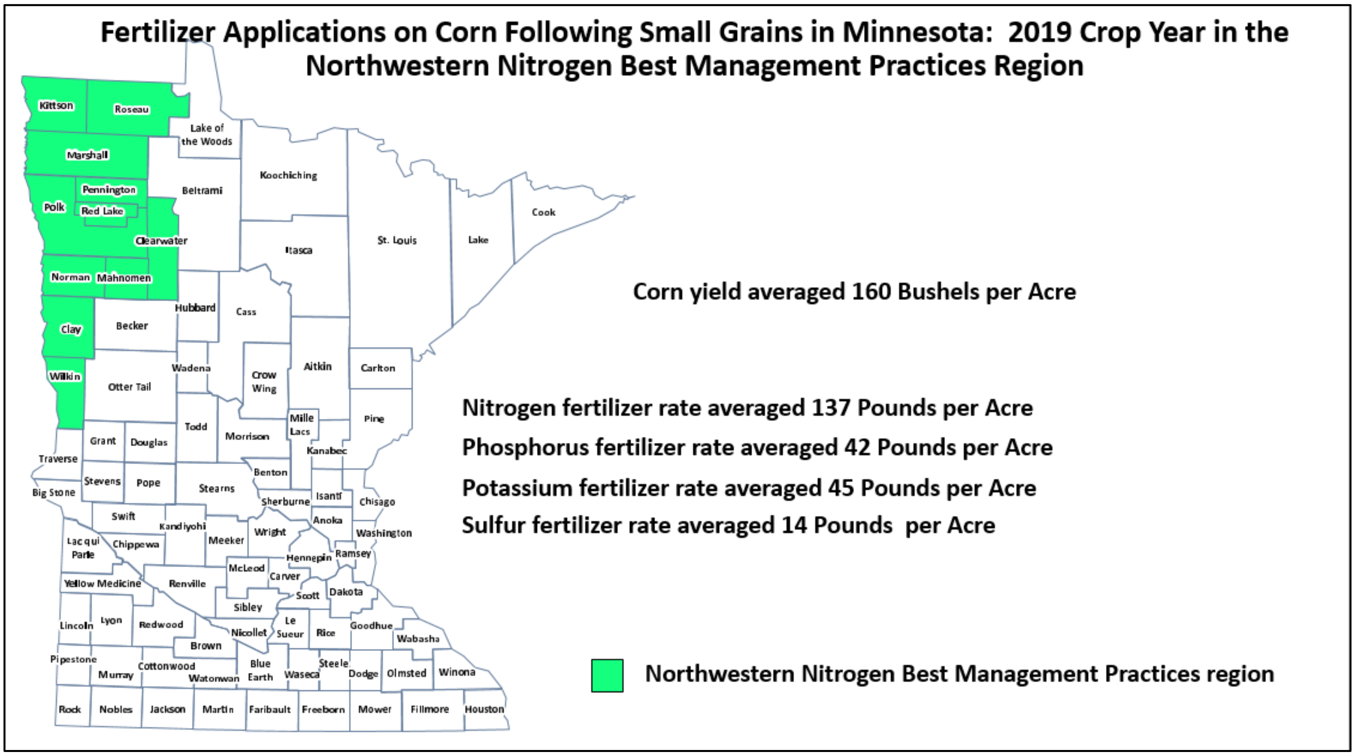

Figure 51. The average corn yield and average fertilizer rate for corn following small grains in the NW BMP region

[53] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 100% applied phosphorus, 96% applied potassium, and 60% applied sulfur on fields with corn following small grains.

Figure 52 provides the distribution of nitrogen fertilizer rate in the NW BMP region for corn following small grains; the corresponding corn yield are detailed in red.[54] Nitrogen rates are only from commercial fertilizer.

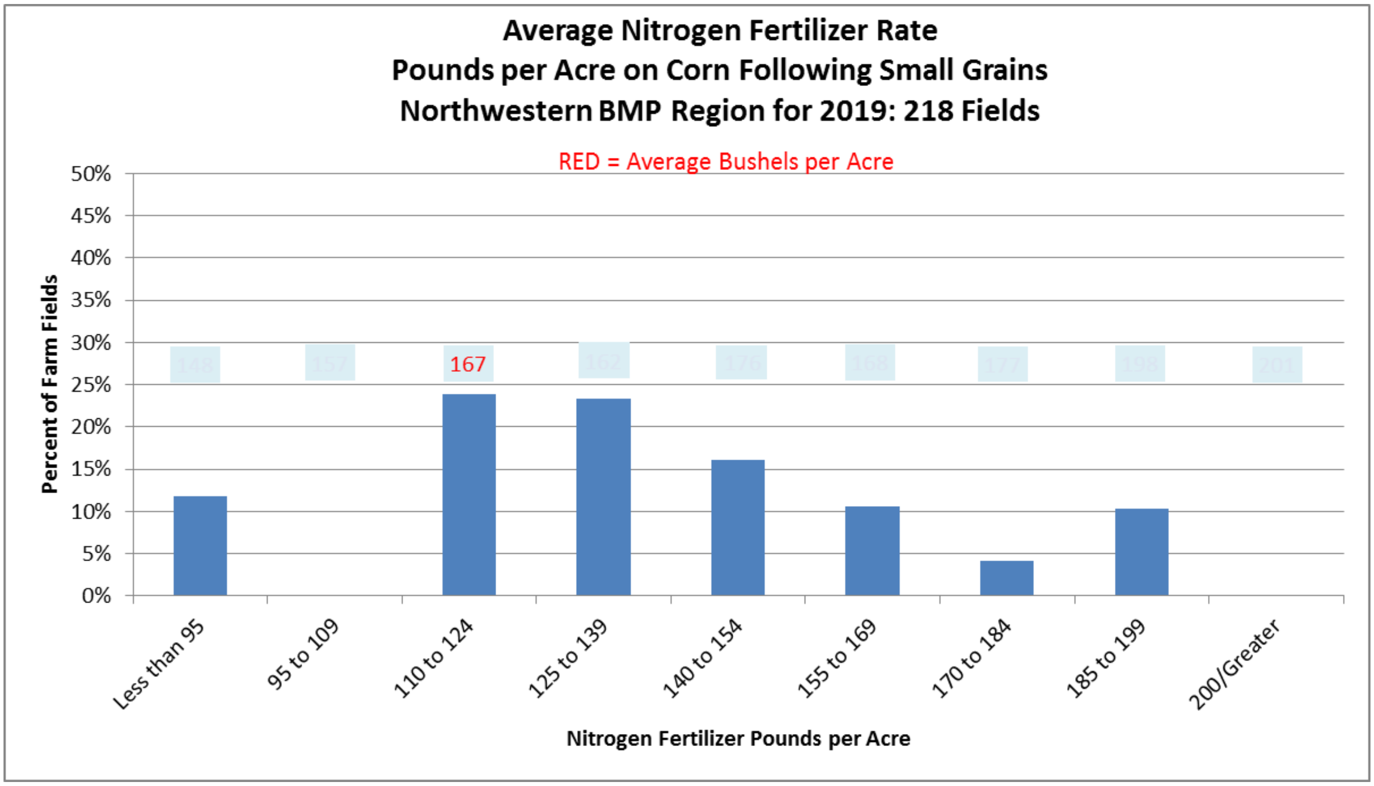

Figure 52. Average nitrogen fertilizer rate and yield on corn following small grains in the NW BMP region for 2019: 218 fields

In the NW BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following small grains are shown in Table 106.

Table 108. Average fertilizer rate and yield in the NW BMP region for corn following small grains

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	137	160	137
Phosphorus	100	42	160	42
Potassium	96	45	160	43
Sulfur	60	14	164	8

[54] Yields are not published if there are less than five responses.

Irrigated and Non-irrigated Sandy Soils BMP Region: Corn Following Small Grains

There were 116 fields that were represented in the IRR BMP region for the corn following small grains analysis. Figure 37 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for corn following small grains in the IRR BMP region.[55]

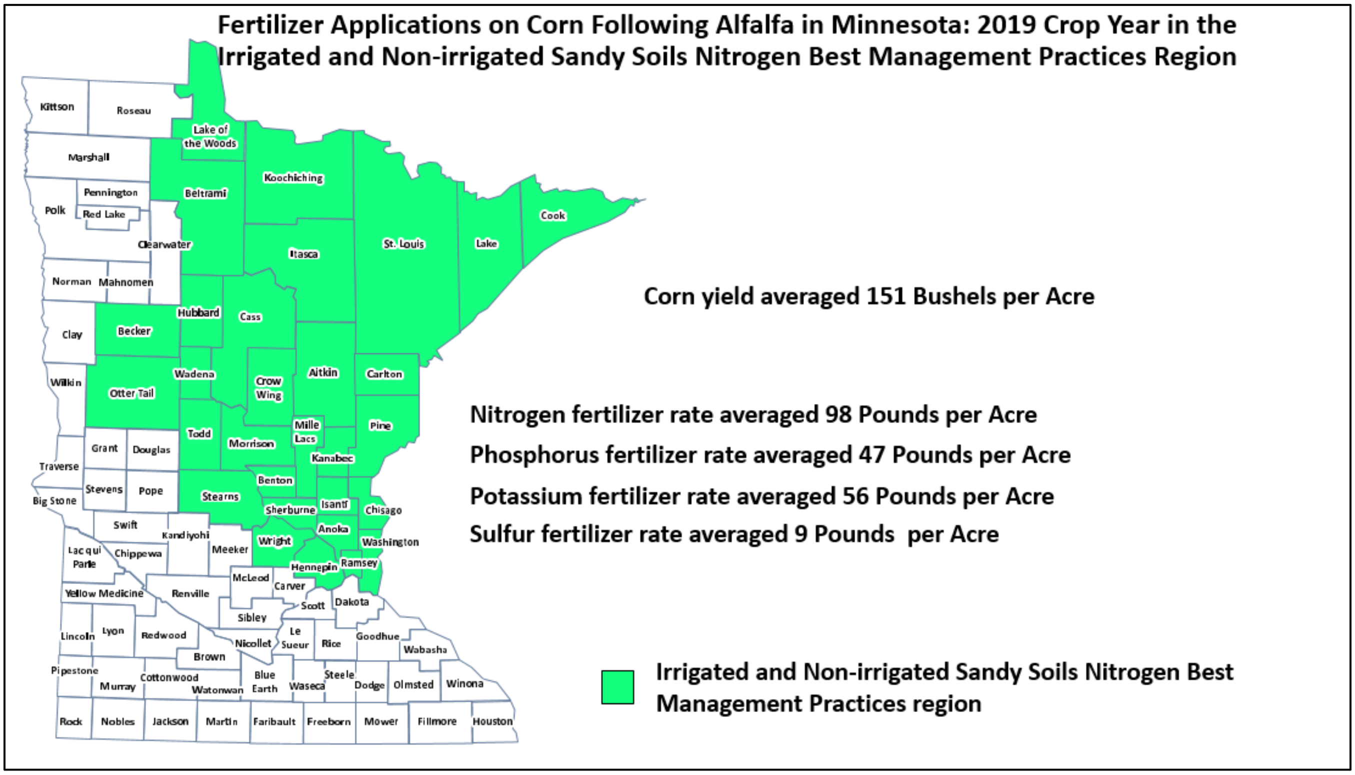

Figure 53. The average corn yield and average fertilizer rate for corn following small grains in the IRR BMP region

[55] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 55% applied phosphorus, 65% applied potassium, and 69% applied sulfur on fields with corn following small grains.

Figure 54 provides the distribution of nitrogen fertilizer rate in the IRR BMP region for corn following small grains; the corresponding corn yield are detailed in red.[56] Nitrogen rates are only from commercial fertilizer.

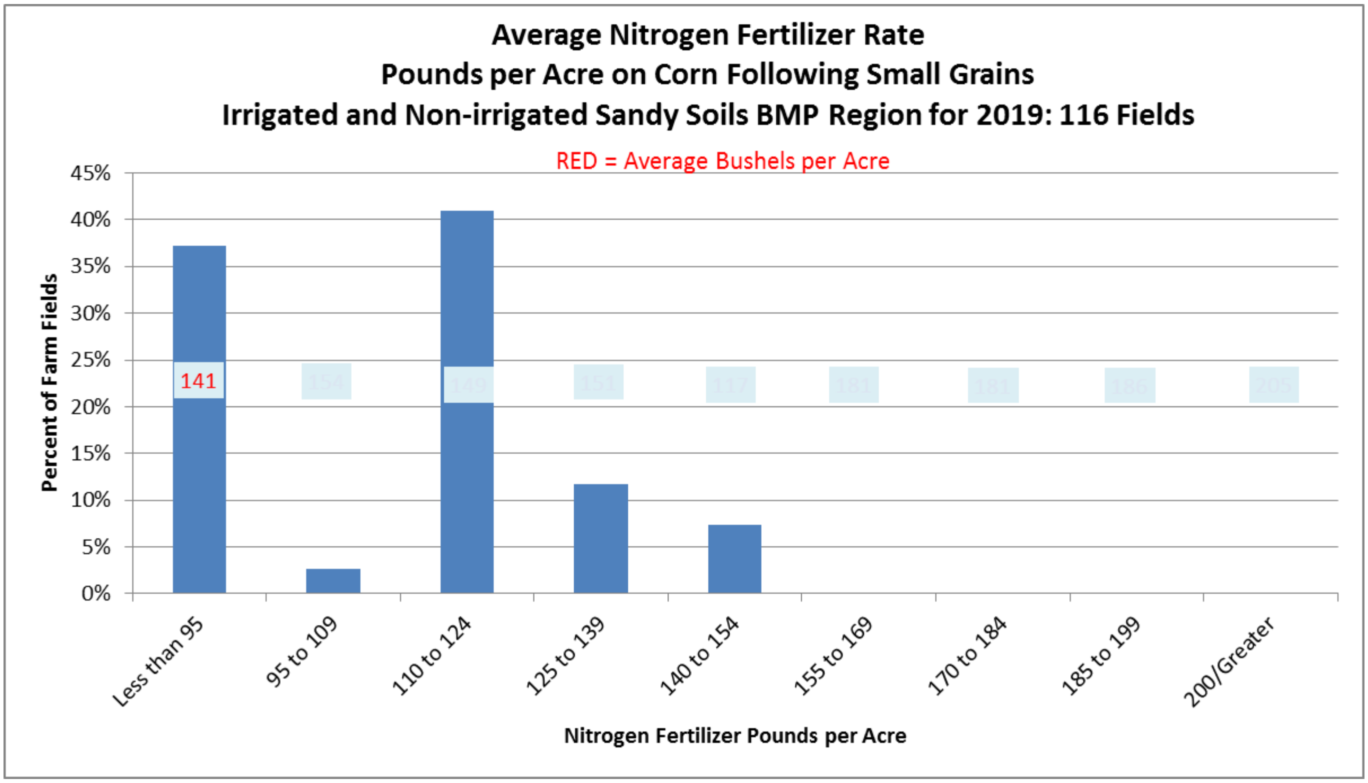

Figure 54. Average nitrogen fertilizer rate and yield on corn following small grains in the IRR BMP region for 2019: 116 fields

In the IRR BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following small grains are shown in Table 109.

Table 109. Average fertilizer rate and yield in the IRR BMP region for corn following small grains

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	98	151	98
Phosphorus	55	47	152	26
Potassium	65	56	151	36
Sulfur	69	9	154	7

[56] Yields are not published if there are less than five responses.

Statewide: Corn Following Other Crops

Statewide, three percent of the fields represented were corn following small grains. Figure 55 details the BMP regions where farmers reported on fields with corn following other crops. There were 544 fields represented in Minnesota.[57]

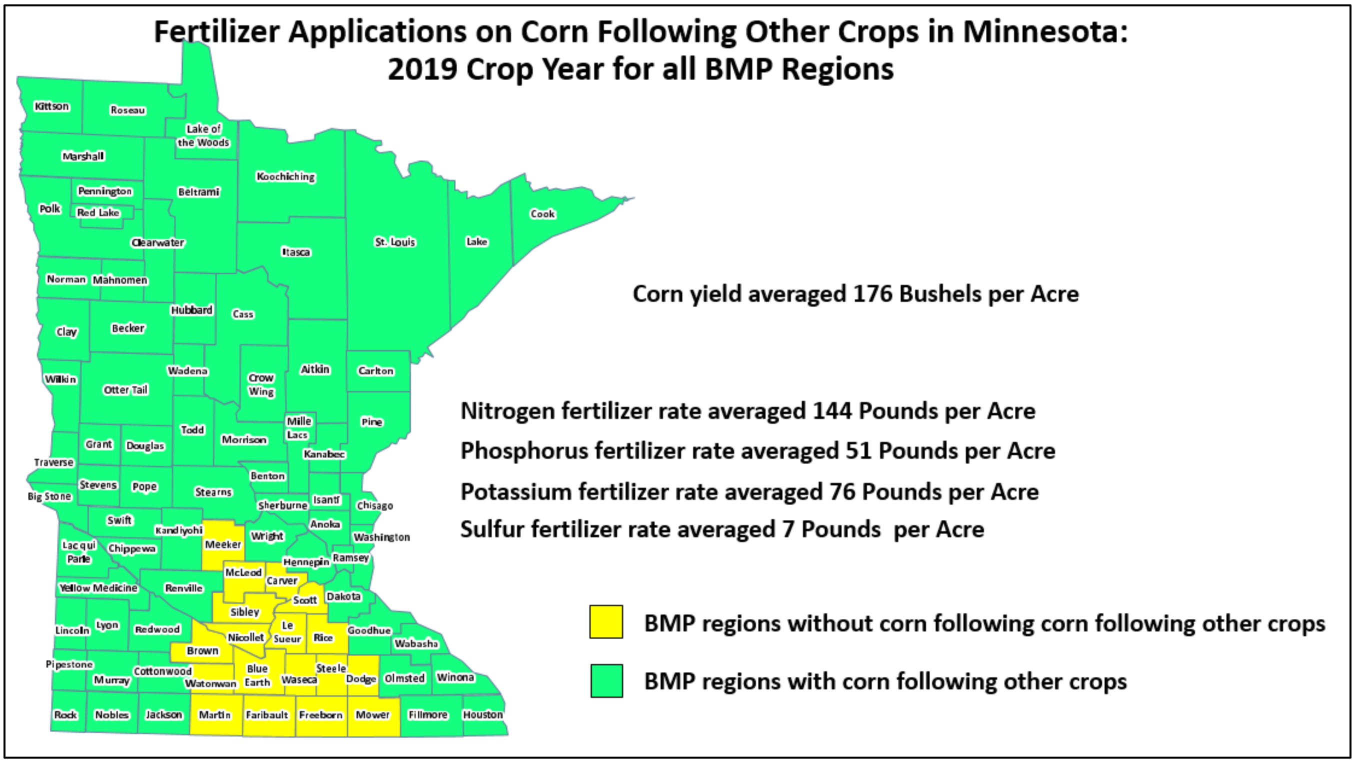

Figure 55. The average corn yield and average fertilizer rate for corn following other crops in Minnesota

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[57] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2018 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 84% applied phosphorus, 89% applied potassium, and 61% applied sulfur on fields with corn following other crops.

Figure 56 provides the distribution of average nitrogen fertilizer rate in Minnesota for corn following other crops; the corresponding corn yield is detailed in red.[58] Nitrogen rates are only from commercial fertilizer.

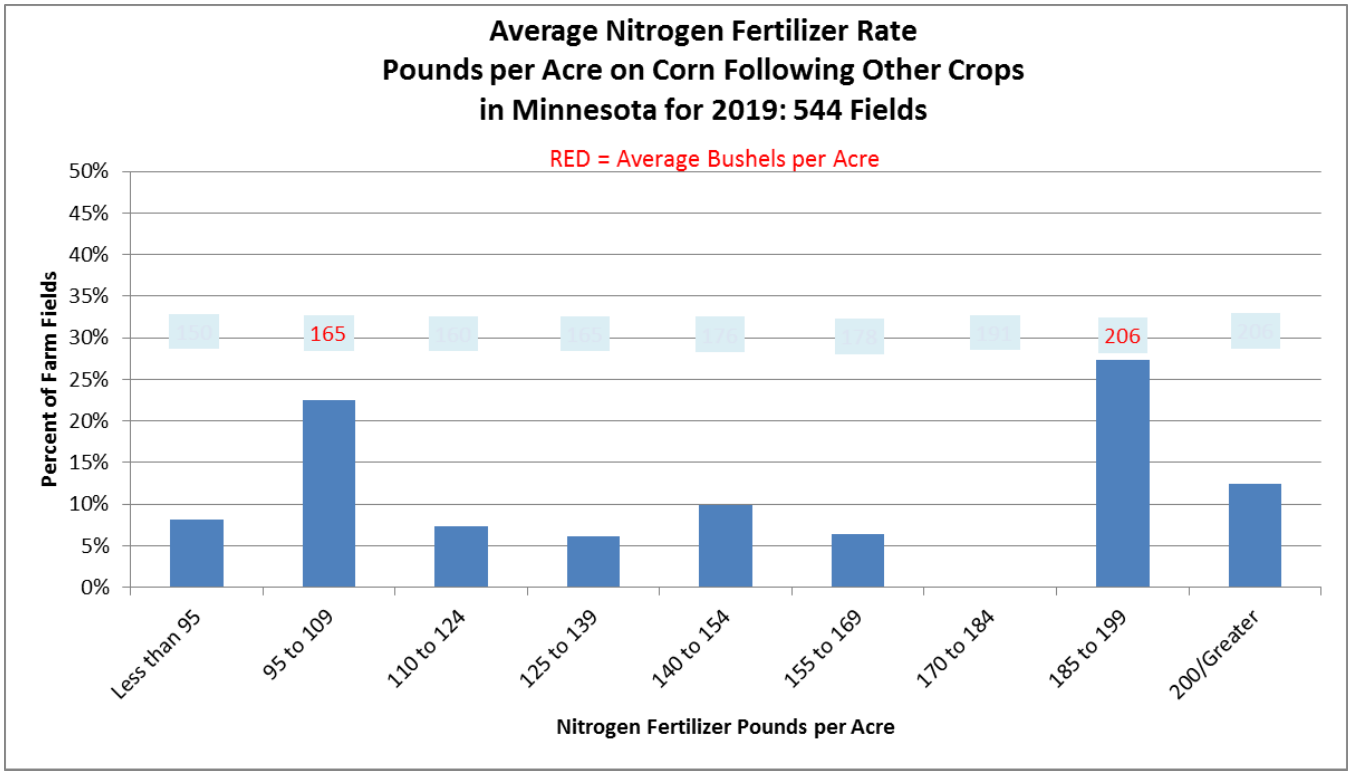

Figure 56. Average nitrogen fertilizer rate and yield on corn following other crops in Minnesota for 2019: 544 fields

In Minnesota, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following other crops are shown in Table 110.

Table 110. Average fertilizer rate and corn yield in Minnesota for corn following other crops

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	144	176	144
Phosphorus	84	51	169	43
Potassium	89	76	175	68
Sulfur	61	7	177	4

[58] Yields are not published if there are less than five responses.

Southeastern BMP Region: Corn Following Other Crops

Less than five responses reported corn following other crops in the SE BMP region.

South Central BMP Region: Corn Following Other Crops

No responses reported corn following other crops in the SC BMP region.

Southwestern and West Central BMP Region: Corn Following Other Crops

There were 105 fields that were represented in the SW BMP region for the corn following other crops analysis. Figure 57 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for corn following other crops in the SW BMP region.[59]

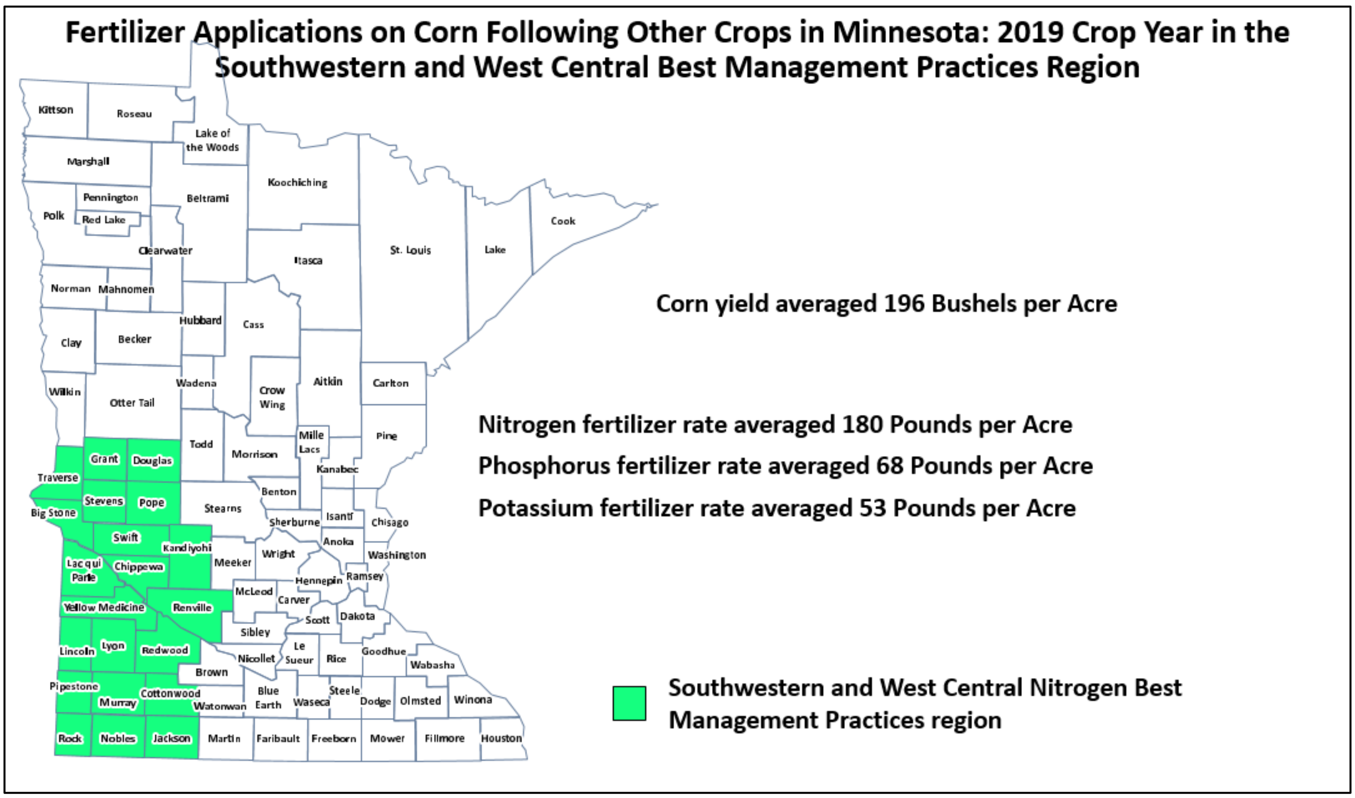

Figure 57. The average corn yield and average fertilizer rate for corn following other crops in the SW BMP region

[59] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 100% applied phosphorus, and 100% applied potassium on fields with corn following other crops. Less than five respondents reported applying sulfur.

Figure 58 provides the distribution of nitrogen fertilizer rate in the SW BMP region for corn following other crops; the corresponding corn yield are detailed in red.[60] Nitrogen rates are only from commercial fertilizer.

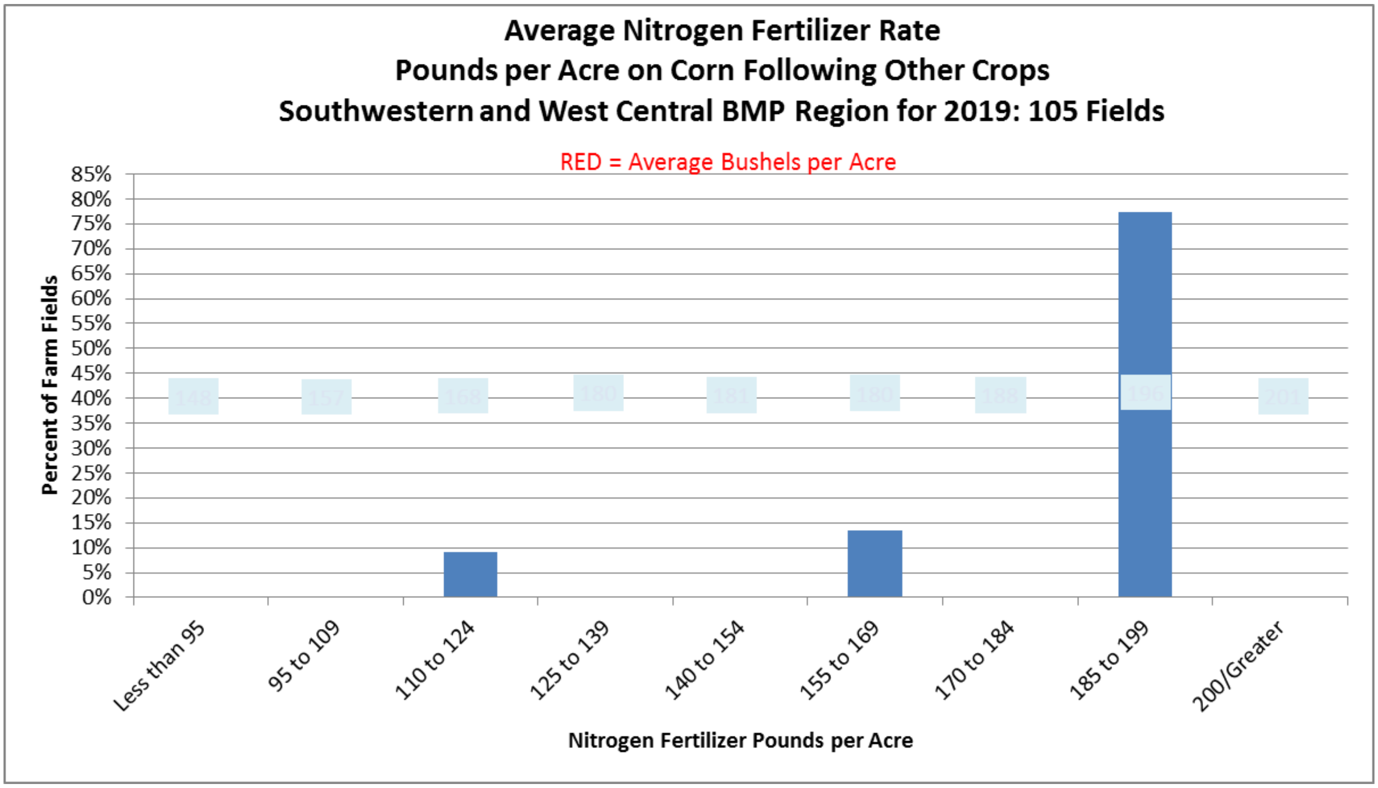

Figure 58. Average nitrogen fertilizer rate and yield on corn following other crops in the SW BMP region for 2019: 105 fields

In the SW BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following other crops are shown in Table 111.

Table 111. Average fertilizer rate and yield in the SW BMP region for corn following other crops

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	180	196	180
Phosphorus	100	68	196	68
Potassium	100	53	196	53
Sulfur	**	**	**	**

** Less than five responses

[60] Yields are not published if there are less than five responses.

Northwestern BMP Region: Corn Following Other Crops

There were 140 fields that were represented in the NW BMP region for the corn following other crops analysis. Figure 59 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for corn following other crops in the NW BMP region.[61]

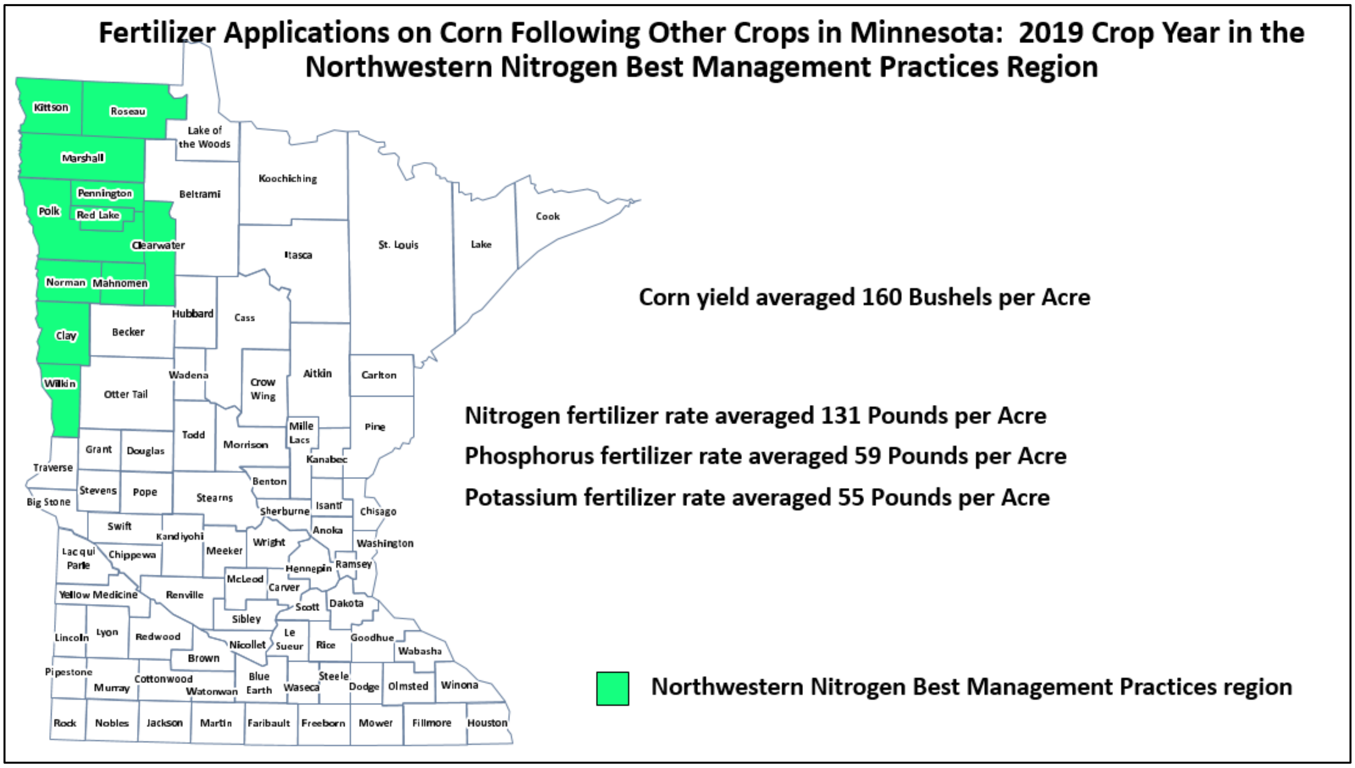

Figure 59. The average corn yield and average fertilizer rate for corn following other crops in the NW BMP region

[61] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 100% applied phosphorus, and 83% applied potassium on fields with corn following other crops. Less than five respondents reported applying sulfur.

Figure 60 provides the distribution of nitrogen fertilizer rate in the NW BMP region for corn following other crops; the corresponding corn yield are detailed in red.[62] Nitrogen rates are only from commercial fertilizer.

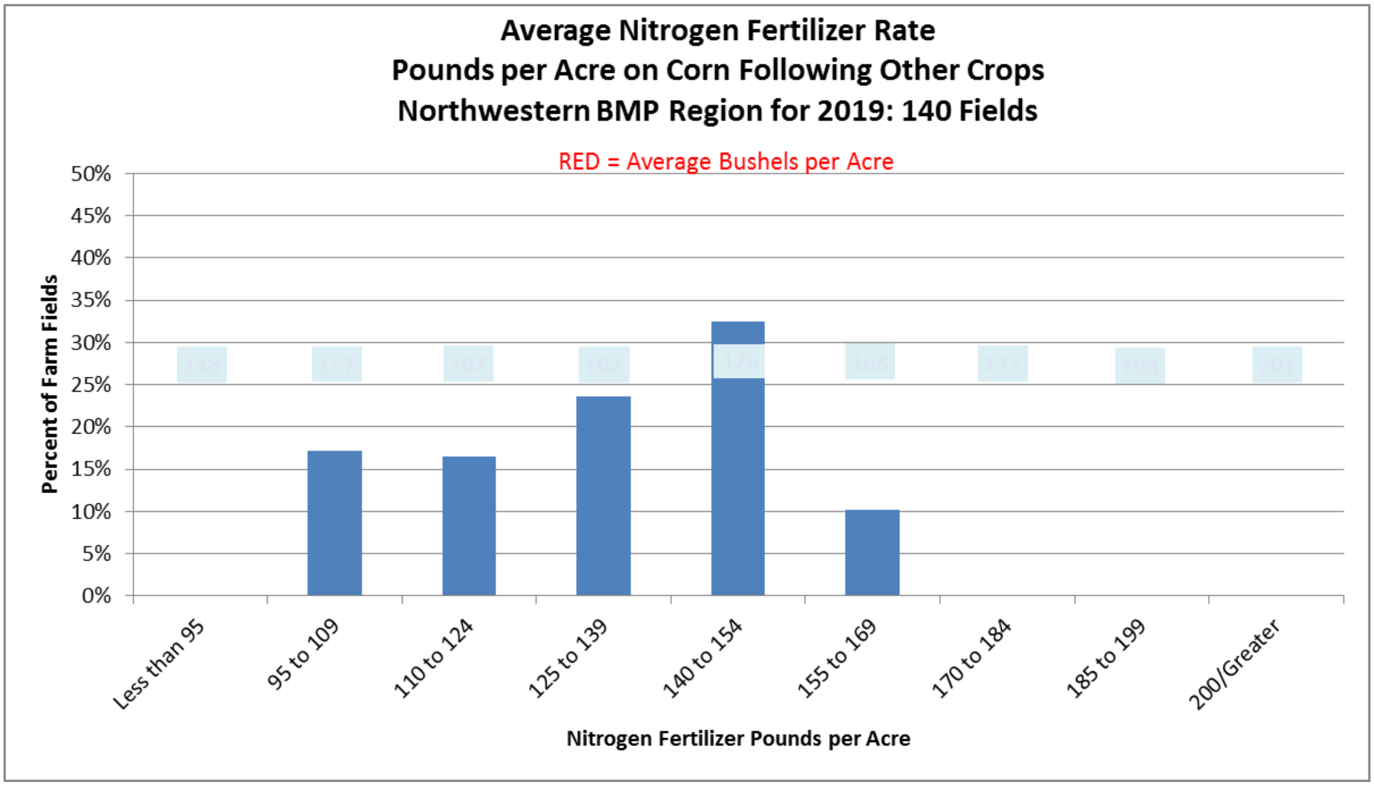

Figure 60. Average nitrogen fertilizer rate and yield on corn following other crops in the NW BMP region for 2019: 140 fields

In the NW BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following other crops are shown in Table 112.

Table 112. Average fertilizer rate and yield in the NW BMP region for corn following other crops

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	131	160	131
Phosphorus	100	59	160	59
Potassium	83	55	164	46
Sulfur	**	**	**	**

** Less than five responses

62 Yields are not published if there are less than five responses.

Irrigated and Non-irrigated Sandy Soils BMP Region: Corn Following Other Crops

There were 182 fields that were represented in the IRR BMP region for the corn following other crops analysis. Figure 61 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for corn following other crops in the IRR BMP region.[63]

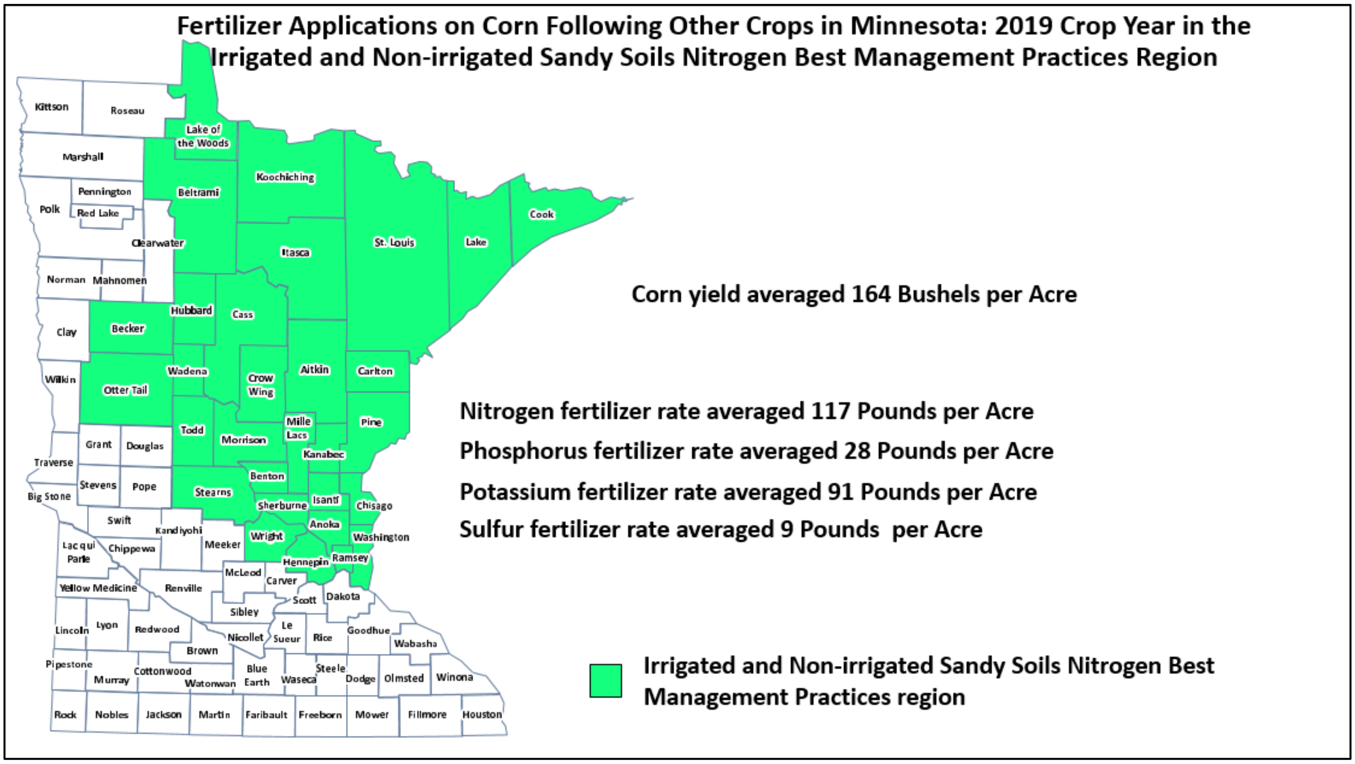

Figure 61. The average corn yield and average fertilizer rate for corn following other crops in the IRR BMP region

[63] The published averages are for respondents that applied commercial fertilizer on corn fields without manure to the 2019 corn crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 71% applied phosphorus, 100% applied potassium, and 54% applied sulfur on fields with corn following small grains.

Figure 62 provides the distribution of nitrogen fertilizer rate in the IRR BMP region for corn following other crops; the corresponding corn yield are detailed in red.[64] Nitrogen rates are only from commercial fertilizer.

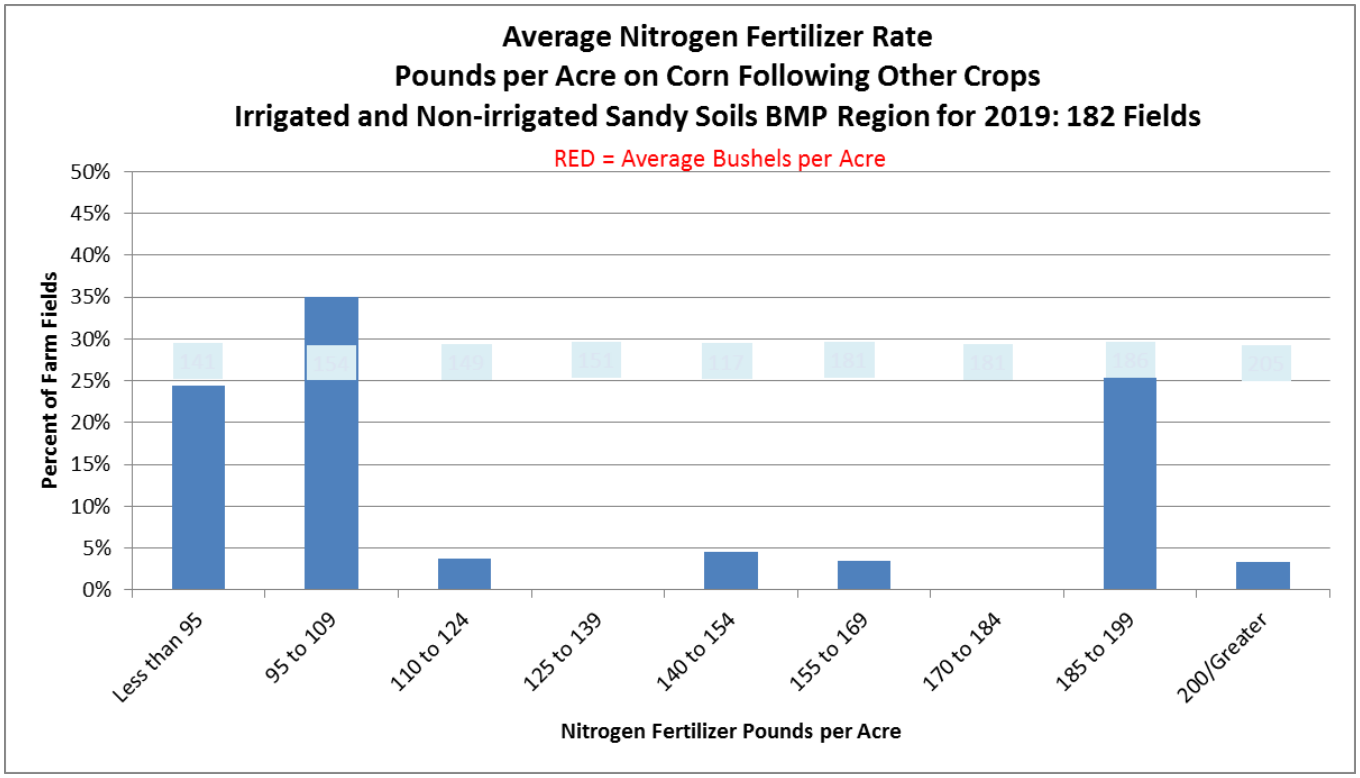

Figure 62. Average nitrogen fertilizer rate and yield on corn following other crops in the IRR BMP region for 2019: 182 fields

In the IRR BMP region, the percent of fertilized corn fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of corn following other crops are shown in Table 113.

Table 113. Average fertilizer rate and yield in the IRR BMP region for corn following other crops

Nutrients Applied	Percent of Fertilized Corn Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Corn Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Corn Fields Pounds per Acre
Nitrogen	100	117	164	117
Phosphorus	71	28	142	20
Potassium	100	91	164	91
Sulfur	54	9	154	5

[64] Yields are not published if there are less than five responses.

Soybean Section

Soybeans are a major crop in Minnesota, and no BMP regions had less than nine farmers that reported growing soybeans in Minnesota. Therefore, all BMP region farmers were included in the following soybean section.

Farmers in the survey were first asked "How many acres of soybeans did you plant?" Table 114 details the number of farmers[65] and corresponding soybean acres planted by BMP region for the 2019 crop year (SAQ-1[66]).

Table 114. Summary of respondents and corresponding soybean acres planted by BMP region for the 2019 crop year

BMP Region	Number of Respondents	Number of Soybean Acres
Northwestern	2,665	1,664,275
Irrigated and Non-irrigated Sandy Soils	4,257	814,226
Southwestern and West Central	8,394	2,222,409
South Central	7,304	1,779,323
Southeastern	2,449	369,768
Statewide	**25,069**	**6,850,000**

Farmers in the survey were then asked, "Did all your soybean fields receive manure for the 2019 crop year?" Table 115 details the percent of farmers who had a soybean field without manure applied by BMP region (SFQ-1). Farmers that answered yes to this question applied manure on all their soybean fields for the 2019 growing year.

Table 115. Percent of respondents with a soybean field without manure applied

BMP Region	All Soybean Fields Applied with Manure	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	11
Irrigated and Non-irrigated Sandy Soils	No	89
Southwestern and West Central	Yes	3
Southwestern and West Central	No	97
South Central	Yes	3
South Central	No	96
Southeastern	Yes	6
Southeastern	No	94
Statewide	**Yes**	**4**
Statewide	**No**	**96**

[65] Farmers and respondents are used interchangeably in this document. The farmer interviewed is the respondent.

[66] SAQ1 is Soybean All Question 1 and can be found at the end of the report in the appendix. All question references will be in this format. SFQ stands for Soybean Fertilizer Question and is in the same appendix.

Table 116 details the number of represented respondents and all soybean acres who reported having a field without manure applied to the 2019 soybean crop. Due to the low amount of row crop agriculture in portions of Minnesota, survey results were not listed when there were less than five responses in any category for soybeans with fertilizer. Excluded are respondents and acres from Table 116 who applied manure on all of their soybean fields. Farmers with manured acres will analyzed in the manure section of this report.

Table 116. Summary of respondents and corresponding soybean acres by BMP region for farmers who reported a field without manure applied in the fall of 2018 or anytime in the 2019 crop year

BMP Region	Number of Respondents	Number of Soybean Acres
Northwestern	2,493	1,524,661
Irrigated and Non-irrigated Sandy Soils	3,610	745,128
Southwestern and West Central	7,725	2,084,012
South Central	6,685	1,706,546
Southeastern	2,172	336,455
Statewide	**22,686**	**6,396,802**

All soybean fields without manure applied are included in the analysis for the following tables. There were 22,686 soybean fields represented in the commercial fertilizer analysis.

Farmers were then told by the phone enumerator[67] "First on a soybean field with no manure or compost applied in the fall of 2018 and no manure or compost applied anytime during the 2019 crop year. Think about your largest soybean field that you planted in 2019 without any manure. I will now ask you questions about that specific field. All following questions will be in relation to that specific field." Farmers were then asked, "Was this field irrigated?" Farmers were only asked about irrigation on the largest field being surveyed, therefore they could have had a field that was irrigated but not the largest soybean field on their farm.

Table 117 details the percent of farmers who irrigated their largest soybean field, without manure, applied by BMP region (SFQ-2).

Table 117. Percent of respondents who irrigated their largest soybean field

BMP Region	Largest Soybean Field was Irrigated	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	9
Irrigated and Non-irrigated Sandy Soils	No	91
Southwestern and West Central	Yes	1
Southwestern and West Central	No	99
South Central	Yes	1
South Central	No	99
Southeastern	Yes	5
Southeastern	No	95
Statewide	**Yes**	**3**
Statewide	**No**	**97**

[67] A phone enumerator is a NASS employee who calls on the phone to survey farmers for the Minnesota pesticide and fertilizer survey.

Next, farmers were asked, "What was the crop grown on this field in 2018 before the 2019 soybean crop?" Table 118 details the previous crop planted before the current soybean crop by BMP region and corresponding yield (SFQ-3 and SFQ-5). The table includes the next question to the farmers "What was the average soybean yield of this field over the past three soybean crops?" The average soybean yield was 38 bushels per acre in the Northwestern BMP region, 43 bushels per acre in the Irrigated and Non-irrigated Sandy Soils BMP region, 54 bushels per acre in the Southwestern and West Central BMP region, 50 bushels per acre in the South Central BMP region, and 54 bushels per acre in the Southeastern BMP region. The average soybean yield across all soybean fields in Minnesota was 49 bushels per acre.

Table 118. Percent of fields by previous crop and the corresponding soybean yield in 2019

BMP Region	Previous Crop	Percent of Fields	Average Soybean Yield Bushels per Acre
Northwestern	Soybeans	6	37
Northwestern	Corn	24	41
Northwestern	Alfalfa	**	**
Northwestern	Small Grains	64	37
Northwestern	Other	6	39
Irrigated and Non-irrigated Sandy Soils	Soybeans	14	34
Irrigated and Non-irrigated Sandy Soils	Corn	78	45
Irrigated and Non-irrigated Sandy Soils	Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	6	40
Irrigated and Non-irrigated Sandy Soils	Other	1	42
Southwestern and West Central	Soybeans	4	49
Southwestern and West Central	Corn	92	51
Southwestern and West Central	Alfalfa	**	**
Southwestern and West Central	Small Grains	3	48
Southwestern and West Central	Other	**	**
South Central	Soybeans	3	44
South Central	Corn	94	52
South Central	Alfalfa	**	**
South Central	Small Grains	**	**
South Central	Other	2	42
Southeastern	Soybeans	6	49
Southeastern	Corn	90	55
Southeastern	Other	**	**
Statewide	**Soybeans**	**6**	**41**
Statewide	**Corn**	**83**	**51**
Statewide	**Alfalfa**	**<1**	**43**
Statewide	**Small Grains**	**9**	**39**
Statewide	**Other**	**2**	**42**

** Less than five responses

Commercial Fertilizer Applications on Soybeans

Farmers were then asked, "Was any commercial fertilizer applied to this soybean field for the 2019 soybean crop?" Table 119 details the percent of non-manured soybean fields applied with commercial fertilizer (SFQ-6).

Table 119. Commercial fertilizer applied to non-manured soybean fields

BMP Region	Fertilizer Applied	Percent of Respondents
Northwestern	Yes	50
Northwestern	No	50
Irrigated and Non-irrigated Sandy Soils	Yes	45
Irrigated and Non-irrigated Sandy Soils	No	55
Southwestern and West Central	Yes	18
Southwestern and West Central	No	82
South Central	Yes	16
South Central	No	84
Southeastern	Yes	36
Southeastern	No	64
Statewide	**Yes**	**27**
Statewide	**No**	**73**

Farmers were asked "Was any commercial fertilizer applied to this corn field with a variable rate or more than one rate such as by management zone or grid?" Table 120 details the percent of respondents using variable rate commercial fertilizer applied by BMP region on their largest soybean field (SFQ-7).

Table 120. Variable rate commercial fertilizer application by BMP region on the farmer's largest soybean field

BMP Region	Variable Rate Fertilizer Application	Percent of Respondents
Northwestern	Variable Rate	20
Northwestern	One Rate	80
Irrigated and Non-irrigated Sandy Soils	Variable Rate	26
Irrigated and Non-irrigated Sandy Soils	One Rate	74
Southwestern and West Central	Variable Rate	41
Southwestern and West Central	One Rate	59
South Central	Variable Rate	41
South Central	One Rate	59
Southeastern	Variable Rate	34
Southeastern	One Rate	66
Statewide	**Variable Rate**	**23**
Statewide	**One Rate**	**77**

There were 22,686 soybean fields represented in the commercial fertilizer analysis, and farmers provided complete information for 6,167 soybean fields with fertilizer applied. Of the 6,167 represented farmers that reported complete data, 6,145 farmers reported applying fertilizer that included the nutrient rate and timing on their soybean fields. The following soybean fertilizer tables are based on those 6,145 fields.

Table 121 details the percent of all represented soybean fields applied with fertilizer and the percent of fertilized fields treated with nitrogen, phosphorus, potassium, and sulfur by BMP region (SFQ-6 and SFQ-FERT TABLE).

Table 121. The percent of soybean fields applied with commercial fertilizer and the percent of fertilized fields treated with nitrogen, phosphorus, potassium, and sulfur by BMP region

BMP Region	Percent of All Represented Fields Fertilized	Percent of Fertilized Fields Treated with Nitrogen	Percent of Fertilized Fields Treated with Phosphorus	Percent of Fertilized Fields Treated with Potassium	Percent of Fertilized Fields Treated with Sulfur
Northwestern	49	96	94	77	22
Irrigated and Non-irrigated Sandy Soils	45	81	75	98	30
Southwestern and West Central	18	97	94	91	28
South Central	16	92	86	92	34
Southeastern	36	73	73	98	13
Statewide	**27**	**89**	**85**	**91**	**26**

Table 122 details the percent of all represented soybean fields with fertilizer and treated with nitrogen, the average nitrogen rate on fields treated with commercial nitrogen fertilizer, and the average nitrogen rate on all fertilized soybean fields by BMP region (SFQ-6 and SFQ-FERT TABLE). Statewide, 89% of fertilized soybean fields received nitrogen. These are nitrogen rates on all soybean acres treated with commercial fertilizer, regardless of previous crop. Nitrogen rates are for commercial fertilizer only.

Table 122. The percent of all represented soybean fields applied with commercial fertilizer containing nitrogen, the average rate on fields treated with nitrogen, and the average nitrogen rate on all fertilized fields by BMP region

BMP Region	Percent of Fertilized Fields Treated with Nitrogen	Average Commercial Nitrogen Rate On Fields Treated with Nitrogen Pounds per Acre	Average Commercial Nitrogen Rate Across All Fertilized Soybean Fields Pounds per Acre
Northwestern	96	14	13
Irrigated and Non-irrigated Sandy Soils	81	16	13
Southwestern and West Central	97	14	14
South Central	92	14	13
Southeastern	73	15	11
Statewide	**89**	**15**	**13**

Table 123 details the percent of all represented soybean fields with fertilizer and treated with phosphorus, the average phosphorus rate on fields treated with commercial phosphorus fertilizer, and the average phosphorus rate on all fertilized corn fields by BMP region (SFQ-6 and SFQ-FERT TABLE). Statewide, 85% of fertilized soybean fields received phosphorus. These are phosphorus rates on all soybean acres treated with commercial fertilizer, regardless of previous crop. Phosphorus rates are for commercial fertilizer only.

Table 123. The percent of all represented soybean fields applied with commercial fertilizer containing phosphorus, the average rate on fields treated with phosphorus, and the average phosphorus rate on all fertilized fields by BMP region

BMP Region	Percent of Fertilized Fields Treated with Phosphorus	Average Commercial Phosphorus Rate On Fields Treated with Phosphorus Pounds per Acre	Average Commercial Phosphorus Rate Across All Fertilized Soybean Fields Pounds per Acre
Northwestern	94	41	39
Irrigated and Non-irrigated Sandy Soils	75	36	27
Southwestern and West Central	94	37	35
South Central	86	35	30
Southeastern	73	39	28
Statewide	**85**	**37**	**32**

Table 124 details the percent of all represented soybean fields with fertilizer and treated with potassium, the average potassium rate on fields treated with commercial potassium fertilizer, and the average potassium rate on all fertilized soybean fields by BMP region (SFQ-6 and SFQ-FERT TABLE). Statewide, 91% of fertilized soybean fields received potassium. These are potassium rates on all soybean acres treated with commercial fertilizer, regardless of previous crop. Potassium rates are for commercial fertilizer only.

Table 124. The percent of all represented soybean fields applied with commercial fertilizer containing potassium, the average rate on fields treated with potassium, and the average potassium rate on all fertilized fields by BMP region

BMP Region	Percent of Fertilized Fields Treated with Potassium	Average Commercial Potassium Rate On Fields Treated with Potassium Pounds per Acre	Average Commercial Potassium Rate Across All Fertilized Soybean Fields Pounds per Acre
Northwestern	77	46	35
Irrigated and Non-irrigated Sandy Soils	98	60	58
Southwestern and West Central	91	44	40
South Central	92	56	51
Southeastern	98	70	69
Statewide	**91**	**54**	**50**

Table 125 details the percent of all represented soybean fields with fertilizer and treated with sulfur, the average sulfur rate on fields treated with commercial sulfur fertilizer, and the average sulfur rate on all fertilized soybean fields by BMP region (SFQ-6 and SFQ-FERT TABLE). Statewide, 26% of fertilized soybean fields received sulfur. These are sulfur rates on all soybean acres treated with commercial fertilizer, regardless of previous crop. Sulfur rates are for commercial fertilizer only.

Table 125. The percent of all represented soybean fields applied with commercial fertilizer containing sulfur, the average rate on fields treated with sulfur, and the average sulfur rate on all fertilized fields by BMP region

BMP Region	Percent of Fertilized Fields Treated with Sulfur	Average Commercial Sulfur Rate On Fields Treated with Sulfur Pounds per Acre	Average Commercial Sulfur Rate Across All Fertilized Soybean Fields Pounds per Acre
Northwestern	22	8	2
Irrigated and Non-irrigated Sandy Soils	30	10	3
Southwestern and West Central	28	9	2
South Central	34	9	3
Southeastern	**	**	**
Statewide	**26**	**9**	**2**

** Less than five responses

Table 126 details the nitrogen fertilizer rate and soybean yield by BMP region on soybean following various crops (SFQ-3, SFQ-5 and SFQ-FERT TABLE). These are soybean fields applied with commercial nitrogen fertilizer and no manure applications.

Table 126. Average amount of nitrogen applied and corresponding soybean yield by BMP region and previous crop

BMP Region	Previous Crop	Average Nitrogen Rate Pounds per Acre	Average Soybean Yield Bushels per Acre
Northwestern	Soybeans	**	**
Northwestern	Corn	10	45
Northwestern	Small Grains	13	37
Northwestern	Other	19	37
Irrigated and Non-irrigated Sandy Soils	Soybeans	16	35
Irrigated and Non-irrigated Sandy Soils	Corn	15	45
Irrigated and Non-irrigated Sandy Soils	Small Grains	28	41
Irrigated and Non-irrigated Sandy Soils	Other	**	**
Southwestern and West Central	Soybeans	12	43
Southwestern and West Central	Corn	15	51
Southwestern and West Central	Small Grains	**	**
South Central	Soybeans	**	**
South Central	Corn	14	52
South Central	Small Grains	**	**
Southeastern	Soybeans	**	**
Southeastern	Corn	15	56
Southeastern	Other	**	**
Statewide	**Soybeans**	**16**	**39**
Statewide	**Corn**	**15**	**50**
Statewide	**Small Grains**	**14**	**38**
Statewide	**Other**	**16**	**43**

** Less than five responses

Table 127 details the phosphorus fertilizer rate and soybean yield by BMP region on soybean following various crops (SFQ-3, SFQ-5 and SFQ-FERT TABLE). These are soybean fields applied with commercial phosphorus fertilizer and no manure applications.

Table 127. Average amount of phosphorus applied and corresponding soybean yield by BMP region and previous crop

BMP Region	Previous Crop	Average Phosphorus Rate Pounds per Acre	Average Soybean Yield Bushels per Acre
Northwestern	Soybeans	**	**
Northwestern	Corn	35	45
Northwestern	Small Grains	41	37
Northwestern	Other	66	37
Irrigated and Non-irrigated Sandy Soils	Soybeans	35	35
Irrigated and Non-irrigated Sandy Soils	Corn	36	45
Irrigated and Non-irrigated Sandy Soils	Small Grains	36	41
Irrigated and Non-irrigated Sandy Soils	Other	**	**
Southwestern and West Central	Soybeans	39	43
Southwestern and West Central	Corn	38	51
Southwestern and West Central	Small Grains	**	**
South Central	Soybeans	**	**
South Central	Corn	36	51
South Central	Small Grains	**	**
Southeastern	Soybeans	**	**
Southeastern	Corn	39	56
Southeastern	Other	**	**
Statewide	**Soybeans**	**40**	**39**
Statewide	**Corn**	**37**	**50**
Statewide	**Small Grains**	**39**	**38**
Statewide	**Other**	**45**	**43**

** Less than five responses

Table 128 details the potassium fertilizer rate and soybean yield by BMP region on soybean following various crops (SFQ-3, SFQ-5 and SFQ-FERT TABLE). These are soybean fields applied with commercial potassium fertilizer and no manure applications.

Table 128. Average amount of potassium applied and corresponding soybean yield by BMP region and previous crop

BMP Region	Previous Crop	Average Potassium Rate Pounds per Acre	Average Soybean Yield Bushels per Acre
Northwestern	Soybeans	51	34
Northwestern	Corn	44	45
Northwestern	Small Grains	46	37
Northwestern	Other	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	65	34
Irrigated and Non-irrigated Sandy Soils	Corn	59	44
Irrigated and Non-irrigated Sandy Soils	Small Grains	54	41
Irrigated and Non-irrigated Sandy Soils	Other	**	**
Southwestern and West Central	Soybeans	**	**
Southwestern and West Central	Corn	45	52
Southwestern and West Central	Alfalfa	**	**
Southwestern and West Central	Small Grains	**	**
South Central	Soybeans	**	**
South Central	Corn	56	52
South Central	Small Grains	**	**
Southeastern	Soybeans	**	**
Southeastern	Corn	72	56
Southeastern	Other	**	**
Statewide	**Soybeans**	**62**	**38**
Statewide	**Corn**	**56**	**50**
Statewide	**Alfalfa**	**	**
Statewide	**Small Grains**	**45**	**38**
Statewide	**Other**	**44**	**44**

** Less than five responses

Table 129 details the sulfur fertilizer rate and soybean yield by BMP region on soybean following various crops (SFQ-3, SFQ-5 and SFQ-FERT TABLE). These are soybean fields applied with commercial sulfur fertilizer and no manure applications.

Table 129. Average amount of sulfur applied and corresponding soybean yield by BMP region and previous crop

BMP Region	Previous Crop	Average Sulfur Rate Pounds per Acre	Average Soybean Yield Bushels per Acre
Northwestern	Soybeans	**	**
Northwestern	Corn	7	47
Northwestern	Small Grains	8	39
Irrigated and Non-irrigated Sandy Soils	Soybeans	9	42
Irrigated and Non-irrigated Sandy Soils	Corn	11	43
Irrigated and Non-irrigated Sandy Soils	Small Grains	**	**
Southwestern and West Central	Soybeans	**	**
Southwestern and West Central	Corn	9	50
Southwestern and West Central	Small Grains	**	**
South Central	Corn	9	55
Southeastern	Corn	**	**
Statewide	**Soybeans**	6	41
Statewide	**Corn**	10	50
Statewide	**Small Grains**	9	41

** Less than five responses

Fertilizer Sources and Timing

Table 130 details the respondents and corresponding soybean acres by BMP region for all farmers in this study who fall applied nitrogen on the largest soybean field (SFQ-FERT TABLE). This table includes all sources of fall applied nitrogen from commercial fertilizer.

Table 130. Average amount of fall applied nitrogen and corresponding soybean yield by BMP region

BMP Region	Percent of Respondents: Fall Applied Nitrogen	Average Fall Nitrogen Rate Pounds per Acre	Average Soybean Yield Bushels per Acre
Northwestern	18	17	39
Irrigated and Non-irrigated Sandy Soils	7	14	54
Southwestern and West Central	34	15	54
South Central	24	15	55
Southeastern	**	**	**
Statewide	**18**	**16**	**51**

** Less than five responses

Table 131 details the respondents and corresponding soybean acres by BMP region for all farmers in this study who fall applied phosphorus on the largest soybean field (SFQ-FERT TABLE). This table includes all sources of fall applied phosphorus from commercial fertilizer.

Table 131. Average amount of fall applied phosphorus and corresponding soybean yield by BMP region

BMP Region	Percent of Respondents: Fall Applied Phosphorus	Average Fall Phosphorus Rate Pounds per Acre	Average Soybean Yield Bushels per Acre
Northwestern	18	54	39
Irrigated and Non-irrigated Sandy Soils	7	44	54
Southwestern and West Central	34	41	54
South Central	21	38	54
Southeastern	**	**	**
Statewide	18	45	51

Table 132 details the respondents and corresponding soybean acres by BMP region for all farmers in this study who fall applied potassium on the largest soybean field (SFQ-FERT TABLE). This table includes all sources of fall applied potassium from commercial fertilizer.

Table 132. Average amount of fall applied potassium and corresponding soybean yield by BMP region

BMP Region	Percent of Respondents: Fall Applied Potassium	Average Fall Potassium Rate Pounds per Acre	Average Soybean Yield Bushels per Acre
Northwestern	18	59	39
Irrigated and Non-irrigated Sandy Soils	9	59	52
Southwestern and West Central	35	45	54
South Central	31	65	54
Southeastern	**	**	**
Statewide	**21**	**58**	**51**

** Less than five responses

Table 133 details the percent of respondents and corresponding soybean acres by BMP region for all farmers in this study who fall applied sulfur on the largest soybean field (SFQ-FERT TABLE). This table includes all sources of fall applied sulfur from commercial fertilizer.

Table 133. Average amount of fall applied sulfur and corresponding soybean yield by BMP region

BMP Region	Percent of Respondents: Fall Applied Sulfur	Average Fall Sulfur Rate Pounds per Acre	Average Soybean Yield Bushels per Acre
Northwestern	**	**	**
Irrigated and Non-irrigated Sandy Soils	**	**	**
Southwestern and West Central	**	**	**
South Central	11	10	54
Southeastern	**	**	**
Statewide	**5**	**8**	**50**

** Less than five responses

Table 134 details the major form of nitrogen fertilizer applied in each BMP region and statewide along with the percent of respondents for those forms (SFQ-8b). 'Other' forms of fertilizer containing nitrogen would include sources of phosphorus, such as MAP or DAP, and sulfur, such as AMS, on surveyed soybean fields.

Table 134. The major form of nitrogen applied to the field

BMP Region	Major Form of Nitrogen Applied	Percent of Respondents
Northwestern	Urea	17
Northwestern	Other	80
Northwestern	Unknown	3
Irrigated and Non-irrigated Sandy Soils	Urea	19
Irrigated and Non-irrigated Sandy Soils	Liquid Nitrogen	<1
Irrigated and Non-irrigated Sandy Soils	Other	72
Irrigated and Non-irrigated Sandy Soils	Unknown	9
Southwestern and West Central	Urea	17
Southwestern and West Central	Liquid Nitrogen	1
Southwestern and West Central	Other	82
South Central	Urea	5
South Central	Liquid Nitrogen	13
South Central	Other	79
South Central	Unknown	3
Southeastern	Urea	25
Southeastern	Liquid Nitrogen	75
Statewide	**Urea**	**16**
Statewide	**Liquid Nitrogen**	**3**
Statewide	**Other**	**78**
Statewide	**Unknown**	**3**

Table 135 details the major form of nitrogen used, average nitrogen rate from all sources, and average soybean yield of the 2019 soybean crop (SFQ-5, SFQ-8, and SFQ-8b).

Table 135. Average amount of nitrogen applied and corresponding yield by BMP region and type of nitrogen

BMP Region	Major Form of Nitrogen Applied	Average Nitrogen Rate Pound per Acre	Average Soybean Yield Bushels per Acre
Northwestern	Urea	23	37
Northwestern	Liquid Nitrogen	12	38
Northwestern	Other	**	**
Irrigated and Non-irrigated Sandy Soils	Urea	25	47
Irrigated and Non-irrigated Sandy Soils	Liquid Nitrogen	**	**
Irrigated and Non-irrigated Sandy Soils	Other	14	43
Irrigated and Non-irrigated Sandy Soils	Unknown	13	39
Southwestern and West Central	Urea	22	50
Southwestern and West Central	Liquid Nitrogen	**	**
Southwestern and West Central	Other	13	51
South Central	Urea	**	**
South Central	Liquid Nitrogen	**	**
South Central	Other	12	51
South Central	Unknown	**	**
Southeastern	Urea	19	55
Southeastern	Liquid Nitrogen	14	54
Statewide	**Urea**	**23**	**48**
Statewide	**Liquid**	**20**	**53**
Statewide	**Other**	**13**	**47**
Statewide	**Unknown**	**15**	**41**

** Less than five responses

Table 136 details any commercial fertilizer applied in the fall of 2018 for the 2019 soybean crop across all fertilized fields (SFQ-FERT TABLE).

Table 136. Commerical fertilizer applied in the fall of 2018 for the 2019 soybean crop

BMP Region	Any Commercial Fertilizer Application in the Fall of 2018	Percent of Respondents
Northwestern	Yes	19
Northwestern	No	81
Irrigated and Non-irrigated Sandy Soils	Yes	10
Irrigated and Non-irrigated Sandy Soils	No	90
Southwestern and West Central	Yes	36
Southwestern and West Central	No	64
South Central	Yes	31
South Central	No	69
Southeastern	Yes	7
Southeastern	No	93
Statewide	**Yes**	**21**
Statewide	**No**	**79**

Anhydrous ammonia is not applied to soybeans.

Less than five responses reported:

- Urea applied in the fall of 2018 for the 2019 soybean crop.
- Liquid nitrogen (28% or 32%) applied in the fall of 2018 for the 2019 soybean crop.

Table 137 details other fertilizers containing nitrogen applied in the fall of 2018 for the 2019 soybean crop (SFQ-FERT TABLE).

Table 137. Other fertilizers containing nitrogen applied in the fall of 2018 for the 2019 soybean crop

BMP Region	Other Sources of Fertilizer Containing Nitrogen in the Fall of 2018	Percent of Respondents
Northwestern	Yes	10
Northwestern	No	90
Irrigated and Non-irrigated Sandy Soils	Yes	7
Irrigated and Non-irrigated Sandy Soils	No	93
Southwestern and West Central	Yes	27
Southwestern and West Central	No	73
South Central	Yes	25
South Central	No	75
Southeastern	Yes	7
Southeastern	No	93
Statewide	**Yes**	**16**
Statewide	**No**	**84**

Table 138 details phosphorus fertilizer, such as MAP or DAP, applied in the fall of 2018 for the 2019 soybean crop (SFQ-FERT TABLE).

Table 138. Fertilizer containing phosphorus applied in the fall of 2018 for the 2019 soybean crop

BMP Region	Phosphorus Application in the Fall of 2018	Percent of Respondents
Northwestern	Yes	10
Northwestern	No	90
Irrigated and Non-irrigated Sandy Soils	Yes	7
Irrigated and Non-irrigated Sandy Soils	No	93
Southwestern and West Central	Yes	27
Southwestern and West Central	No	73
South Central	Yes	21
South Central	No	79
Southeastern	Yes	4
Southeastern	No	96
Statewide	**Yes**	**14**
Statewide	**No**	**86**

Table 139 details potassium fertilizer applied in the fall of 2018 for the 2019 soybean crop (SFQ-FERT TABLE).[68]

Table 139. Fertilizer containing potassium applied in the fall of 2018 for the 2019 soybean crop

	Potassium Application in the Fall of 2018	Percent of Respondents
Northwestern	Yes	18
Northwestern	No	82
Irrigated and Non-irrigated Sandy Soils	Yes	9
Irrigated and Non-irrigated Sandy Soils	No	91
Southwestern and West Central	Yes	24
Southwestern and West Central	No	76
South Central	Yes	46
South Central	No	54
Southeastern	Yes	7
Southeastern	No	93
Statewide	**Yes**	**21**
Statewide	**No**	**79**

Table 140 details sulfur fertilizer, such as AMS[69], applied in the fall of 2018 for the 2019 soybean crop (SFQ-FERT TABLE).

Table 140. Fertilizer containing sulfur applied in the fall of 2018 for the 2019 soybean crop

BMP Region	Sulfur Application in the Fall of 2018	Percent of Respondents
Northwestern	Yes	5
Northwestern	No	95
Irrigated and Non-irrigated Sandy Soils	Yes	2
Irrigated and Non-irrigated Sandy Soils	No	98
Southwestern and West Central	Yes	7
Southwestern and West Central	No	93
South Central	Yes	11
South Central	No	89
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**5**
Statewide	**No**	**95**

[68] Potassium, also known as potash (0-0-60), does not contain nitrogen.
[69] AMS is an example of a fertilizer that contains sulfur. There are many fertilizers that contain sulfur.

Table 141 details commercial fertilizer applied in the spring as a preplant for the 2019 soybean crop (SFQ-FERT TABLE).

Table 141. Commercial fertilizer in the spring applied as a preplant for the 2019 soybean crop

BMP Region	Any Commercial Fertilizer Application as a Preplant in the Spring of 2019	Percent of Respondents
Northwestern	Yes	64
Northwestern	No	36
Irrigated and Non-irrigated Sandy Soils	Yes	68
Irrigated and Non-irrigated Sandy Soils	No	32
Southwestern and West Central	Yes	52
Southwestern and West Central	No	48
South Central	Yes	56
South Central	No	44
Southeastern	Yes	74
Southeastern	No	26
Statewide	**Yes**	**62**
Statewide	**No**	**38**

Table 142 details urea applied in the spring as a preplant for the 2019 soybean crop (SFQ-FERT TABLE).

Table 142. Urea applied in the spring as a preplant for the 2019 soybean crop

BMP Region	Urea Application as a Preplant in the Spring of 2019	Percent of Respondents
Northwestern	Yes	2
Northwestern	No	98
Irrigated and Non-irrigated Sandy Soils	Yes	4
Irrigated and Non-irrigated Sandy Soils	No	96
Southwestern and West Central	Yes	4
Southwestern and West Central	No	96
South Central	Yes	4
South Central	No	96
Southeastern	Yes	8
Southeastern	No	92
Statewide	**Yes**	**4**
Statewide	**No**	**96**

Table 143 details liquid nitrogen fertilizer applied in the spring as a preplant for the 2019 soybean crop (CFQ-FERT TABLE).

Table 143. Liquid nitrogen fertilizer applied in the spring as a preplant for the 2019 soybean crop

BMP Region	Liquid Nitrogen (28%, 32%) Application as a Preplant in the Spring of 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	<1
Irrigated and Non-irrigated Sandy Soils	No	>99
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	11
South Central	No	89
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**2**
Statewide	**No**	**98**

Table 144 details other nitrogen fertilizer sources applied in the spring as a preplant for the 2019 soybean crop (SFQ-FERT TABLE).

Table 144. Other nitrogen sources applied in the spring as a preplant for the 2019 soybean crop

BMP Region	Other Sources of Nitrogen Fertilizer as a Preplant in the Spring of 2019	Percent of Respondents
Northwestern	Yes	50
Northwestern	No	50
Irrigated and Non-irrigated Sandy Soils	Yes	49
Irrigated and Non-irrigated Sandy Soils	No	51
Southwestern and West Central	Yes	41
Southwestern and West Central	No	59
South Central	Yes	35
South Central	No	65
Southeastern	Yes	42
Southeastern	No	58
Statewide	**Yes**	**44**
Statewide	**No**	**56**

Table 145 details phosphorus fertilizer, such as MAP or DAP, applied in the spring as a preplant for the 2019 soybean crop (SFQ-FERT TABLE).

Table 145. Fertilizer containing phosphorus applied in the spring as a preplant for the 2019 soybean crop

BMP Region	Phosphorus Application as a Preplant in the Spring of 2019	Percent of Respondents
Northwestern	Yes	59
Northwestern	No	41
Irrigated and Non-irrigated Sandy Soils	Yes	52
Irrigated and Non-irrigated Sandy Soils	No	48
Southwestern and West Central	Yes	47
Southwestern and West Central	No	53
South Central	Yes	52
South Central	No	48
Southeastern	Yes	49
Southeastern	No	51
Statewide	**Yes**	**52**
Statewide	**No**	**48**

Table 146 details potassium fertilizer applied in the spring as a preplant for the 2019 soybean crop (SFQ-FERT TABLE).

Table 146. Fertilizer containing potassium applied in the spring as a preplant for the 2019 soybean crop

BMP Region	Potassium Application as a Preplant in the Spring of 2019	Percent of Respondents
Northwestern	Yes	50
Northwestern	No	50
Irrigated and Non-irrigated Sandy Soils	Yes	67
Irrigated and Non-irrigated Sandy Soils	No	33
Southwestern and West Central	Yes	45
Southwestern and West Central	No	55
South Central	Yes	52
South Central	No	48
Southeastern	Yes	72
Southeastern	No	28
Statewide	**Yes**	**57**
Statewide	**No**	**43**

Table 147 details sulfur fertilizer, such as AMS, applied in the spring as a preplant for the 2019 soybean crop (SFQ-FERT TABLE).

Table 147. Fertilizer containing sulfur applied in the spring as a preplant for the 2019 soybean crop

BMP Region	Sulfur Application as a Preplant in the Spring of 2019	Percent of Respondents
Northwestern	Yes	15
Northwestern	No	85
Irrigated and Non-irrigated Sandy Soils	Yes	20
Irrigated and Non-irrigated Sandy Soils	No	80
Southwestern and West Central	Yes	16
Southwestern and West Central	No	84
South Central	Yes	18
South Central	No	82
Southeastern	Yes	13
Southeastern	No	87
Statewide	**Yes**	**17**
Statewide	**No**	**83**

Table 148 details commercial fertilizer applied in the spring as a starter or at planting for the 2019 soybean crop (SFQ-FERT TABLE). No anhydrous ammonia was applied as a starter or at planting.

Table 148. Commercial fertilizer applied in the spring at planting for the 2019 soybean crop

BMP Region	Any Commercial Fertilizer Application as a Starter or at Planting in the Spring of 2019	Percent of Respondents
Northwestern	Yes	22
Northwestern	No	78
Irrigated and Non-irrigated Sandy Soils	Yes	22
Irrigated and Non-irrigated Sandy Soils	No	78
Southwestern and West Central	Yes	13
Southwestern and West Central	No	87
South Central	Yes	18
South Central	No	82
Southeastern	Yes	24
Southeastern	No	76
Statewide	**Yes**	**19**
Statewide	**No**	**81**

Table 149 details urea applied in the spring as a starter or at planting for the 2019 soybean crop (SFQ-FERT TABLE).

Table 149. Urea applied in the spring at planting for the 2019 soybean crop

BMP Region	Urea Application as a Starter or at Planting in the Spring of 2019	Percent of Respondents
Northwestern	Yes	2
Northwestern	No	98
Irrigated and Non-irrigated Sandy Soils	Yes	3
Irrigated and Non-irrigated Sandy Soils	No	97
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	0
South Central	No	100
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**1**
Statewide	**No**	**99**

Table 150 details liquid nitrogen fertilizer applied in the spring as a starter or at planting for the 2019 soybean crop (SFQ-FERT TABLE).

Table 150. Liquid nitrogen fertilizer applied in the spring at planting for the 2019 soybean crop

BMP Region	Liquid Nitrogen (28%, 32%) Application as a Starter or at Planting in the Spring of 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	0
Irrigated and Non-irrigated Sandy Soils	No	100
Southwestern and West Central	Yes	1
Southwestern and West Central	No	99
South Central	Yes	6
South Central	No	94
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**1**
Statewide	**No**	**99**

Table 151 details other nitrogen fertilizers applied in the spring or at planting for the 2019 soybean crop (SFQ-FERT TABLE).

Table 151. Other nitrogen fertilizers applied in the spring at planting for the 2019 soybean crop

BMP Region	Other Nitrogen Fertilizers as a Starter or at Planting in the in the Spring of 2019	Percent of Respondents
Northwestern	Yes	17
Northwestern	No	83
Irrigated and Non-irrigated Sandy Soils	Yes	11
Irrigated and Non-irrigated Sandy Soils	No	89
Southwestern and West Central	Yes	13
Southwestern and West Central	No	87
South Central	Yes	11
South Central	No	89
Southeastern	Yes	19
Southeastern	No	81
Statewide	**Yes**	**14**
Statewide	**No**	**86**

Table 152 details phosphorus fertilizer, such as MAP or DAP, applied in the spring at planting for the 2019 soybean crop (SFQ-FERT TABLE).

Table 152. Fertilizer containing phosphorus applied in the spring at planting for the 2019 soybean crop

BMP Region	Phosphorus Application as a Starter or at Planting in the in the Spring of 2019	Percent of Respondents
Northwestern	Yes	19
Northwestern	No	81
Irrigated and Non-irrigated Sandy Soils	Yes	17
Irrigated and Non-irrigated Sandy Soils	No	83
Southwestern and West Central	Yes	13
Southwestern and West Central	No	87
South Central	Yes	11
South Central	No	89
Southeastern	Yes	24
Southeastern	No	76
Statewide	**Yes**	**17**
Statewide	**No**	**83**

Table 153 details potassium fertilizer applied in the spring at planting for the 2019 soybean crop (SFQ-FERT TABLE).

Table 153. Fertilizer containing potassium applied in the spring at planting for the 2019 soybean crop

BMP Region	Potassium Application as a Starter or at Planting in the in the Spring of 2019	Percent of Respondents
Northwestern	Yes	8
Northwestern	No	92
Irrigated and Non-irrigated Sandy Soils	Yes	11
Irrigated and Non-irrigated Sandy Soils	No	89
Southwestern and West Central	Yes	12
Southwestern and West Central	No	88
South Central	Yes	7
South Central	No	93
Southeastern	Yes	19
Southeastern	No	81
Statewide	**Yes**	**14**
Statewide	**No**	**86**

Table 154 details sulfur fertilizer, such as AMS, applied in the spring at planting for the 2019 soybean crop (SFQ-FERT TABLE).

Table 154. Fertilizer containing sulfur applied in the spring at planting for the 2019 soybean crop

BMP Region	Sulfur Application as a Starter or at Planting in the in the Spring of 2019	Percent of Respondents
Northwestern	Yes	2
Northwestern	No	98
Irrigated and Non-irrigated Sandy Soils	Yes	9
Irrigated and Non-irrigated Sandy Soils	No	91
Southwestern and West Central	Yes	5
Southwestern and West Central	No	95
South Central	Yes	5
South Central	No	95
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**5**
Statewide	**No**	**95**

Table 155 details commercial fertilizers applied as a post planting or sidedress for the 2019 soybean crop (SFQ-FERT TABLE).

Table 155. Commercial fertilizers applied as a post planting or sidedress for the 2019 soybean crop

BMP Region	Any Commercial Fertilizer Application After Planting such as a Sidedress	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	5
Irrigated and Non-irrigated Sandy Soils	No	95
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	1
South Central	No	99
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**2**
Statewide	**No**	**98**

Table 156 details urea applied as a post planting or sidedress for the 2019 soybean crop (SFQ-FERT TABLE).

Table 156. Urea applied as a post planting or sidedress for the 2019 soybean crop

BMP Region	Urea Application After Planting such as a Sidedress in 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	3
Irrigated and Non-irrigated Sandy Soils	No	97
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	0
South Central	No	100
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**1**
Statewide	**No**	**99**

No responses reported applied liquid nitrogen as a sidedress to the 2019 soybean crop (SFQ-FERT TABLE).

Table 157 details other nitrogen fertilizers applied as a post planting or sidedress the 2019 soybean crop (SFQ-FERT TABLE).

Table 157. Other nitrogen fertilizers applied in the spring at planting for the 2019 soybean crop

BMP Region	Other Nitrogen Fertilizers After Planting such as a Sidedress in 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	1
Irrigated and Non-irrigated Sandy Soils	No	99
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	1
South Central	No	99
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**<1**
Statewide	**No**	**<99**

Table 158 details phosphorus fertilizer, such as MAP or DAP, applied as a post planting or sidedress for the 2019 soybean crop (SFQ-FERT TABLE).

Table 158. Fertilizer containing phosphorus applied as a post planting or sidedress for the 2019 soybean crop

BMP Region	Phosphorus Application After Planting such as a Sidedress in 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	0
Irrigated and Non-irrigated Sandy Soils	No	100
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	1
South Central	No	99
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**<1**
Statewide	**No**	**>99**

Table 159 details potassium fertilizer applied as a post planting or sidedress for the 2019 soybean crop (SFQ-FERT TABLE).

Table 159. Fertilizer containing potassium applied as a post planting or sidedress for the 2019 soybean crop

BMP Region	Potassium Application After Planting such as a Sidedress in 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	1
Irrigated and Non-irrigated Sandy Soils	No	99
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	1
South Central	No	99
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**1**
Statewide	**No**	**99**

Table 160 details sulfur fertilizer, such as AMS, applied as a post planting or sidedress for the 2019 soybean crop (SFQ-FERT TABLE).

Table 160. Fertilizer containing sulfur applied as a post planting or sidedress for the 2018 soybean crop

BMP Region	Sulfur Application After Planting such as a Sidedress in 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	1
Irrigated and Non-irrigated Sandy Soils	No	99
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	0
South Central	No	100
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**<1**
Statewide	**No**	**>99**

Table 161 details commercial fertilizers applied as a post planting or top dress for the 2019 soybean crop (SFQ-FERT TABLE).

Table 161. Commercial fertilizers applied as a post planting or top dress for the 2019 soybean crop

BMP Region	Any Commercial Fertilizer Application After Planting such as a Top Dress	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	1
Irrigated and Non-irrigated Sandy Soils	No	99
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	0
South Central	No	100
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**<1**
Statewide	**No**	**>99**

No responses reported applied

- Urea as a top dress to the 2019 soybean crop.
- Liquid nitrogen as a top dress to the 2019 soybean crop.

Table 162 details other nitrogen fertilizers applied as a post planting or top dress the 2019 soybean crop (SFQ-FERT TABLE).

Table 162. Other nitrogen fertilizers applied in the spring at planting for the 2019 soybean crop

BMP Region	Other Nitrogen Fertilizers After Planting such as a Top dress in 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	1
Irrigated and Non-irrigated Sandy Soils	No	99
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	0
South Central	No	100
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**<1**
Statewide	**No**	**>99**

No responses reported applying fertilizer containing phosphorus as a top dress for the 2019 soybean crop (SFQ-FERT TABLE).

Table 163 details potassium fertilizer applied as a post planting or top dress for the 2019 soybean crop (SFQ-FERT TABLE).

Table 163. Fertilizer containing potassium applied as a post planting or top dress for the 2019 soybean crop

BMP Region	Potassium Application After Planting such as a Top dress in 2019	Percent of Respondents
Northwestern	Yes	0
Northwestern	No	100
Irrigated and Non-irrigated Sandy Soils	Yes	1
Irrigated and Non-irrigated Sandy Soils	No	99
Southwestern and West Central	Yes	0
Southwestern and West Central	No	100
South Central	Yes	0
South Central	No	100
Southeastern	Yes	0
Southeastern	No	100
Statewide	**Yes**	**<1**
Statewide	**No**	**>99**

No responses reported fertilizer applied containing sulfur as a top dress for the 2019 soybean crop (SFQ-FERT TABLE).

No responses reported fertilizer applied through irrigation or fertigation for the 2019 soybean crop (SFQ-FERT TABLE).

Figure 63 details the form of nitrogen that was applied to soybean acres statewide based on total pounds of nitrogen applied[70] (SFQ-FERT TABLE).

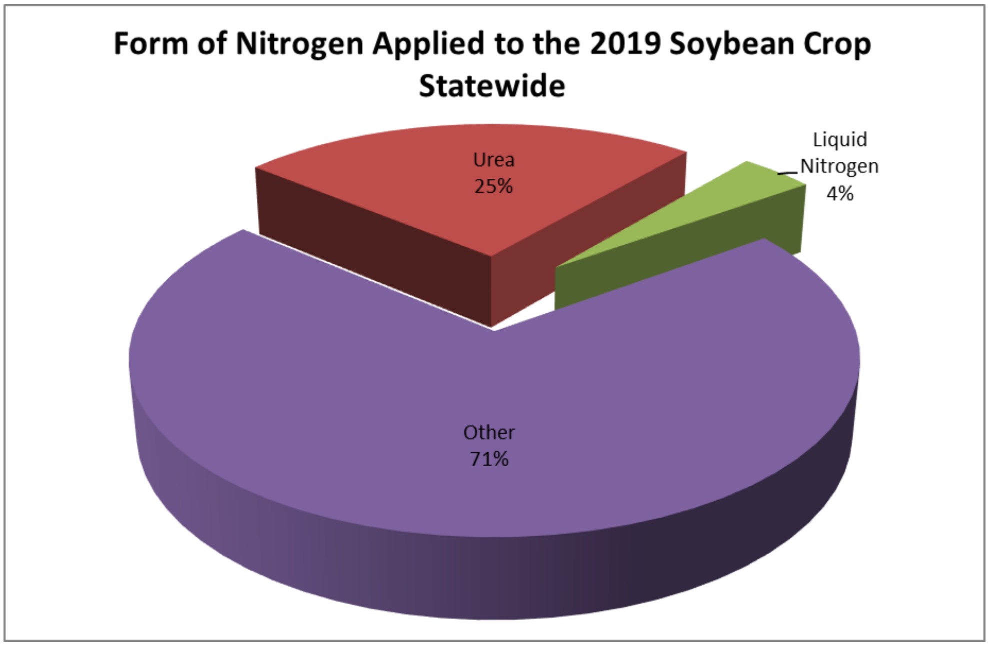

Figure 63. The form of the nitrogen applied to soybean acres in state for the 2019 crop year for all fields applied with nitrogen fertilizer (Based on total pounds applied)

Figure 64 details the form of nitrogen that was applied to soybean acres in the SE BMP region based on total pounds of nitrogen applied (SFQ-FERT TABLE).

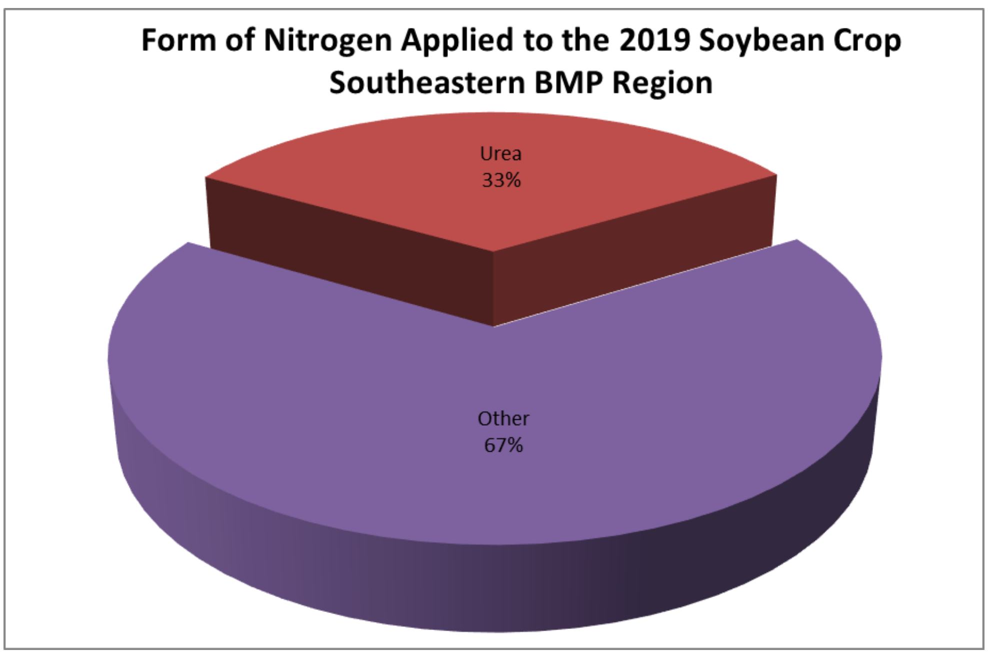

Figure 64. The form of the nitrogen applied to soybean acres in the SE BMP region for the 2019 crop year for all fields applied with nitrogen fertilizer (Based on total pounds applied)

[70] Anhydrous ammonia was not a source of nitrogen for soybean acres.

Figure 65 details the form of nitrogen that was applied to soybean acres in the SC BMP region based on total pounds of nitrogen applied (SFQ-FERT TABLE).

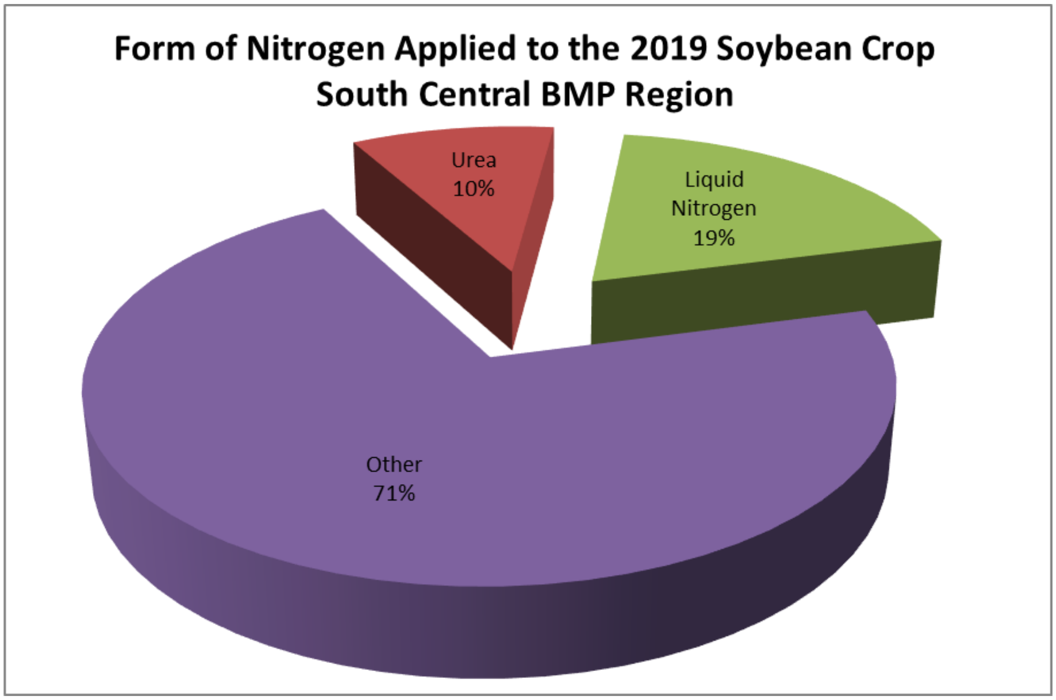

Figure 65. The form of the nitrogen applied to soybean acres in the SC BMP region for the 2019 crop year for all fields applied with nitrogen fertilizer (Based on total pounds applied)

Figure 66 details the form of nitrogen that was applied to soybean acres in the SW BMP region based on total pounds of nitrogen applied (SFQ-FERT TABLE).

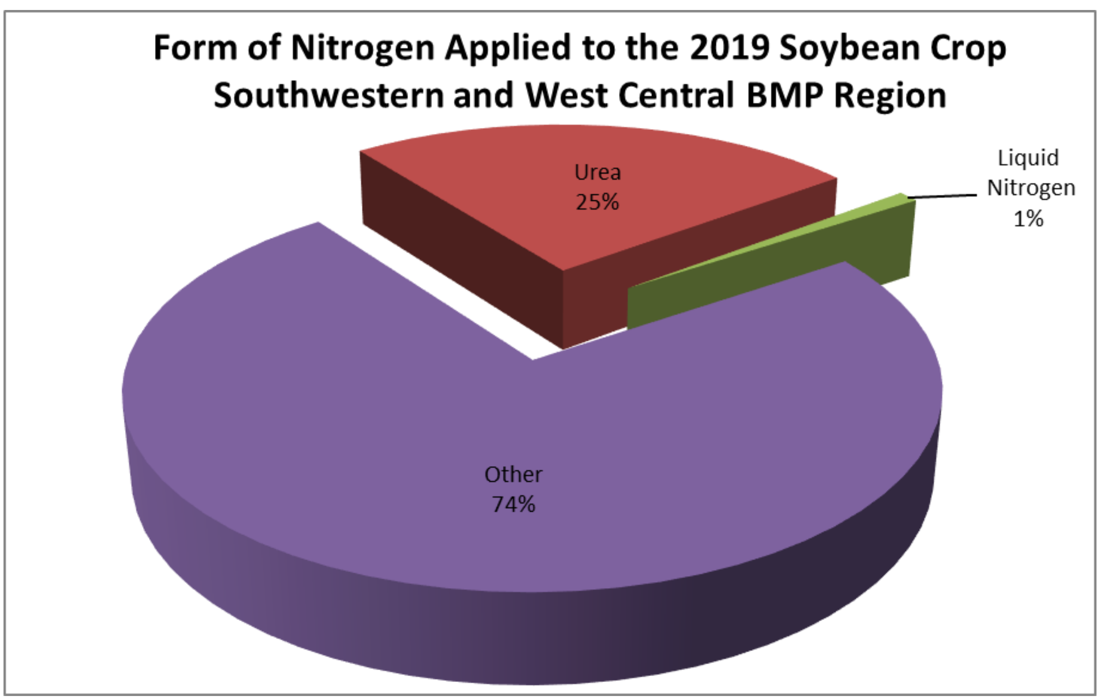

Figure 66. The form of the nitrogen applied to soybean acres in the SW BMP region for the 2019 crop year for all fields applied with nitrogen fertilizer (Based on total pounds applied)

Figure 67 details the form of nitrogen that was applied to soybean acres in the NW BMP region based on total pounds of nitrogen applied (SFQ-FERT TABLE).

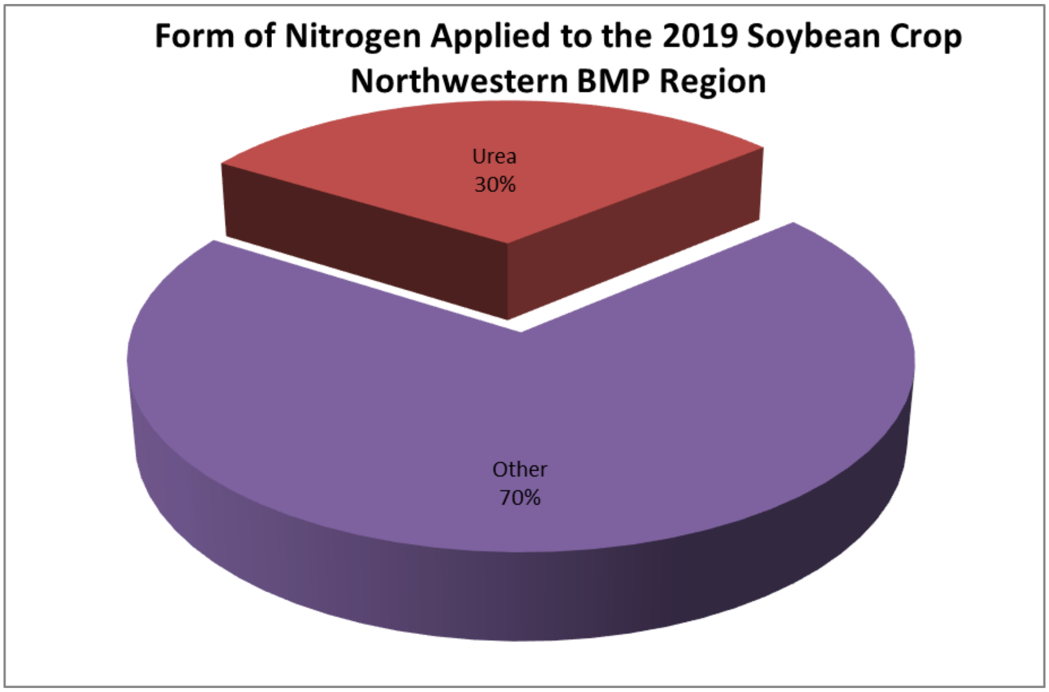

Figure 67. The form of the nitrogen applied to soybean acres in the NW BMP region for the 2019 crop year for all fields applied with nitrogen fertilizer (Based on total pounds applied)

Figure 68 details the form of nitrogen that was applied to soybean acres in the IRR BMP region based on total pounds of nitrogen applied (SFQ-FERT TABLE).

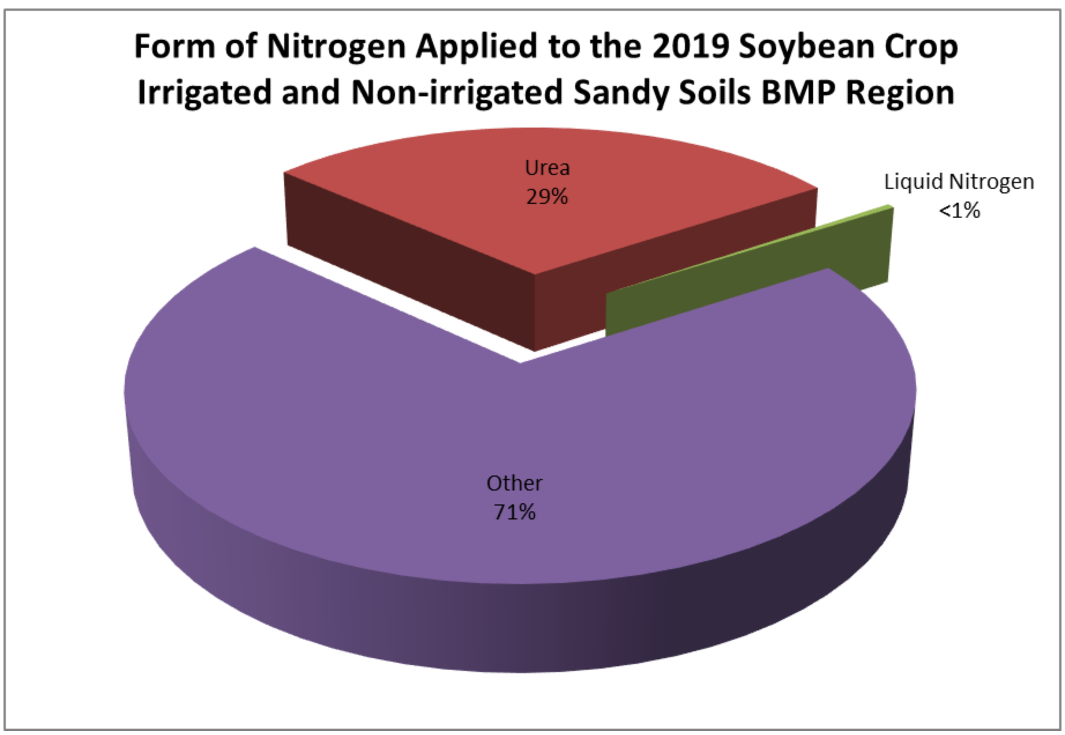

Figure 68. The form of the nitrogen applied to soybean acres in the IRR BMP region for the 2019 crop year for all fields applied with nitrogen fertilizer (Based on total pounds applied)

Figure 69 details the application timing of urea on soybean acres in Minnesota for the largest field by pounds of nitrogen applied (SFQ-FERT TABLE).

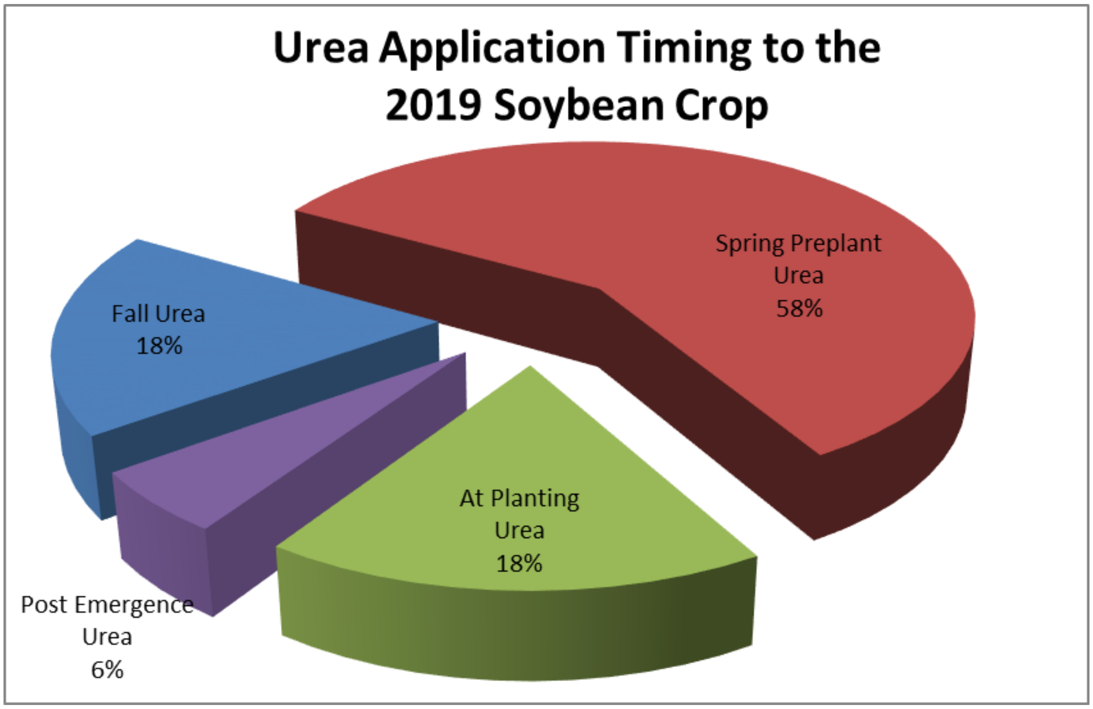

Figure 69. The application timing of urea to soybean acres in Minnesota by pounds of nitrogen applied in the 2019 crop year

Figure 70 details the application timing of liquid nitrogen fertilizer on soybean acres in Minnesota for the largest field by pounds of nitrogen applied (SFQ-FERT TABLE).

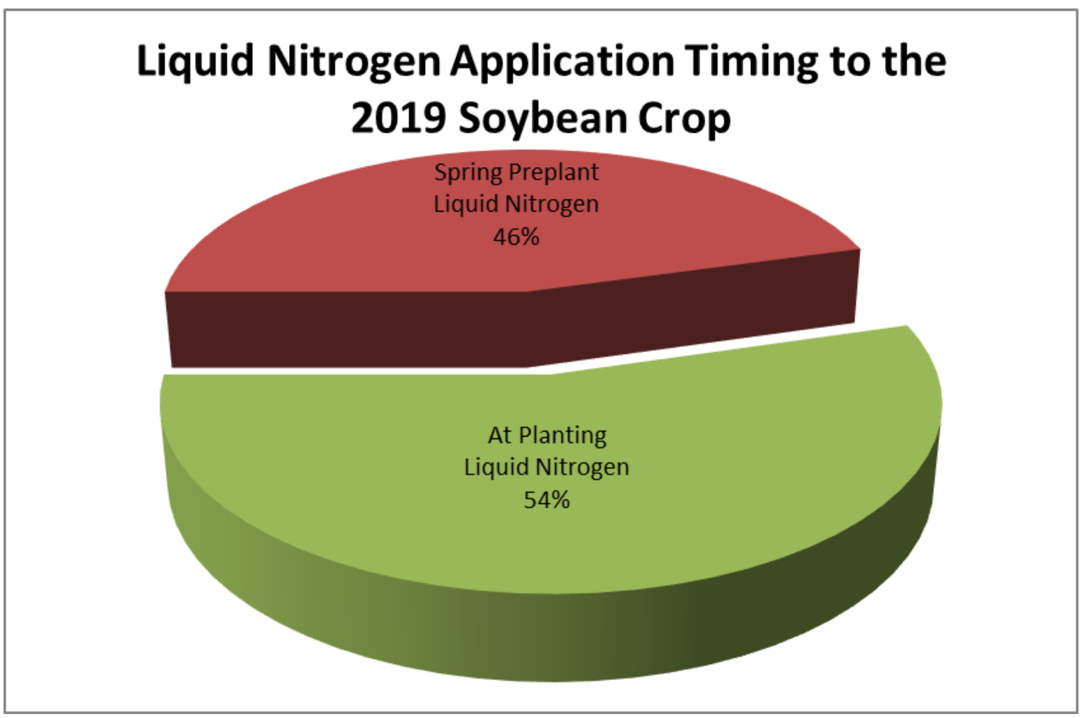

Figure 70. The application timing of liquid nitrogen fertilizer to soybean acres in Minnesota by pounds of nitrogen applied in the 2019 crop year

Figure 71 details the application timing of other nitrogen sources on soybean acres in Minnesota for the largest field by pounds of nitrogen applied (SFQ-FERT TABLE).

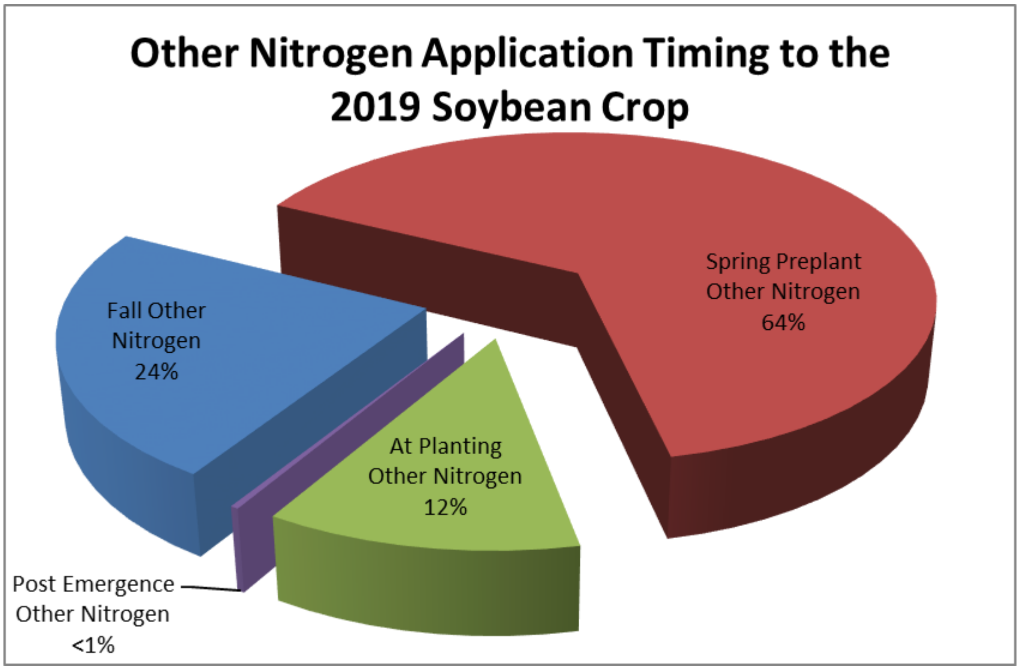

Figure 71. The application timing of other nitrogen sources to soybean acres in Minnesota by pounds of nitrogen applied in the 2019 crop year

Figure 72 details the application timing of phosphorus on soybean acres in Minnesota for the largest field by pounds of phosphorus applied (SFQ-FERT TABLE).

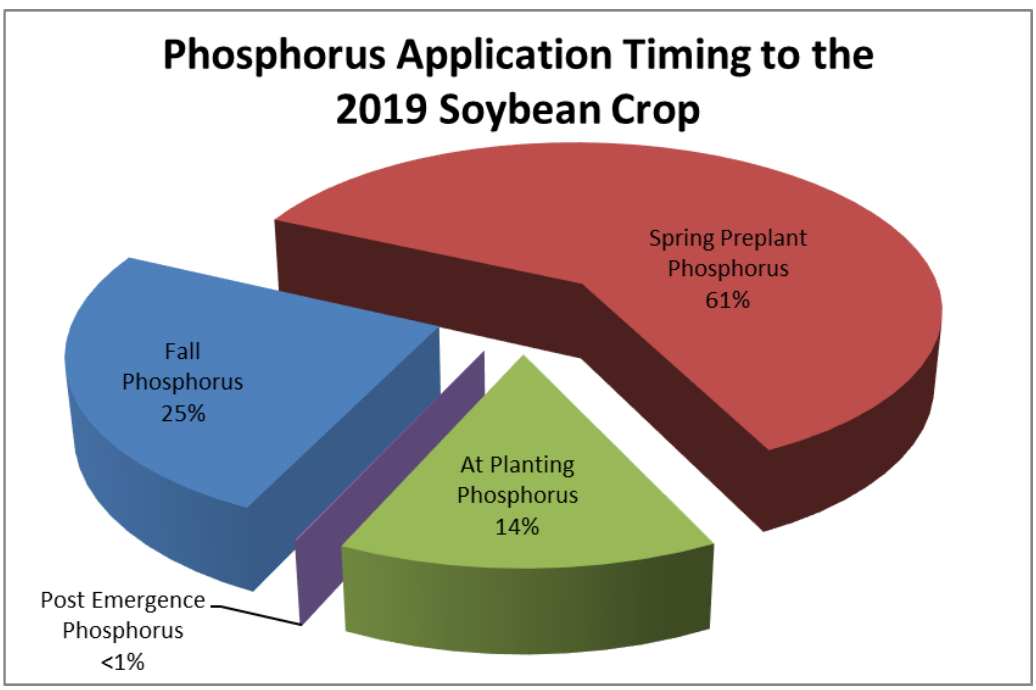

Figure 72. The application timing of phosphorus to soybean acres in Minnesota by pounds of phosphorus applied in the 2019 crop year

Figure 73 details the application timing of potassium on soybean acres in Minnesota for the largest field by pounds of potassium applied (SFQ-FERT TABLE).

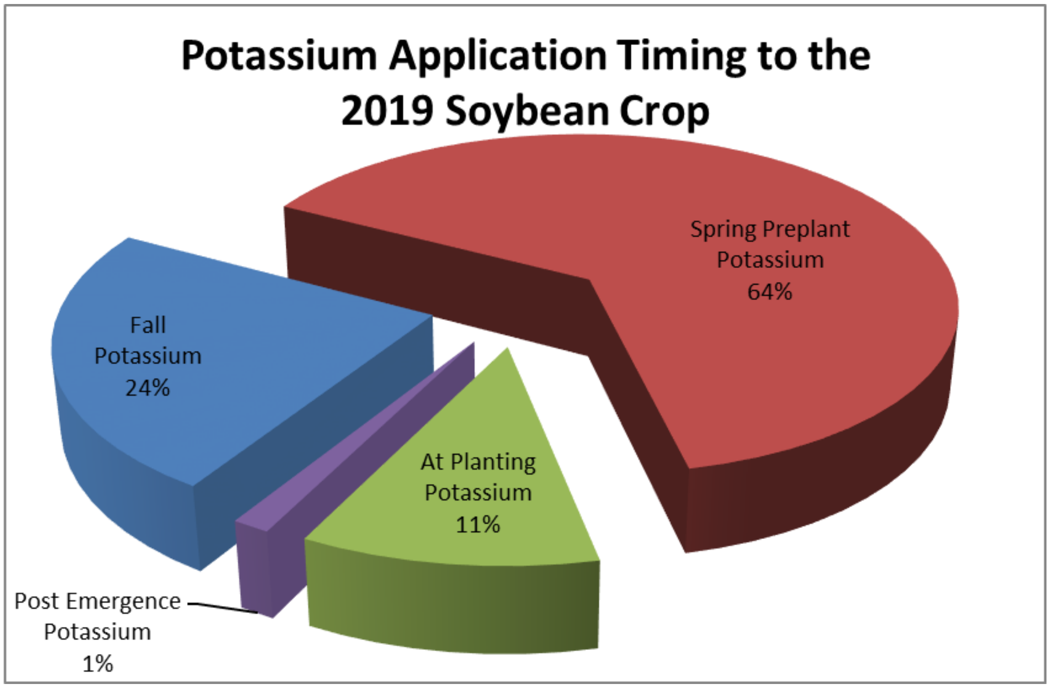

Figure 73. The application timing of potassium to soybean acres in Minnesota by pounds of potassium applied in the 2019 crop year

Figure 74 details the application timing of sulfur on soybean acres in Minnesota for the largest field by pounds of sulfur applied (SFQ-FERT TABLE).

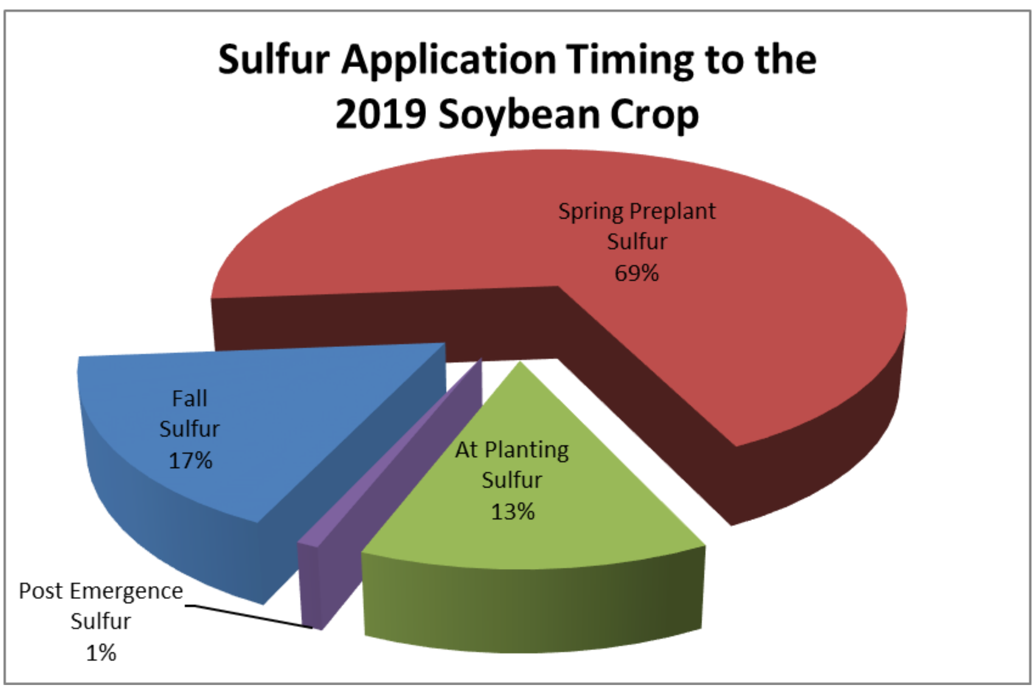

Figure 74. The application timing of sulfur to soybean acres in Minnesota by pounds of sulfur applied in the 2019 crop year

Farmers were asked “Did you use a nitrogen inhibitor or stabilizer on this field?”

Table 164 details the percent of respondents that used a nitrogen inhibitor or stabilizer in the fall of 2018 or in 2019 for the 2019 soybean crop on the farmer’s largest field (SFQ-5 and SFQ-9).

Table 164. Nitrogen inhibitor or stabilizer use for the 2019 soybean crop

BMP Region	Nitrogen Inhibitor or Stabilizer Use	Percent of Respondents	Average Soybean Yield Bushels per Acre
Northwestern	Yes	**	**
Northwestern	No	99	38
Northwestern	Don’t Know	**	**
Irrigated and Non-irrigated Sandy Soils	Yes	**	**
Irrigated and Non-irrigated Sandy Soils	No	90	43
Irrigated and Non-irrigated Sandy Soils	Don’t Know	**	**
Southwestern and West Central	Yes	**	**
Southwestern and West Central	No	100	51
Southwestern and West Central	Don’t Know	**	**
South Central	Yes	**	**
South Central	No	97	52
South Central	Don’t Know	**	**
Southeastern	Yes	**	**
Southeastern	No	100	54
Southeastern	Don’t Know	**	**
Statewide	**Yes**	**3**	**45**
Statewide	**No**	**97**	**47**
Statewide	**Don’t Know**	**	**

** Less than five responses

Application Method of Fertilizer on Soybeans

Fertilizer application practices are used by farmers to get nutrients to the soybean crop's root system as efficiently as possible as well as to prevent nutrient losses. Anhydrous ammonia was not applied to the 2019 soybean crop. Fertigation refers to fertilizer applied to the soybean crop through irrigation pivots.

Table 165 details the application practices of any fertilizer applied in the fall of 2018 for the 2019 soybean crop (SFQ-FERT TABLE). There were 1,300 soybean fields represented in Minnesota.

Table 165. Application practices of any fertilizer applied in fall of 2018 for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	100
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	100
Southwestern and West Central	Broadcast - Incorporated	87
Southwestern and West Central	Broadcast - Not Incorporated	13
South Central	Broadcast - Incorporated	100
Southeastern	Broadcast - Incorporated	**
Southeastern	Broadcast - Not Incorporated	**
Statewide	**Broadcast - Incorporated**	**93**
Statewide	**Broadcast - Not Incorporated**	**7**

** Less than five responses

Table 166 details the application practices of urea applied in the fall of 2018 for the 2019 soybean crop (SFQ-FERT TABLE). There were 154 soybean fields represented in Minnesota.

Table 166. Application practices of urea applied in fall in the fall of 2018 for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	100
Southwestern and West Central	Broadcast - Incorporated	100
Statewide	**Broadcast - Incorporated**	**100**

Less than five responses reported application practices of liquid nitrogen (28% or 32%) in the fall of 2018 for the 2019 soybean crop (SFQ-FERT TABLE).

Table 167 details the application practices of other sources of nitrogen applied in the fall of 2018 for the 2019 soybean crop (SFQ-FERT TABLE). There were 960 soybean fields represented in Minnesota.

Table 167. Application practices of other sources of nitrogen applied in fall of 2018 for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	100
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	100
Southwestern and West Central	Broadcast - Incorporated	87
Southwestern and West Central	Broadcast - Not Incorporated	13
South Central	Broadcast - Incorporated	100
Southeastern	Broadcast - Incorporated	**
Southeastern	Broadcast - Not Incorporated	**
Statewide	**Broadcast - Incorporated**	**91**
Statewide	**Broadcast - Not Incorporated**	**9**

** Less than five responses

Table 168 details the application practices of fertilizers containing phosphorus, such as MAP or DAP, in the fall of 2018 for the 2019 soybean crop (SFQ-FERT TABLE). There were 1,092 soybean fields represented in Minnesota.

Table 168. Application practices of fertilizers containing phosphorus applied in the fall of 2018 for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	100
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	100
Southwestern and West Central	Broadcast - Incorporated	87
Southwestern and West Central	Broadcast - Not Incorporated	13
South Central	Broadcast - Incorporated	100
Southeastern	Broadcast - Incorporated	**
Statewide	**Broadcast - Incorporated**	**94**
Statewide	**Broadcast - Not Incorporated**	**6**

** Less than five responses

Table 169 details the application practices of fertilizers containing potassium in the fall of 2018 for the 2019 soybean crop (SFQ-FERT TABLE). There were 1,270 soybean fields represented in Minnesota.

Table 169. Application practices of fertilizers containing potassium in the fall of 2018 for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	100
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	100
Southwestern and West Central	Broadcast - Incorporated	87
Southwestern and West Central	Broadcast - Not Incorporated	13
South Central	Broadcast - Incorporated	100
Southeastern	Broadcast - Incorporated	**
Southeastern	Broadcast - Not Incorporated	**
Statewide	**Broadcast - Incorporated**	**93**
Statewide	**Broadcast - Not Incorporated**	**7**

** Less than five responses

Table 170 details the application practices of fertilizers containing sulfur, such as AMS, in the fall of 2018 for the 2019 soybean crop (SFQ-FERT TABLE). There were 316 soybean fields represented in Minnesota.

Table 170. Application practices of fertilizers containing sulfur applied in the fall of 2018 for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	**
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	**
Southwestern and West Central	Broadcast - Incorporated	78
Southwestern and West Central	Broadcast - Not Incorporated	22
South Central	Broadcast - Incorporated	**
Statewide	**Broadcast - Incorporated**	**92**
Statewide	**Broadcast - Not Incorporated**	**8**

** Less than five responses

Table 171 details the application practices of any fertilizer applied in the in the spring as a preplant for the 2019 soybean crop (SFQ-FERT TABLE). There were 3,832 soybean fields represented in Minnesota.

Table 171. Application practices of all fertilizer applications as a preplant in the spring for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	94
Northwest	Broadcast - Not Incorporated	3
Northwest	Other	3
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	83
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	17
Southwestern and West Central	Broadcast - Incorporated	89
Southwestern and West Central	Broadcast - Not Incorporated	11
South Central	Broadcast - Incorporated	94
South Central	Broadcast - Not Incorporated	6
Southeastern	Broadcast - Incorporated	87
Southeastern	Broadcast - Not Incorporated	13
Statewide	**Broadcast - Incorporated**	**89**
Statewide	**Broadcast - Not Incorporated**	**10**
Statewide	**Other**	**1**

Table 172 details the application practices of urea applied in the spring as a preplant for the 2019 soybean crop (SFQ-FERT TABLE). There were 502 soybean fields represented in Minnesota.

Table 172. Application practices of urea applied as a preplant in the spring for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	71
Northwest	Broadcast - Not Incorporated	29
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	86
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	14
Southwestern and West Central	Broadcast - Incorporated	100
South Central	Broadcast - Incorporated	100
Southeastern	Broadcast - Incorporated	100
Statewide	**Broadcast - Incorporated**	**92**
Statewide	**Broadcast - Not Incorporated**	**8**

Table 173 details the application practices of liquid nitrogen (28% or 32%) applied in the spring as a preplant for the 2019 soybean crop (SFQ-FERT TABLE). There were 127 soybean fields represented in Minnesota.

Table 173. Application practices of liquid nitrogen applied as a preplant in the spring for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	**
South Central	Broadcast - Incorporated	**
Statewide	**Broadcast - Incorporated**	**100**

** Less than five responses

Table 174 details the application practices of other sources of nitrogen applied in the spring as a preplant for the 2019 soybean crop (SFQ-FERT TABLE). There were 2,670 soybean fields represented in Minnesota.

Table 174. Application practices of other sources of nitrogen applied as a preplant in the spring for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	96
Northwest	Other	4
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	81
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	19
Southwestern and West Central	Broadcast - Incorporated	86
Southwestern and West Central	Broadcast - Not Incorporated	14
South Central	Broadcast - Incorporated	90
South Central	Broadcast - Not Incorporated	10
Southeastern	Broadcast - Incorporated	81
Southeastern	Broadcast - Not Incorporated	19
Statewide	**Broadcast - Incorporated**	**87**
Statewide	**Broadcast - Not Incorporated**	**12**
Statewide	**Other**	**1**

Table 175 details the application practices of fertilizers containing phosphorus, such as MAP or DAP, in the in the spring as a preplant for the 2019 soybean crop (SFQ-FERT TABLE). There were 3,205 soybean fields represented in Minnesota.

Table 175. Application practices for applications of fertilizers containing phosphorus as a preplant in the spring for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	93
Northwest	Broadcast - Not Incorporated	3
Northwest	Other	4
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	85
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	15
Southwestern and West Central	Broadcast - Incorporated	90
Southwestern and West Central	Broadcast - Not Incorporated	10
South Central	Broadcast - Incorporated	93
South Central	Broadcast - Not Incorporated	7
Southeastern	Broadcast - Incorporated	86
Southeastern	Broadcast - Not Incorporated	14
Statewide	**Broadcast - Incorporated**	**90**
Statewide	**Broadcast - Not Incorporated**	**9**
Statewide	**Other**	**1**

Table 176 details the application practices of fertilizers containing potassium applied in the spring as a preplant for the 2019 soybean crop (SFQ-FERT TABLE). There were 3,494 soybean fields represented in Minnesota.

Table 176. Application practices of fertilizers containing potassium applied as a preplant in the spring for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	93
Northwest	Broadcast - Not Incorporated	3
Northwest	Other	4
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	83
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	17
Southwestern and West Central	Broadcast - Incorporated	87
Southwestern and West Central	Broadcast - Not Incorporated	13
South Central	Broadcast - Incorporated	93
South Central	Broadcast - Not Incorporated	7
Southeastern	Broadcast - Incorporated	86
Southeastern	Broadcast - Not Incorporated	14
Statewide	**Broadcast - Incorporated**	**87**
Statewide	**Broadcast - Not Incorporated**	**12**
Statewide	**Other**	**1**

Table 177 details the application practices of fertilizers containing sulfur applied in the spring as a preplant for the 2019 soybean crop (SFQ-FERT TABLE). There were 998 soybean fields represented in Minnesota.

Table 177. Application practices of fertilizers containing sulfur as a preplant in the spring for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	86
Northwest	Other	14
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	85
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Not Incorporated	15
Southwestern and West Central	Broadcast - Incorporated	81
Southwestern and West Central	Broadcast - Not Incorporated	19
South Central	Broadcast - Incorporated	100
Southeastern	Broadcast - Incorporated	80
Southeastern	Broadcast - Not Incorporated	20
Statewide	**Broadcast - Incorporated**	**86**
Statewide	**Broadcast - Not Incorporated**	**11**
Statewide	**Other**	**3**

Table 178 details the application practices of any fertilizer applied in the spring at planting for the 2019 soybean crop (SFQ-FERT TABLE). There were 1,214 soybean fields represented in Minnesota.

Table 178. Application practices of any fertilizer applied at planting for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	41
Northwest	With planter	59
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	38
Irrigated and Non-Irrigated Sandy Soils	With planter	62
Southwestern and West Central	Broadcast - Incorporated	9
Southwestern and West Central	Broadcast - Not Incorporated	16
Southwestern and West Central	With planter	75
South Central	With planter	100
Southeastern	Broadcast - Incorporated	18
Southeastern	With planter	82
Statewide	**Broadcast - Incorporated**	**25**
Statewide	**Broadcast - Not Incorporated**	**3**
Statewide	**With planter**	**72**

Table 179 details the application practices of urea applied in the spring at planting for the 2019 soybean crop (SFQ-FERT TABLE). There were 214 soybean fields represented in Minnesota.

Table 179. Application practices of urea applied at planting in the spring for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	67
Northwest	With planter	33
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	25
Irrigated and Non-Irrigated Sandy Soils	With planter	75
Southeastern	Broadcast - Incorporated	**
Statewide	**Broadcast - Incorporated**	**47**
Statewide	**With planter**	**53**

** Less than five responses

Less than five responses reported application practices of liquid nitrogen (28% or 32%) at planting for the 2019 soybean crop (SFQ-FERT TABLE).

Table 180 details the application practices of other sources of nitrogen applied in the spring at planting for the 2019 soybean crop (SFQ-FERT TABLE). There were 845 soybean fields represented in Minnesota.

Table 180. Application practices of other sources of nitrogen applied at planting in the spring for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	32
Northwest	With planter	68
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	49
Irrigated and Non-Irrigated Sandy Soils	With planter	51
Southwestern and West Central	Broadcast - Incorporated	9
Southwestern and West Central	Broadcast - Not Incorporated	17
Southwestern and West Central	With planter	74
South Central	With planter	100
Southeastern	With planter	100
Statewide	**Broadcast - Incorporated**	**22**
Statewide	**Broadcast - Not Incorporated**	**4**
Statewide	**With planter**	**75**

Table 181 details the application practices of fertilizers containing phosphorus, such as MAP or DAP, in the spring at planting for the 2019 soybean crop (SFQ-FERT TABLE). There were 1,010 soybean fields represented in Minnesota.

Table 181. Application practices of fertilizers containing phosphorus at planting in the spring for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	34
Northwest	With planter	66
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	38
Irrigated and Non-Irrigated Sandy Soils	With planter	62
Southwestern and West Central	Broadcast - Incorporated	9
Southwestern and West Central	Broadcast - Not Incorporated	16
Southwestern and West Central	With planter	75
South Central	With planter	100
Southeastern	Broadcast - Incorporated	35
Southeastern	With planter	65
Statewide	**Broadcast - Incorporated**	**23**
Statewide	**Broadcast - Not Incorporated**	**3**
Statewide	**With planter**	**74**

Table 182 details the application practices of fertilizers containing potassium in the in the spring at planting for the 2019 soybean crop (SFQ-FERT TABLE). There were 886 soybean fields represented in Minnesota.

Table 182. Application practices of fertilizers containing potassium at planting in the spring for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	Broadcast - Incorporated	52
Northwest	With planter	48
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	38
Irrigated and Non-Irrigated Sandy Soils	With planter	62
Southwestern and West Central	Broadcast - Incorporated	9
Southwestern and West Central	Broadcast - Not Incorporated	17
Southwestern and West Central	With planter	74
South Central	With planter	100
Southeastern	Broadcast - Incorporated	35
Southeastern	With planter	65
Statewide	**Broadcast - Incorporated**	**27**
Statewide	**Broadcast - Not Incorporated**	**3**
Statewide	**With planter**	**70**

Table 183 details the application practices of fertilizers containing sulfur in the in the spring at planting for the 2019 soybean crop (SFQ-FERT TABLE). There were 295 soybean fields represented in Minnesota.

Table 183. Application practices applications of fertilizers containing fertilizers containing sulfur at planting in the spring for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Northwest	With planter	**
Irrigated and Non-Irrigated Sandy Soils	Broadcast - Incorporated	45
Irrigated and Non-Irrigated Sandy Soils	With planter	55
Southwestern and West Central	Broadcast - Incorporated	**
Southwestern and West Central	Broadcast - Not Incorporated	**
Southwestern and West Central	With planter	**
South Central	With planter	**
Statewide	**Broadcast - Incorporated**	**29**
Statewide	**Broadcast - Not Incorporated**	**6**
Statewide	**With planter**	**65**

** Less than five responses

Table 184 details the application practices of any fertilizer applied as a sidedress, top dress, or through irrigation for the 2019 soybean crop (SFQ-FERT TABLE). There were 1,300 soybean fields represented in Minnesota. No soybean farmers reported applying fertilizer thought irrigation in 2019.

Table 184. Application practices of any fertilizer applied as a sidedress, top dress, or through irrigation (fertigation) for the 2019 soybean crop

BMP Region	Application Practice	Percent of Respondents
Irrigated and Non-Irrigated Sandy Soils	Sidedress	100
South Central	Sidedress	**
Statewide	**Sidedress**	**100**

** Less than five responses

Less than five responses reported application practices of:

- Urea as a sidedress or top dress for the 2019 soybean crop.
- Liquid nitrogen (28% or 32%) as a sidedress or top dress for the 2019 soybean crop.
- Other sources of nitrogen as a sidedress or top dress for the 2019 soybean crop.
- Fertilizers containing phosphorus, such as MAP or DAP, as a sidedress or top dress for the 2019 soybean crop.
- Fertilizers containing potassium as a sidedress or top dress for the 2019 soybean crop.
- Fertilizers containing sulfur as a sidedress or top dress the 2019 soybean crop.

Statewide: Soybeans Following Soybeans

Statewide, eight percent of the fields reported were soybeans following soybeans. Figure 75 details the BMP regions where farmers reported on fields with soybeans following soybeans. There were 472 fields represented in Minnesota.[71]

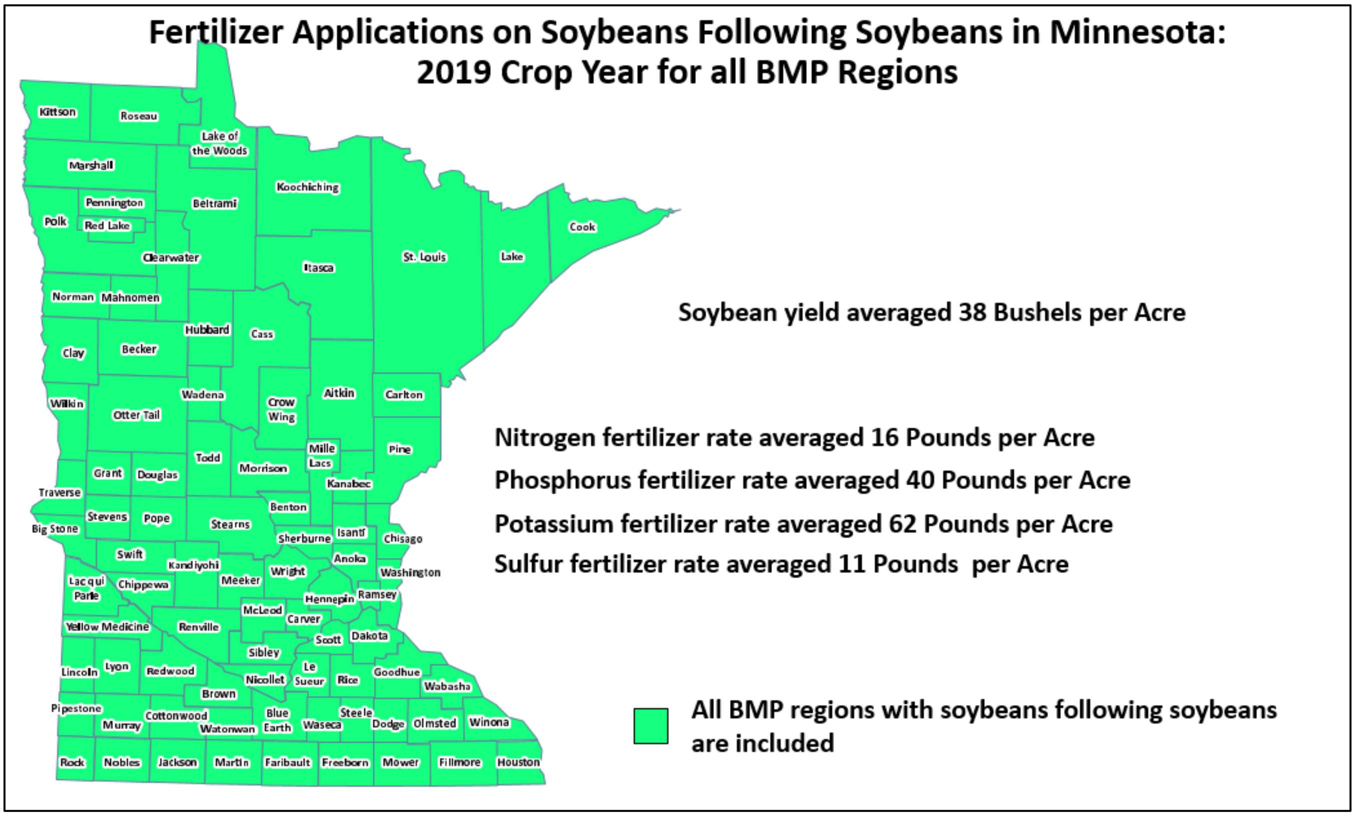

Figure 75. The average fertilizer rate for soybeans following soybeans in Minnesota

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[71] The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2019 soybean crop. Of the respondents that applied commercial fertilizer, 81% applied nitrogen, 80% applied phosphorus, 92% applied potassium, and 21% applied sulfur on fields with soybeans following soybeans.

Figure 76 provides the distribution of average nitrogen fertilizer rate in Minnesota for soybeans following soybeans; the corresponding soybean yield is detailed in red.[72] Nitrogen rates are only from commercial fertilizer.

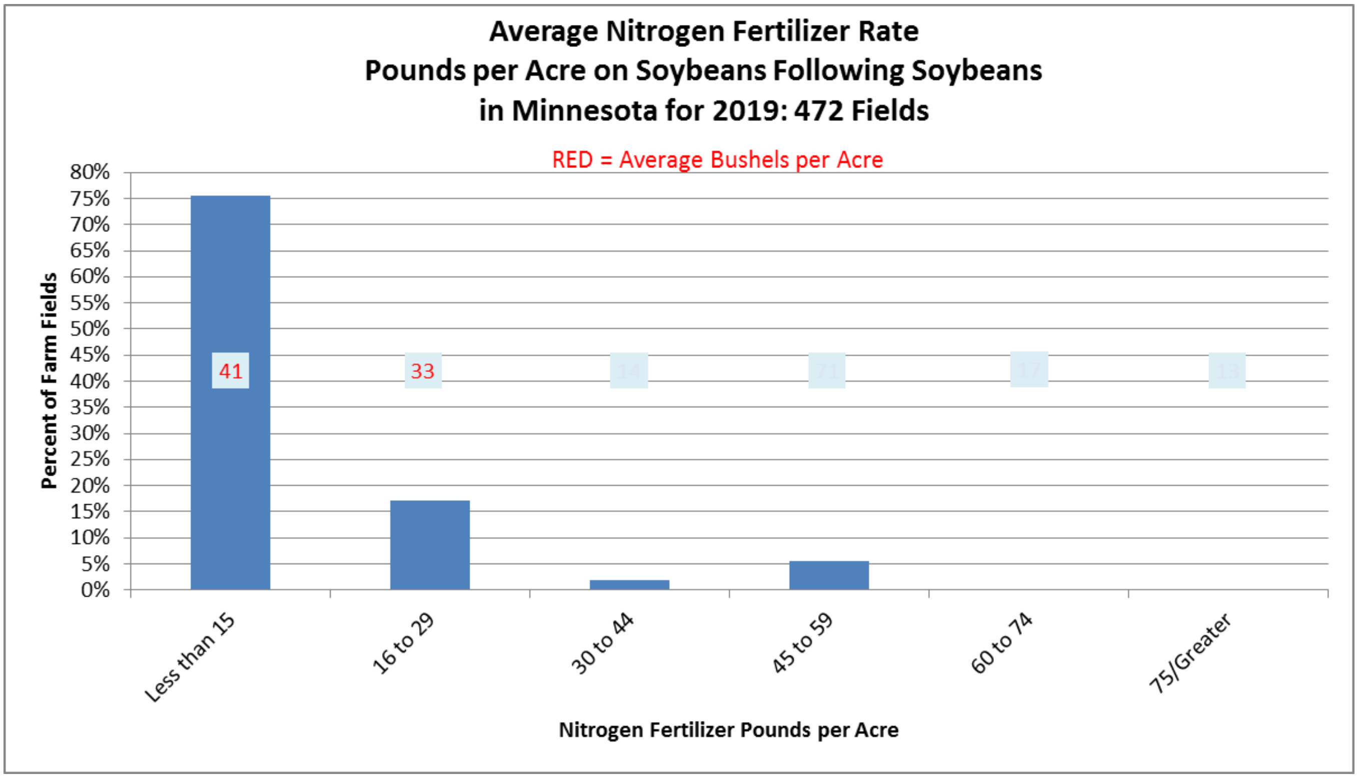

Figure 76. Average nitrogen fertilizer rate on soybeans following soybeans in Minnesota for 2019: 472 fields

In Minnesota, the percent of fertilized soybean fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; and the average nutrient rate across all fertilized fields on soybeans following soybeans in Table 185.

Table 185. Average fertilizer rate in Minnesota for soybeans following soybeans

Nutrients Applied	Percent of Fertilized Soybean Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Soybean Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Soybean Fields Pounds per Acre
Nitrogen	81	16	39	13
Phosphorus	80	40	39	32
Potassium	92	62	38	57
Sulfur	21	6	41	1

[72] Yields are not published if there are less than five responses.

Southeastern BMP Region: Soybeans Following Soybeans

The SE BMP region had less than five responses for soybeans following soybeans.

South Central BMP Region: Soybeans Following Soybeans

The SC BMP region had less than five responses for soybeans following soybeans.

Southwestern and West Central BMP Region: Soybeans Following Soybeans

There were 104 fields that were represented in the SW BMP region for the soybeans following soybeans analysis. Figure 77 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for soybeans following soybeans in the SW BMP region.[73]

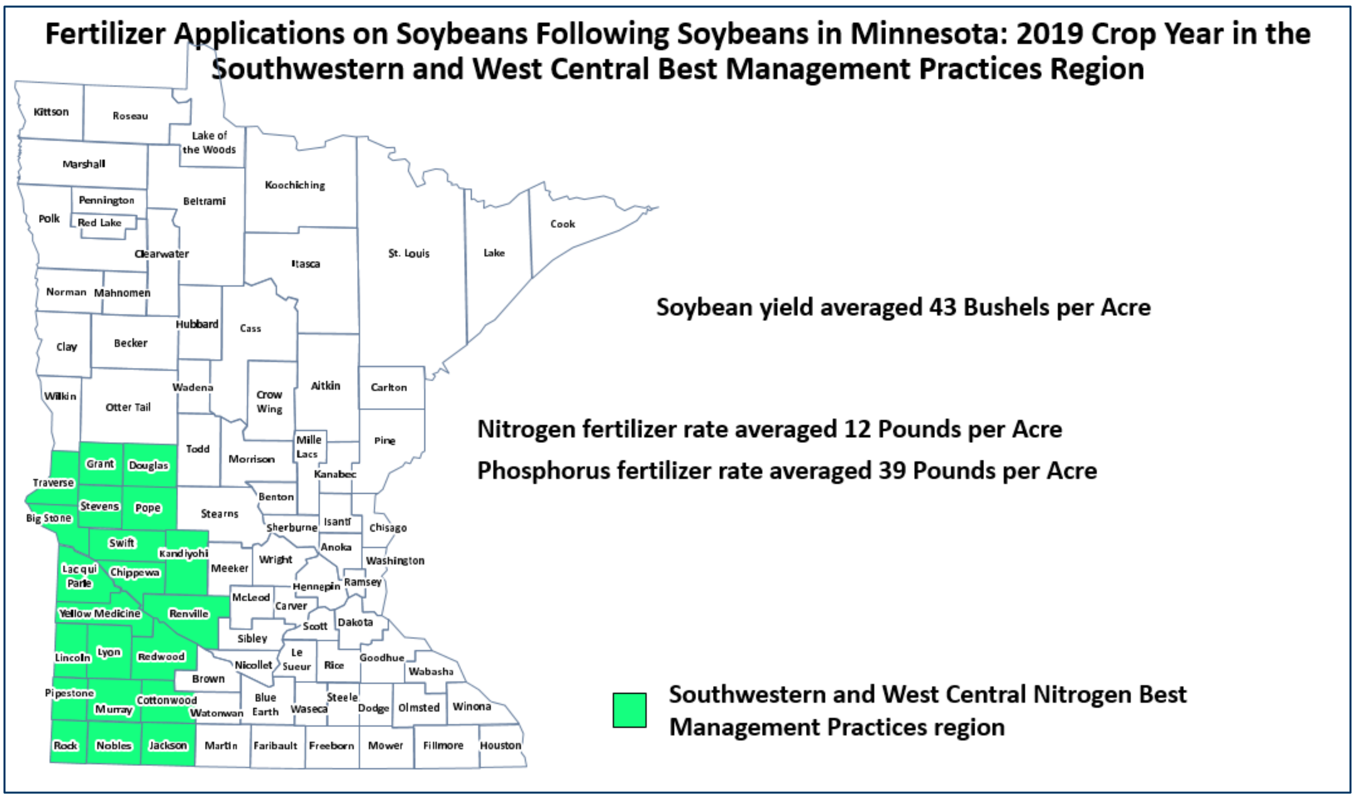

Figure 77. The average soybean yield and average fertilizer rate for soybeans following soybeans in the SW BMP region

[73] The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2019 soybean crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen and 100% applied phosphorus on fields with soybeans following soybeans. Less than five responses reported applying potassium or sulfur.

Figure 78 provides the distribution of nitrogen fertilizer rate in the SW BMP region for soybeans following soybeans; the corresponding soybean yields are detailed in red.[74] Nitrogen rates are only from commercial fertilizer.

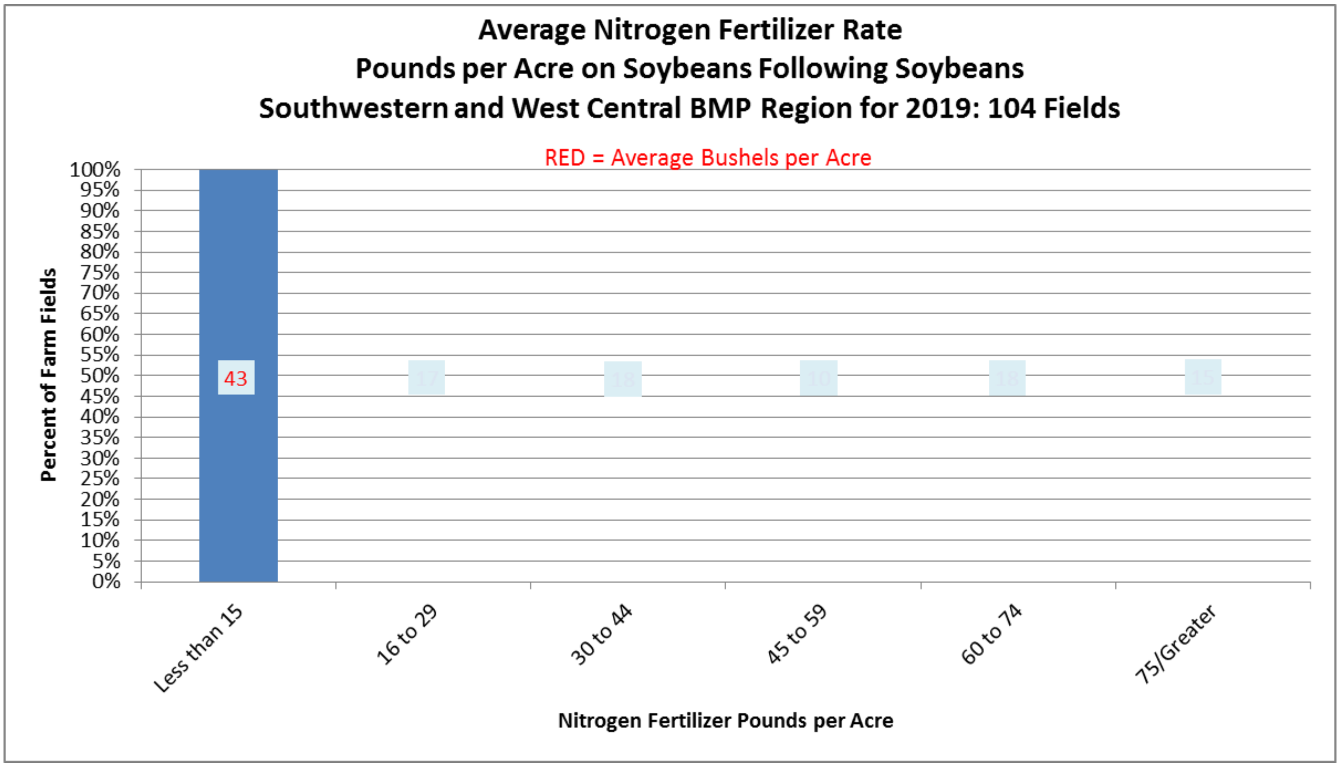

Figure 78. Average nitrogen fertilizer rate and yield on soybeans following soybeans in the SW BMP region for 2019: 104 fields

In the SW BMP region, the percent of fertilized soybean fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of soybeans following soybeans are shown in Table 186.

Table 186. Average fertilizer rate and yield in the SW BMP region for soybeans following soybeans

Nutrients Applied	Percent of Fertilized Soybean Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Soybean Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Soybean Fields Pounds per Acre
Nitrogen	100	12	43	12
Phosphorus	100	39	43	39
Potassium	**	**	**	**
Sulfur	**	**	**	**

** Less than five responses

[74] Yields are not published if there are less than five responses.

Northwest BMP Region: Soybeans Following Soybeans

There were 65 fields that were represented in the NW BMP region for the soybeans following soybeans analysis. Figure 79 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for soybeans following soybeans in the NW BMP region.[75]

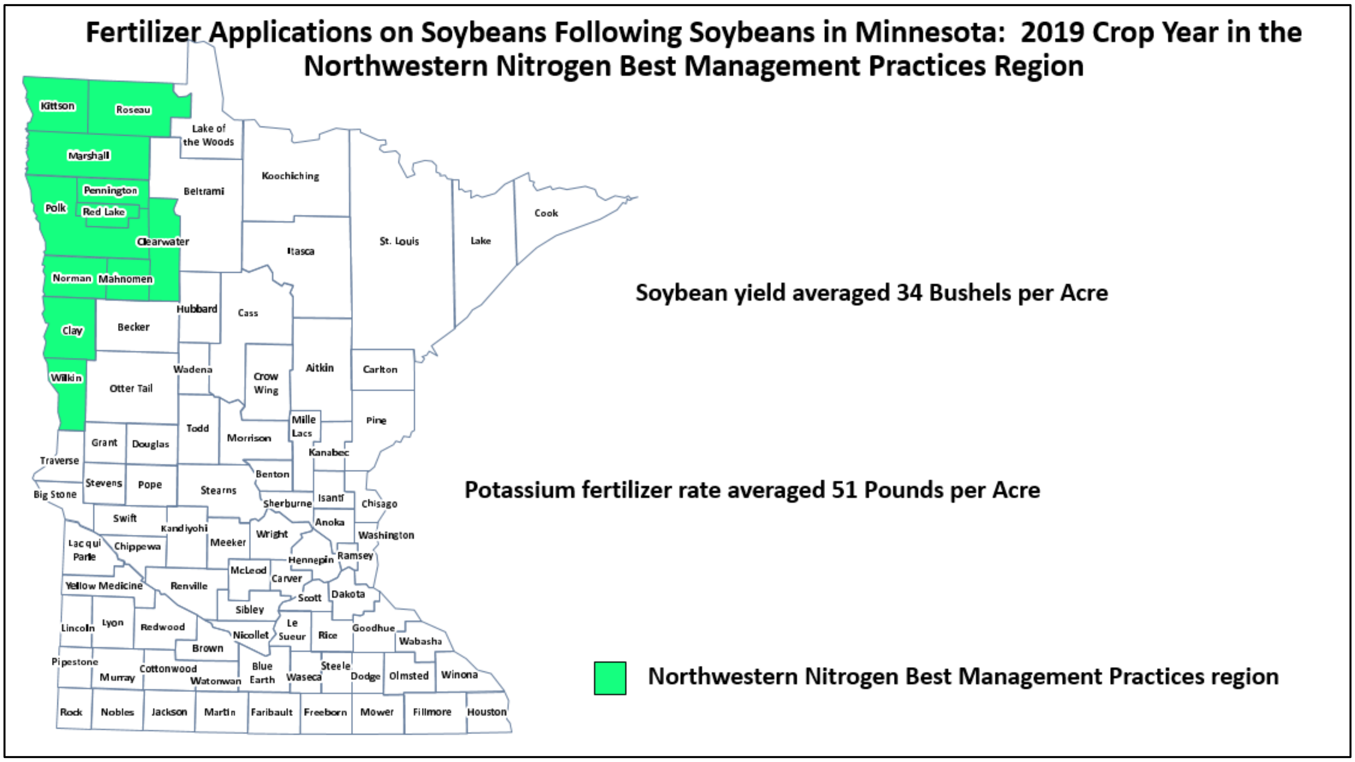

Figure 79. The average soybean yield and average fertilizer rate for soybeans following soybeans in the NW BMP region

[75] The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2019 soybean crop. Of the respondents that applied commercial fertilizer, 100% applied potassium on fields with soybeans following soybeans. Less than five responses reported applying nitrogen, phosphorus, or sulfur.

Less than five responses reported applying nitrogen on fields with soybeans following soybeans.

In the NW BMP region, the percent of fertilized soybean fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of soybeans following soybeans are shown in Table 187.

Table 187. Average fertilizer rate and yield in the NW BMP region for soybeans following soybeans

Nutrients Applied	Percent of Fertilized Soybean Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Soybean Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Soybean Fields Pounds per Acre
Nitrogen	**	**	**	**
Phosphorus	**	**	**	**
Potassium	100	51	34	51
Sulfur	**	**	**	**

** Less than five responses

Irrigated and Non-irrigated Sandy Soils BMP Region: Soybeans Following Soybeans

There were 235 fields that were represented in the IRR BMP region for the soybeans following soybeans analysis. Figure 80 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for soybeans following soybeans in the IRR BMP region.[76]

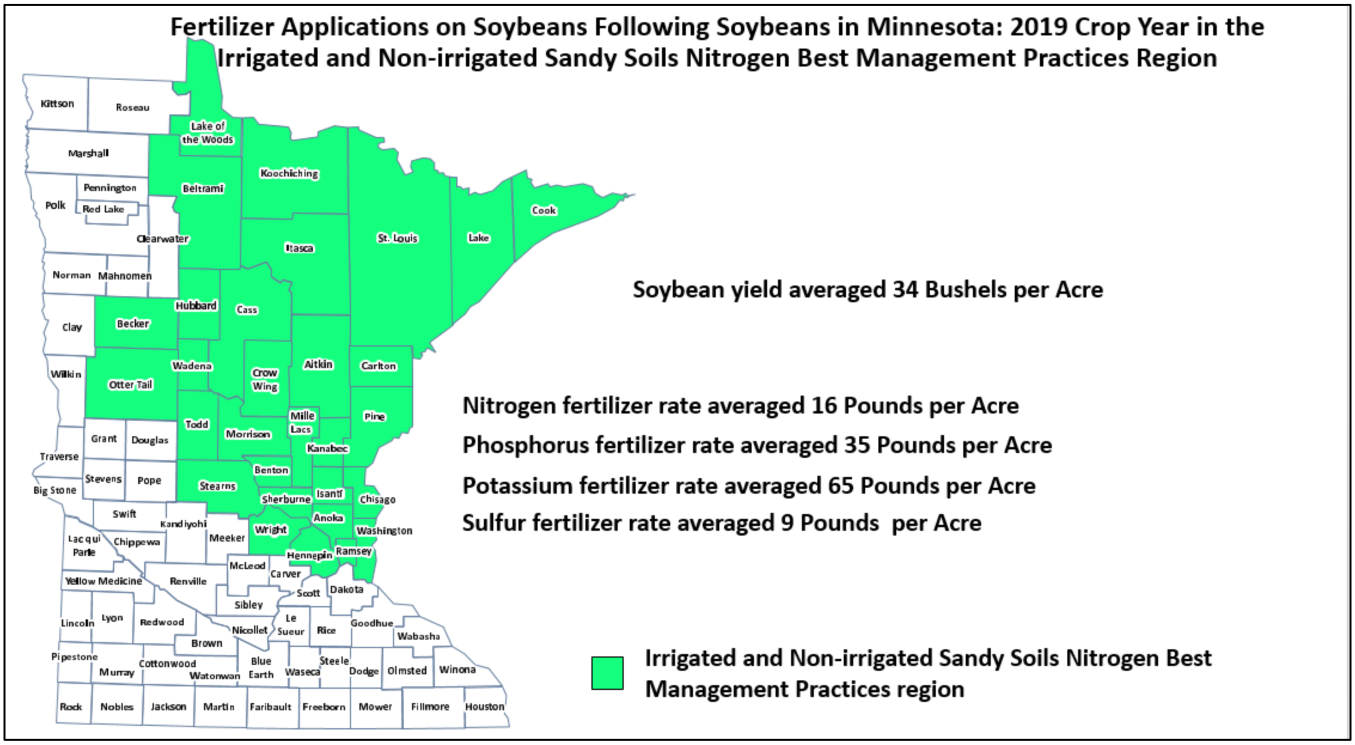

Figure 80. The average soybean yield and average fertilizer rate for soybeans following soybeans in the IRR BMP region

[76] The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2019 soybean crop. Of the respondents that applied commercial fertilizer, 72% applied nitrogen, 69% applied phosphorus, 100% applied potassium, and 18% applied sulfur on fields with soybeans following soybeans.

Figure 81 provides the distribution of nitrogen fertilizer rate in the IRR BMP region for soybeans following soybeans; the corresponding soybean yields are detailed in red.[77] Nitrogen rates are only from commercial fertilizer.

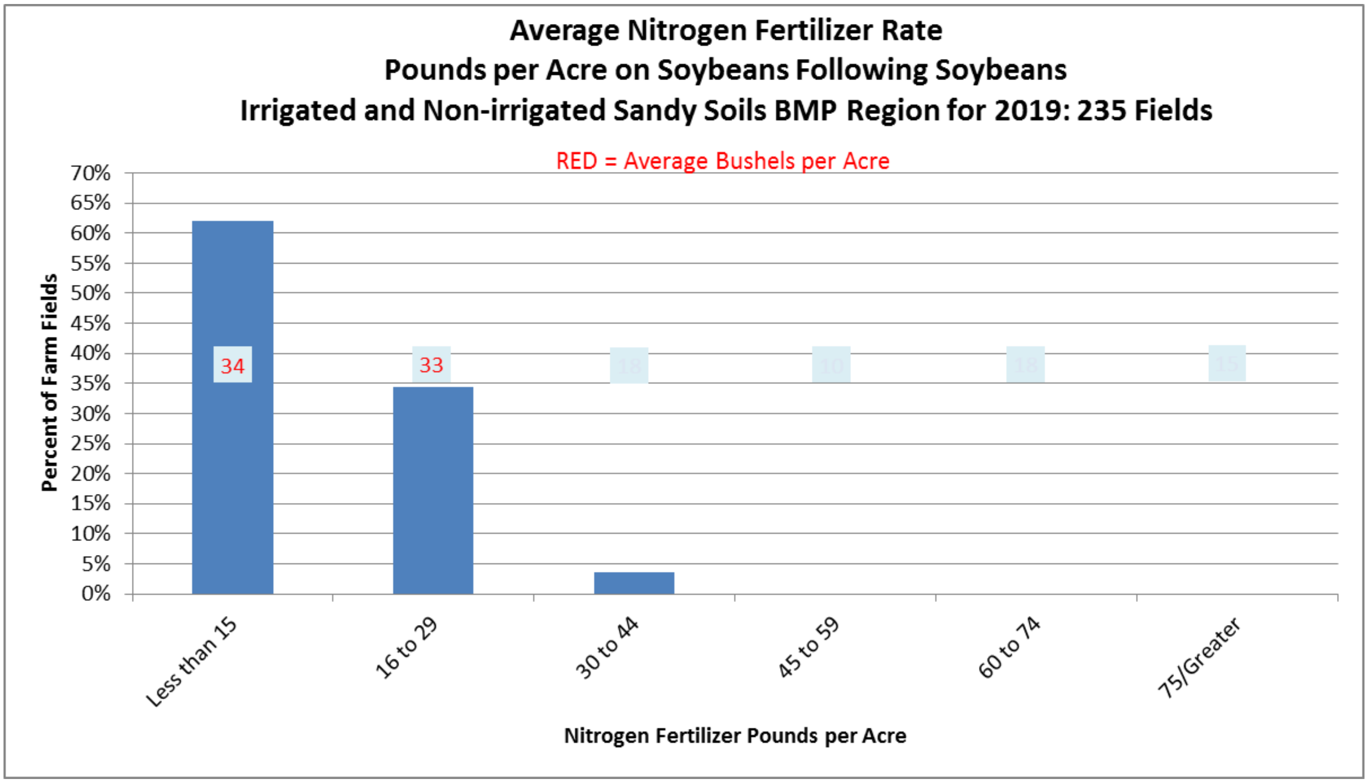

Figure 81. Average nitrogen fertilizer rate and yield on soybeans following soybeans in the IRR BMP region for 2019: 235 fields

In the IRR BMP region, the percent of fertilized soybean fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of soybeans following soybeans are shown in Table 188.

Table 188. Average fertilizer rate and yield in the IRR BMP region for soybeans following soybeans

Nutrients Applied	Percent of Fertilized Soybean Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Soybean Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Soybean Fields Pounds per Acre
Nitrogen	72	16	35	11
Phosphorus	69	35	35	24
Potassium	100	65	34	65
Sulfur	18	9	42	2

[77] Yields are not published if there are less than five responses.

Statewide: Soybeans Following Corn

Statewide, seventy-two percent of the fields reported were soybeans following corn. Figure 82 details the BMP regions where farmers reported on fields with soybeans following corn. There were 4,455 fields represented in Minnesota.[78]

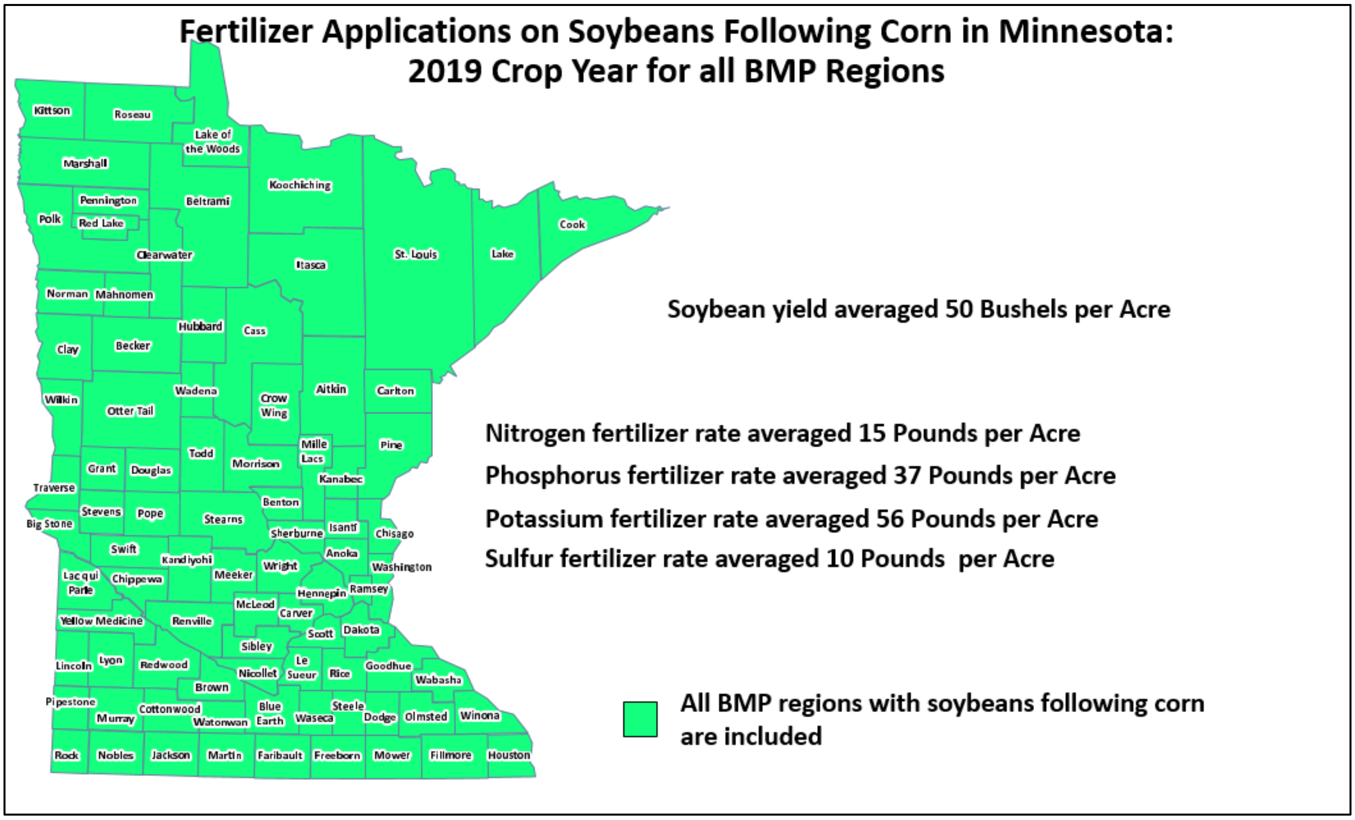

Figure 82. The average fertilizer rate for soybeans following corn in Minnesota

[78] The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2019 soybean crop. Of the respondents that applied commercial fertilizer, 88% applied nitrogen, 83% applied phosphorus, 95% applied potassium, and 29% applied sulfur on fields with soybeans following corn.

Figure 83 provides the distribution of average nitrogen fertilizer rate in Minnesota for soybeans following corn. Nitrogen rates are only from commercial fertilizer.

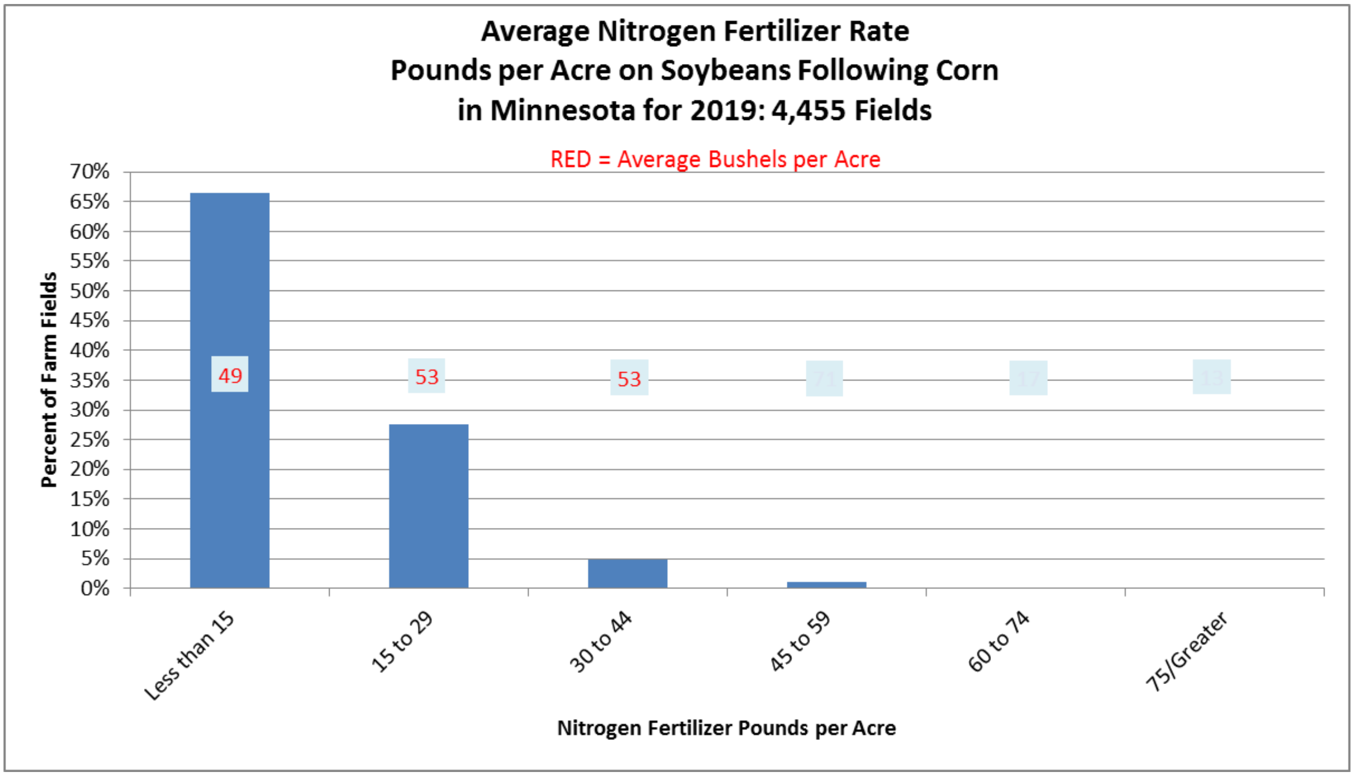

Figure 83. Average nitrogen fertilizer rate on soybeans following corn in Minnesota for 2019: 4,455 fields

In Minnesota, the percent of fertilized soybean fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; and the average nutrient rate across all fertilized fields on soybeans following corn are shown in Table 189.

Table 189. Average fertilizer rate in Minnesota for soybeans following corn

Nutrients Applied	Percent of Fertilized Soybean Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Soybean Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Soybean Fields Pounds per Acre
Nitrogen	88	15	50	13
Phosphorus	83	37	50	31
Potassium	95	56	50	53
Sulfur	29	10	50	3

Southeastern BMP Region: Soybeans Following Corn

There were 658 fields that were represented in the SE BMP region for the soybeans following corn analysis. Figure 84 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for soybeans following soybeans in the SE BMP region.[79]

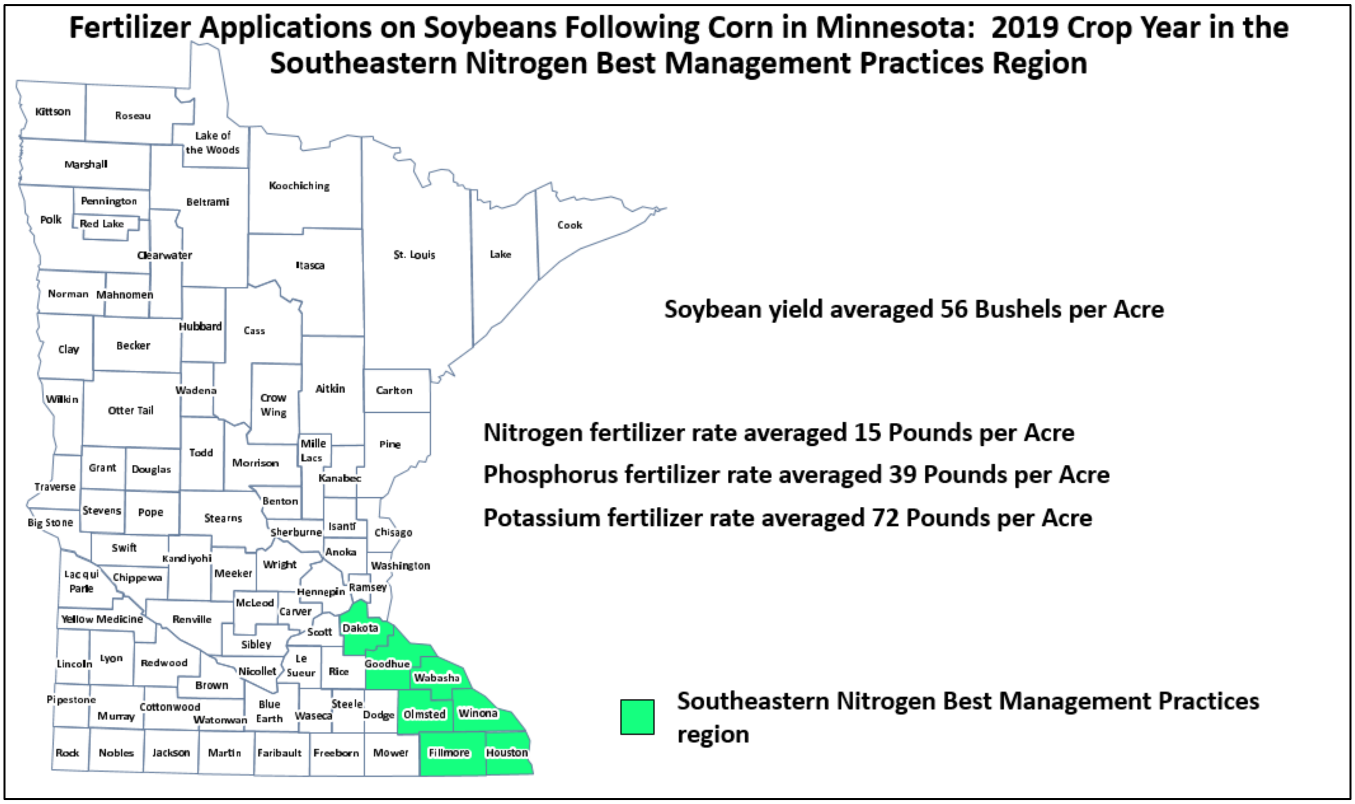

Figure 84. The average soybean yield and average fertilizer rate for soybeans following soybeans in the SE BMP region

[79] The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2019 soybean crop. Of the respondents that applied commercial fertilizer, 71% applied nitrogen, 71% applied phosphorus, and 98% applied potassium on fields with soybeans following corn. Less than five responses reported applying sulfur.

Figure 85 provides the distribution of nitrogen fertilizer rate in the SE BMP region for soybeans following corn; the corresponding soybean yields are detailed in red.[80] Nitrogen rates are only from commercial fertilizer.

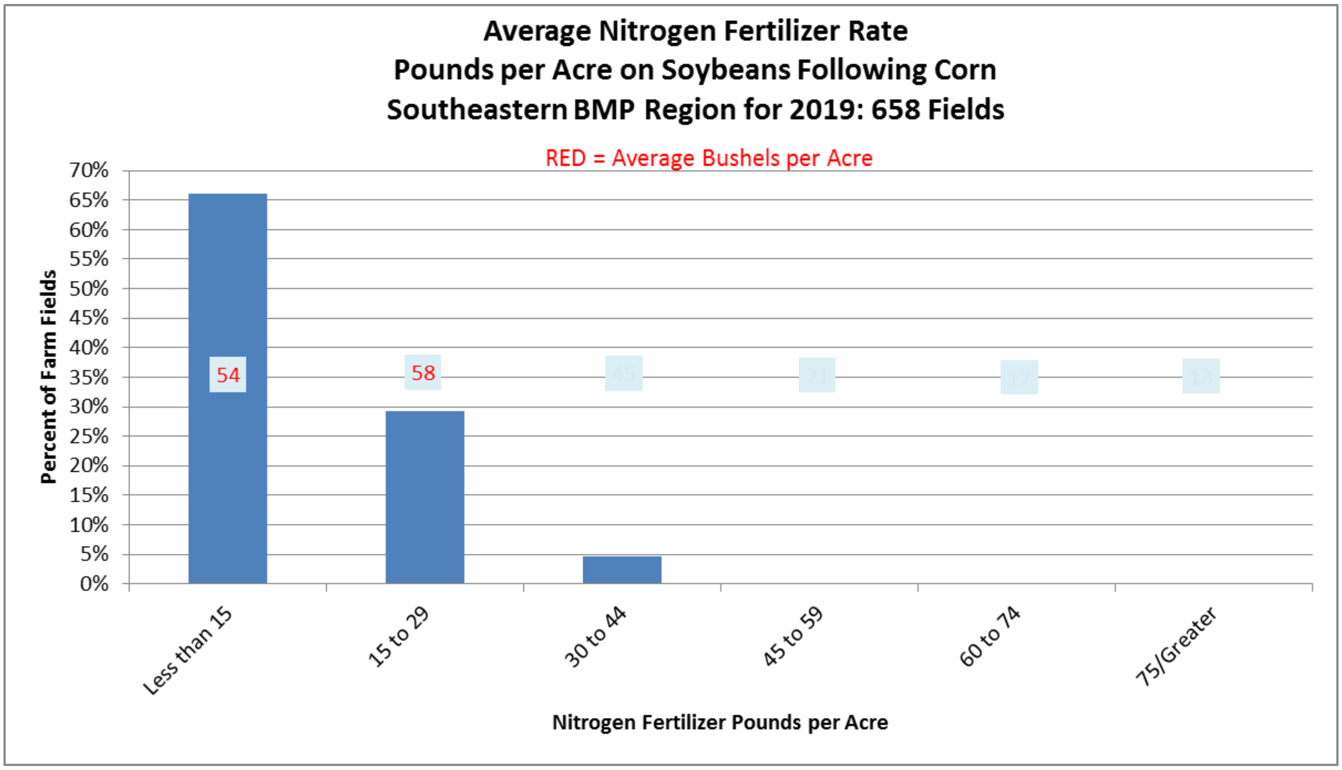

Figure 85. Average nitrogen fertilizer rate and yield on soybeans following corn in the SE BMP region for 2019: 658 fields

In the SE BMP region, the percent of fertilized soybean fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of soybeans following corn are shown in Table 190.

Table 190. Average fertilizer rate and yield in the SE BMP region for soybeans following corn

Nutrients Applied	Percent of Fertilized Soybean Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Soybean Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Soybean Fields Pounds per Acre
Nitrogen	71	15	56	11
Phosphorus	71	39	56	27
Potassium	98	72	56	71
Sulfur	**	**	**	**

** Less than five responses

[80] Yields are not published if there are less than five responses.

South Central BMP Region: Soybeans Following Corn

There were 1,057 fields that were represented in the SC BMP region for the soybeans following corn analysis. Figure 86 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for soybeans following soybeans in the SC BMP region.[81]

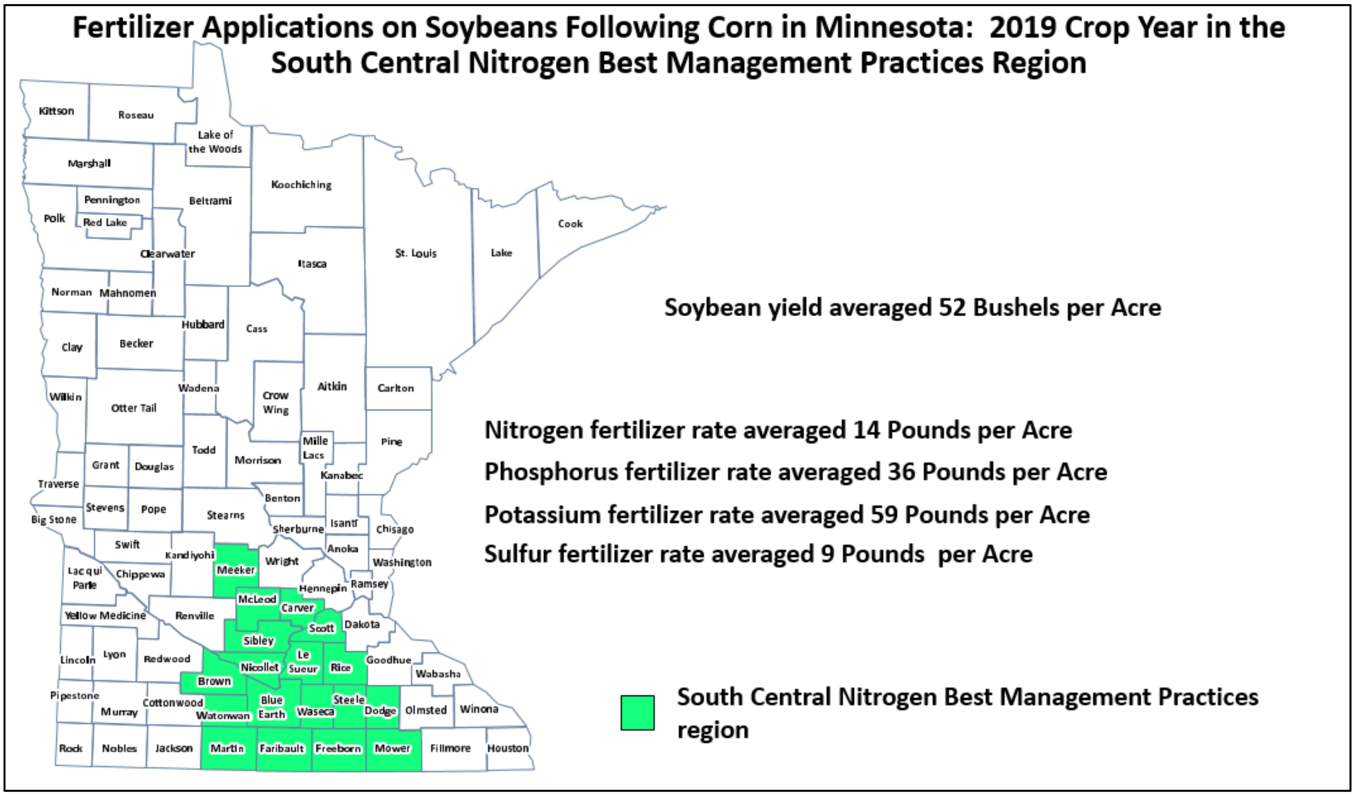

Figure 86. The average soybean yield and average fertilizer rate for soybeans following corn in the SC BMP region

[81] The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2019 soybean crop. Of the respondents that applied commercial fertilizer, 92% applied nitrogen, 86% applied phosphorus, 92% applied potassium, and 35% applied sulfur on fields with soybeans following corn.

Figure 87 provides the distribution of nitrogen fertilizer rate in the SC BMP region for soybeans following corn; the corresponding soybean yields are detailed in red.[82] Nitrogen rates are only from commercial fertilizer.

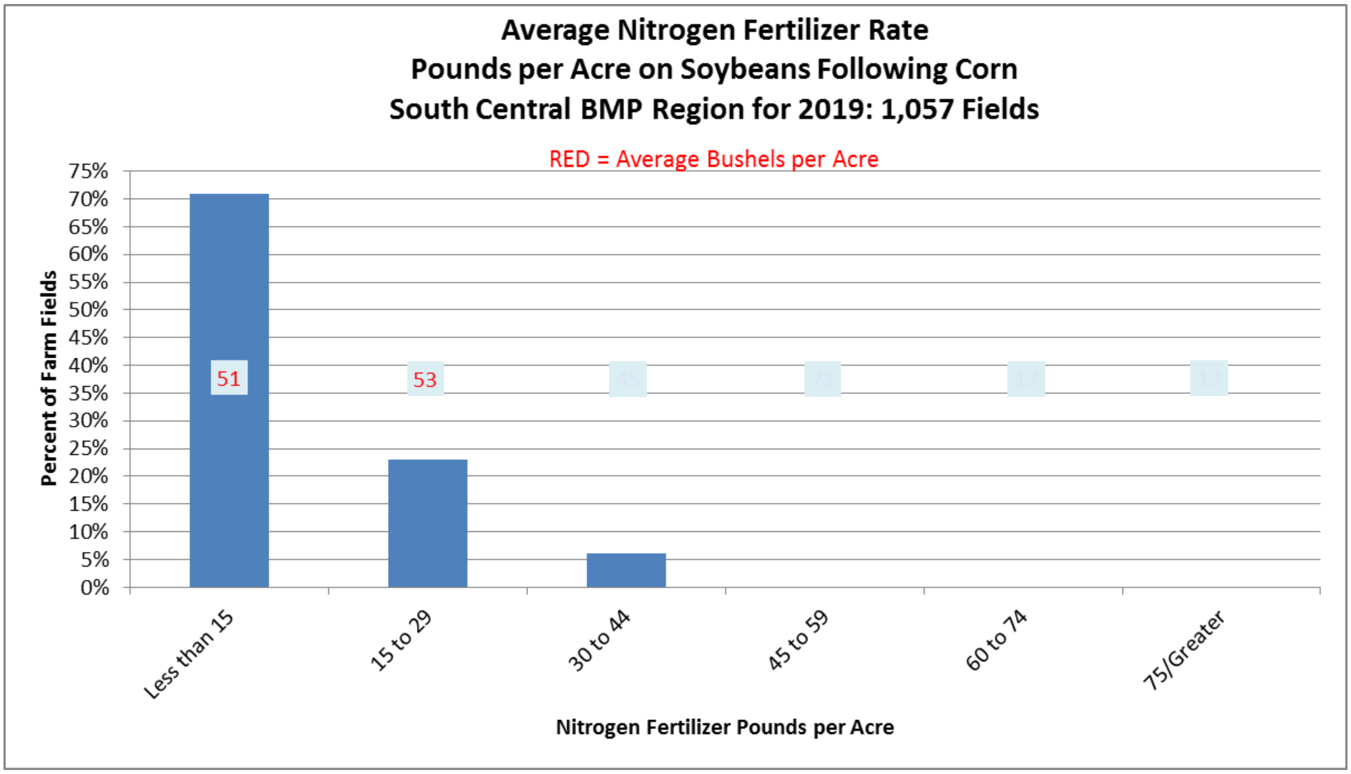

Figure 87. Average nitrogen fertilizer rate and yield on soybeans following corn in the SC BMP region for 2019: 1,057 fields

In the SC BMP region, the percent of fertilized soybean fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of soybeans following corn are shown in Table 191.

Table 191. Average fertilizer rate and yield in the SC BMP region for soybeans following corn

Nutrients Applied	Percent of Fertilized Soybean Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Soybean Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Soybean Fields Pounds per Acre
Nitrogen	92	14	52	13
Phosphorus	86	36	51	31
Potassium	92	56	52	51
Sulfur	35	9	55	3

[82] Yields are not published if there are less than five responses.

Southwestern and West Central BMP Region: Soybeans Following Corn

There were 1,233 fields that were represented in the SW BMP region for the soybeans following corn analysis. Figure 88 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for soybeans following soybeans in the SW BMP region.[83]

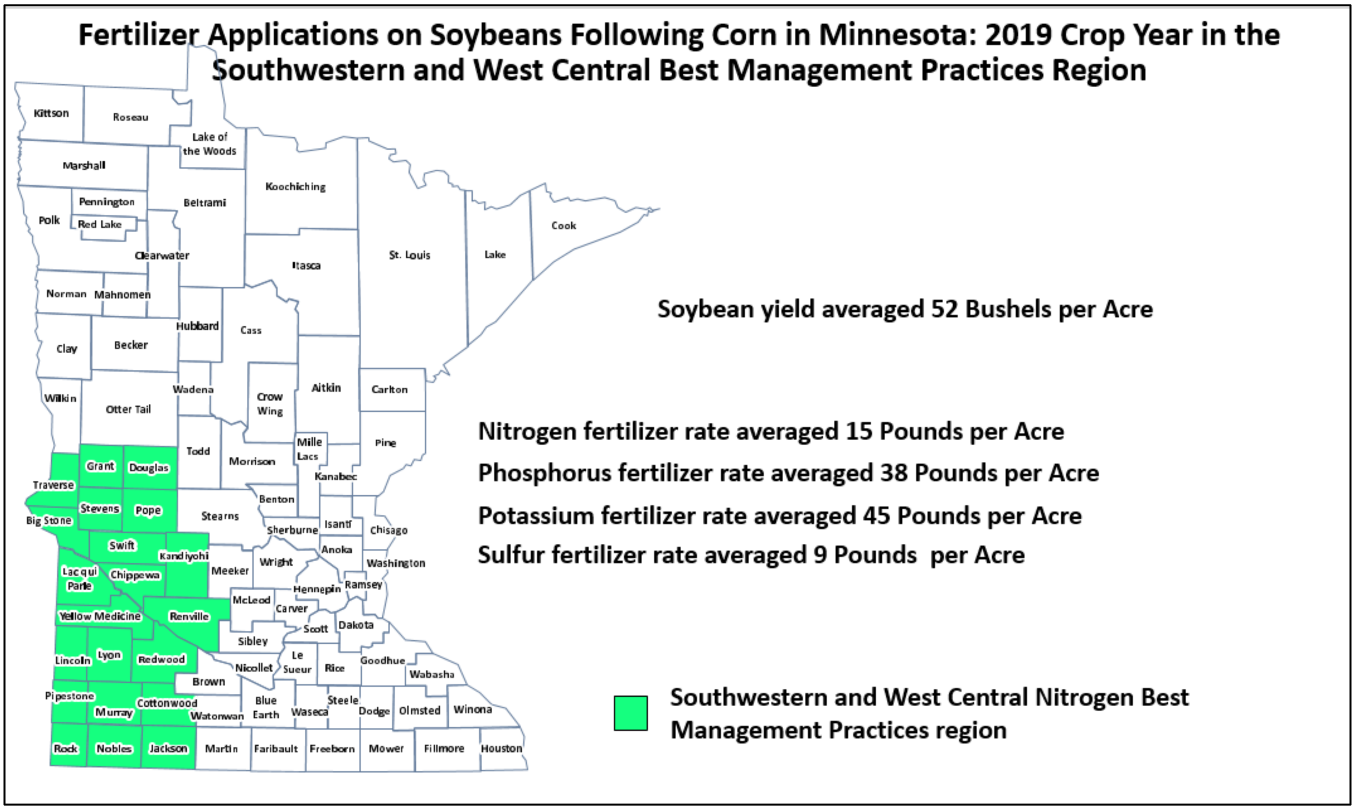

Figure 88. The average soybean yield and average fertilizer rate for soybeans following corn in the SW BMP region

[83] The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2019 soybean crop. Of the respondents that applied commercial fertilizer, 98% applied nitrogen, 95% applied phosphorus, 94% applied potassium, and 24% applied sulfur on fields with soybeans following corn.

Figure 89 provides the distribution of nitrogen fertilizer rate in the SW BMP region for soybeans following corn; the corresponding soybean yields are detailed in red.[84] Nitrogen rates are only from commercial fertilizer.

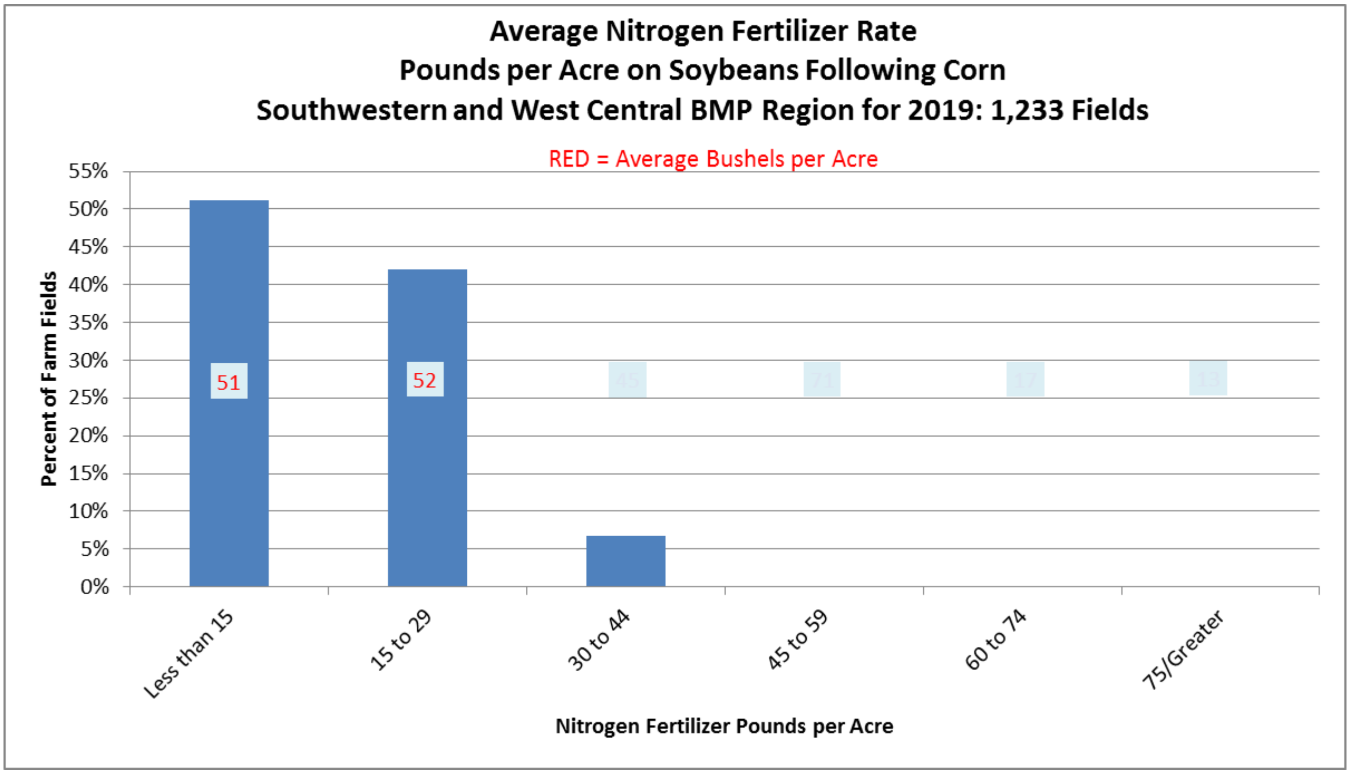

Figure 89. Average nitrogen fertilizer rate and yield on soybeans following corn in the SW BMP region for 2019: 1,233 fields

In the SW BMP region, the percent of fertilized soybean fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of soybeans following corn are shown in Table 192.

Table 192. Average fertilizer rate and yield in the SW BMP region for soybeans following corn

Nutrients Applied	Percent of Fertilized Soybean Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Soybean Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Soybean Fields Pounds per Acre
Nitrogen	98	15	51	14
Phosphorus	95	38	51	36
Potassium	94	45	52	43
Sulfur	24	9	50	2

[84] Yields are not published if there are less than five responses.

Northwestern BMP Region: Soybeans Following Corn

There were 217 fields that were represented in the NW BMP region for the soybeans following corn analysis. Figure 90 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for soybeans following soybeans in the NW BMP region.[85]

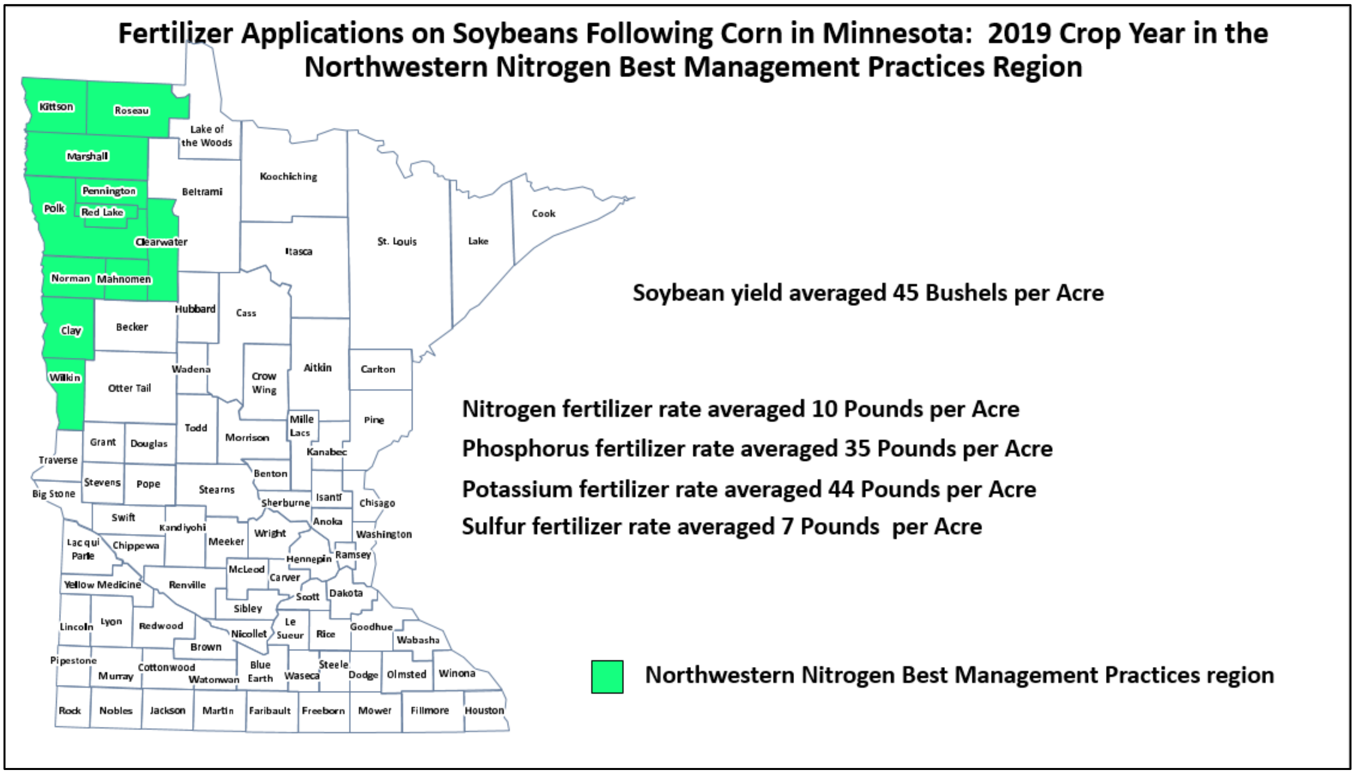

Figure 90. The average soybean yield and average fertilizer rate for soybeans following corn in the NW BMP region

[85] The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2019 soybean crop. Of the respondents that applied commercial fertilizer, 92% applied nitrogen, 92% applied phosphorus, 83% applied potassium, and 33% applied sulfur on fields with soybeans following corn.

Figure 91 provides the distribution of nitrogen fertilizer rate in the NW BMP region for soybeans following corn; the corresponding soybean yields are detailed in red.[86] Nitrogen rates are only from commercial fertilizer.

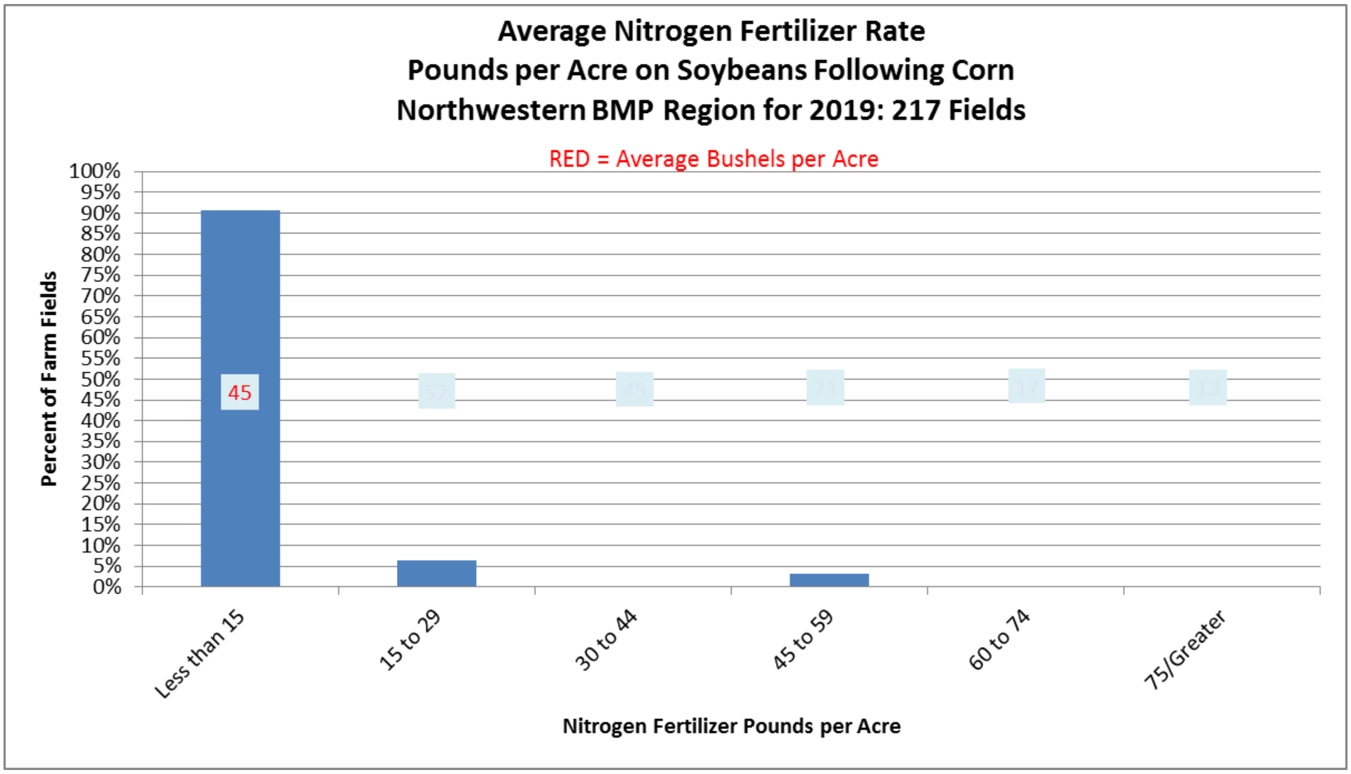

Figure 91. Average nitrogen fertilizer rate and yield on soybeans following corn in the NW BMP region for 2019: 217 fields

In the NW BMP region, the percent of fertilized soybean fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of soybeans following corn are shown in Table 193.

Table 193. Average fertilizer rate and yield in the NW BMP region for soybeans following corn

Nutrients Applied	Percent of Fertilized Soybean Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Soybean Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Soybean Fields Pounds per Acre
Nitrogen	92	10	45	9
Phosphorus	92	35	45	32
Potassium	83	44	45	36
Sulfur	33	7	47	2

[86] Yields are not published if there are less than five responses.

Irrigated and Non-irrigated Sandy Soils BMP Region: Soybeans Following Corn

There were 1,290 fields that were represented in the IRR BMP region for the soybeans following corn analysis. Figure 92 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for soybeans following soybeans in the IRR BMP region.[87]

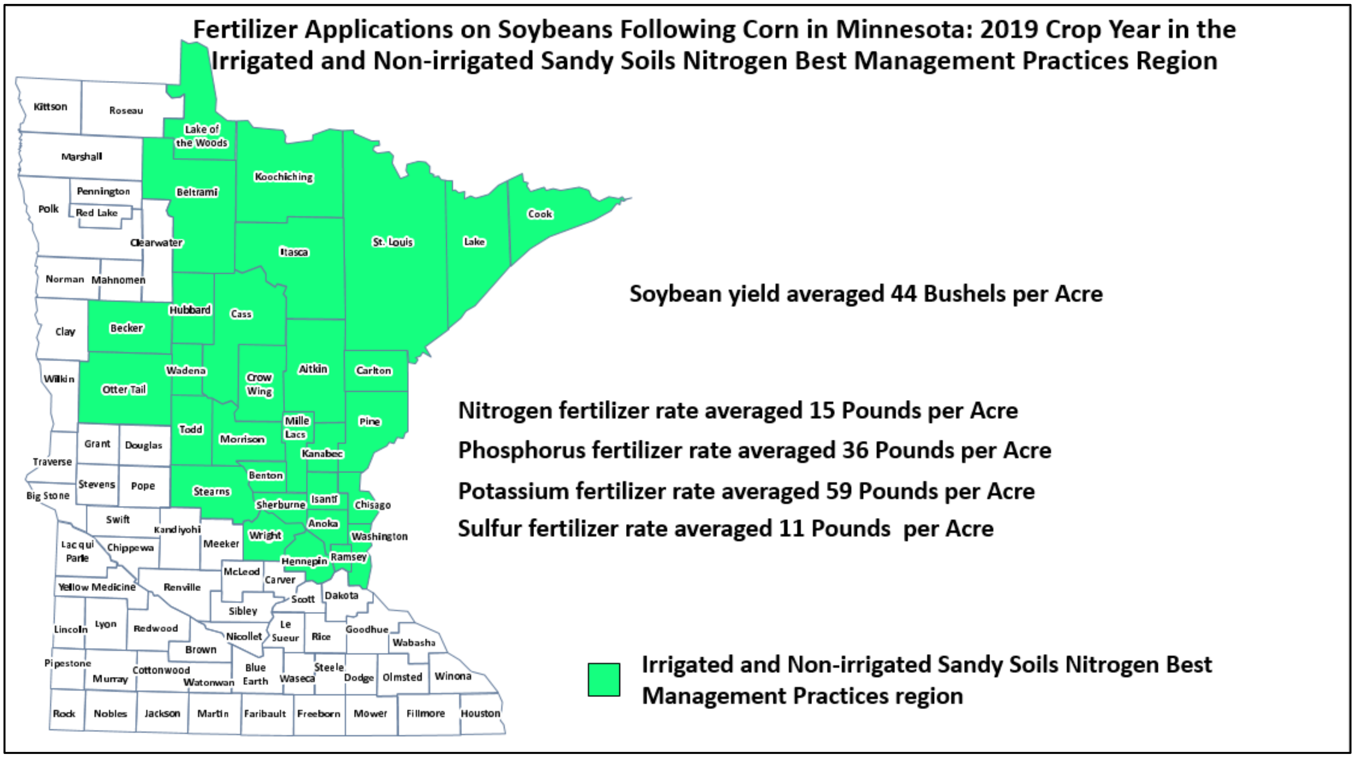

Figure 92. The average soybean yield and average fertilizer rate for soybeans following corn in the IRR BMP region

[87] The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2019 soybean crop. Of the respondents that applied commercial fertilizer, 83% applied nitrogen, 75% applied phosphorus, 98% applied potassium, and 34% applied sulfur on fields with soybeans following corn.

Figure 93 provides the distribution of nitrogen fertilizer rate in the IRR BMP region for soybeans following corn; the corresponding soybean yields are detailed in red.[88] Nitrogen rates are only from commercial fertilizer.

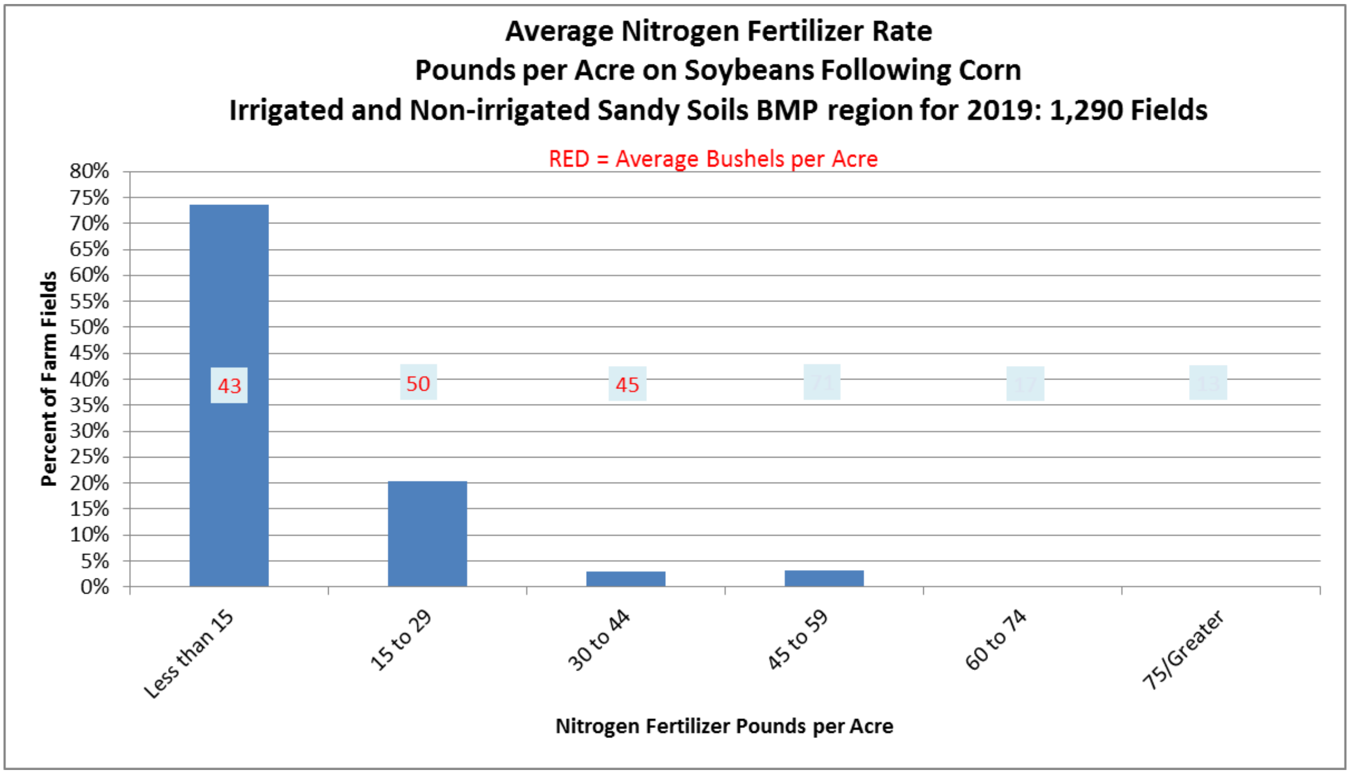

Figure 93. Average nitrogen fertilizer rate and yield on soybeans following corn in the IRR BMP region for 2019: 1,290 fields

In the IRR BMP region, the percent of fertilized soybean fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; corresponding yield; and the average nutrient rate across all fertilized fields of soybeans following corn are shown in Table 194.

Table 194. Average fertilizer rate and yield in the IRR BMP region for soybeans following corn

Nutrients Applied	Percent of Fertilized Soybean Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Soybean Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Soybean Fields Pounds per Acre
Nitrogen	83	15	45	13
Phosphorus	75	36	45	27
Potassium	98	59	44	58
Sulfur	34	11	43	4

[88] Yields are not published if there are less than five responses.

Statewide: Soybeans Following Alfalfa

Statewide, less than five responses had soybeans following alfalfa: therefore, no BMP region had five or more responses for reporting.

Statewide: Soybeans Following Small Grains

Statewide, eighteen percent of the fields reported were soybeans following small grains. Figure 94 details the BMP regions where farmers reported on fields with soybeans following small grains. There were 1,099 fields represented in Minnesota.[89]

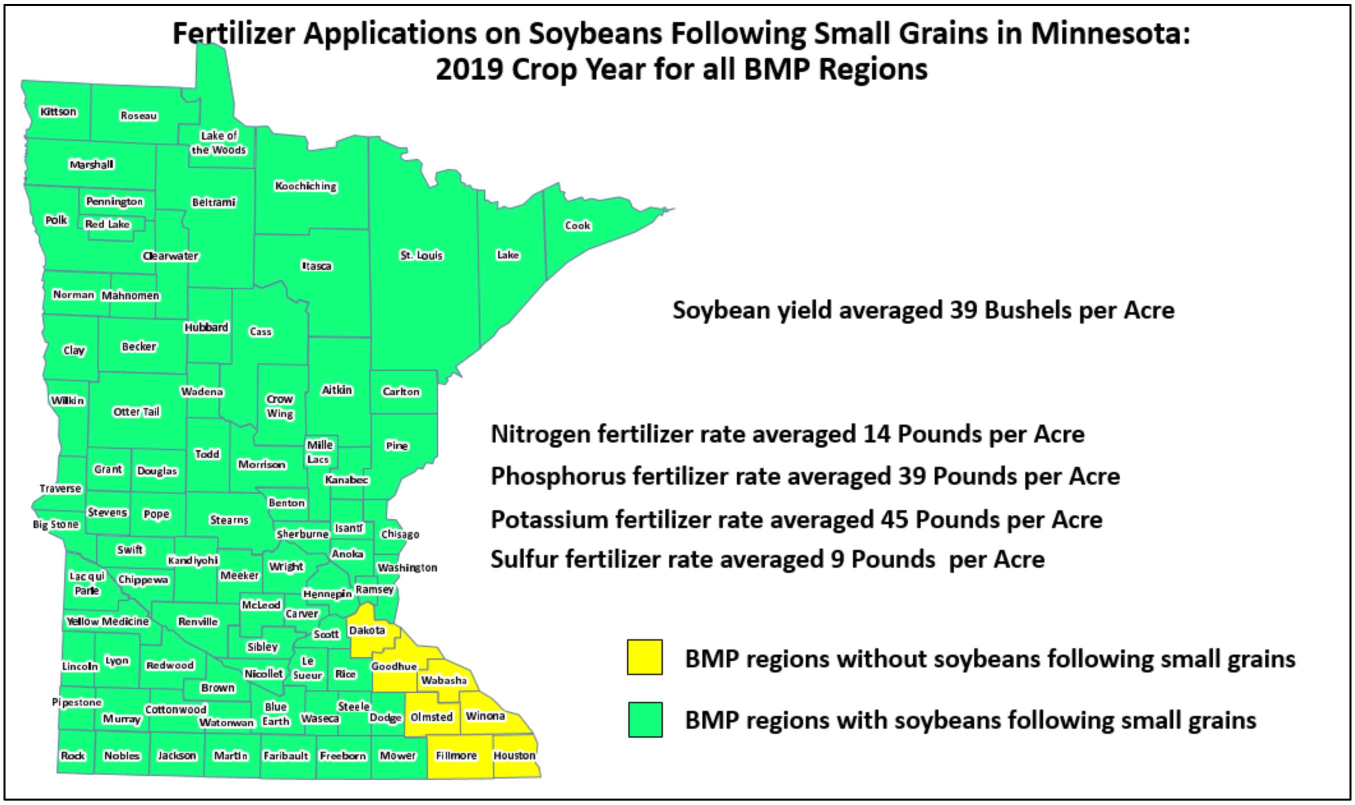

Figure 94. The average fertilizer rate for soybeans following small grains in Minnesota

[89] The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2019 soybean crop. Of the respondents that applied commercial fertilizer, 94% applied nitrogen, 91% applied phosphorus, 75% applied potassium, and 23% applied sulfur on fields with soybeans following small grains.

Figure 95 provides the distribution of average nitrogen fertilizer rate in Minnesota for soybeans following small grains. Nitrogen rates are only from commercial fertilizer.

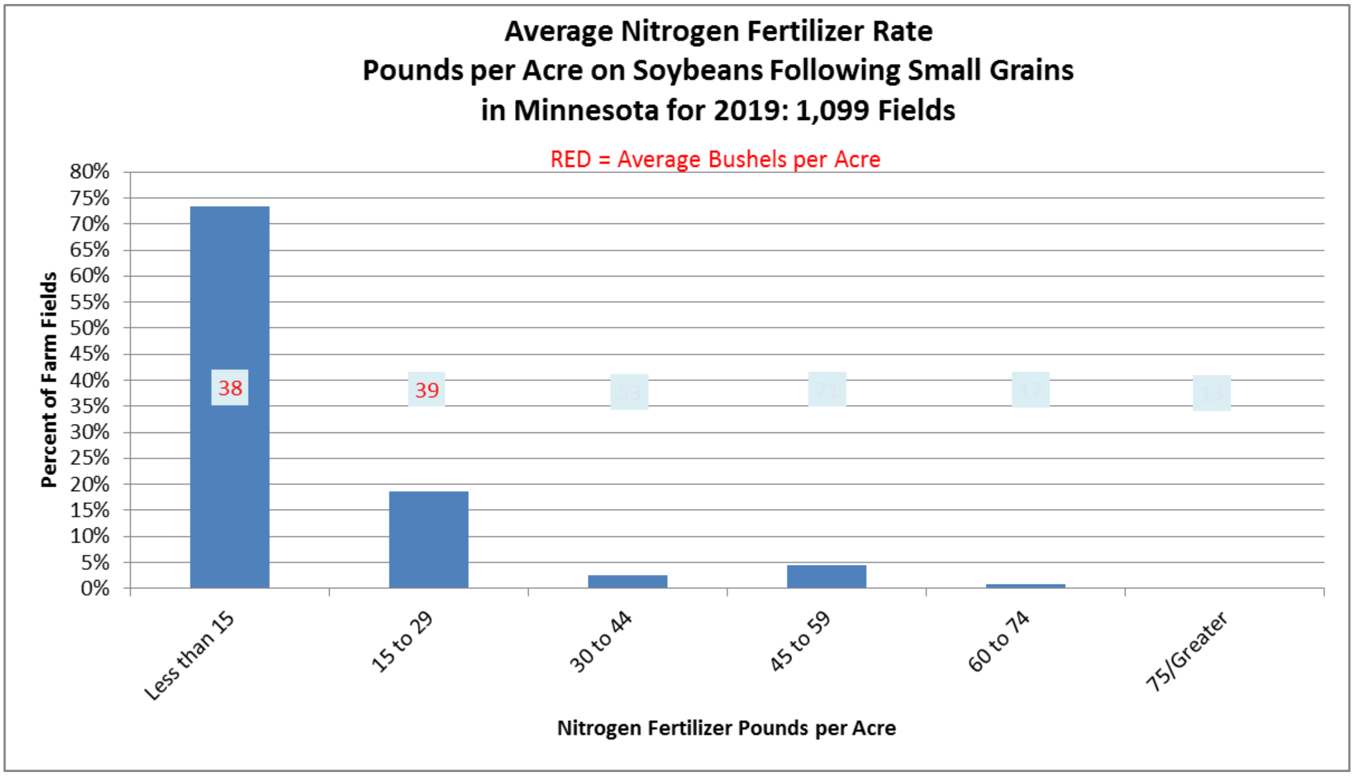

Figure 95. Average nitrogen fertilizer rate on soybeans following small grains in Minnesota for 2019: 1,099 fields

In Minnesota, the percent of fertilized soybean fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; and the average nutrient rate across all fertilized fields on soybeans following small grains are shown in Table 195.

Table 195. Average fertilizer rate in Minnesota for soybeans following small grains

Nutrients Applied	Percent of Fertilized Soybean Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Soybean Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Soybean Fields Pounds per Acre
Nitrogen	94	14	38	14
Phosphorus	91	39	38	35
Potassium	75	45	38	33
Sulfur	23	9	41	2

Southeastern BMP Region: Soybeans Following Small Grains

The SE BMP region had no responses for soybeans following small grains.

South Central BMP Region: Soybeans Following Small Grains

The SC BMP region had less than five responses for soybeans following small grains.

Southwest and West Central BMP Region: Soybeans Following Small Grains

The SW BMP region had less than five responses for soybeans following small grains.

Northwestern BMP Region: Soybeans Following Small Grains

There were 922 fields that were represented in the NW BMP region for soybeans following small grains analysis. Figure 96 details the location, average rate of nitrogen, phosphorus, potassium, and sulfur fertilizer for soybeans following small grains in the NW BMP region.[90]

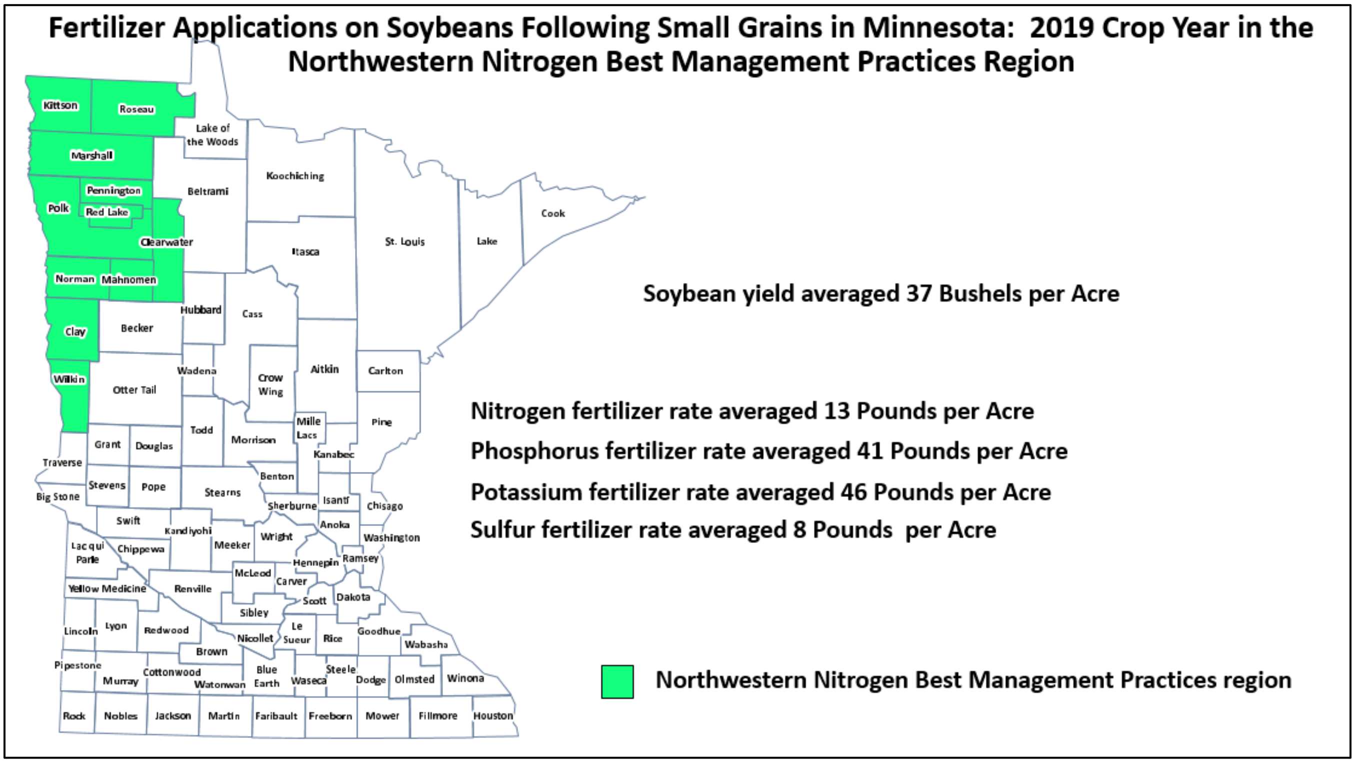

Figure 96. The average fertilizer rate for soybeans following small grains in the NW BMP region

[90] The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2019 soybean crop. Of the respondents that applied commercial fertilizer, 94% applied nitrogen, 92% applied phosphorus, 73% applied potassium, and 20% applied sulfur on fields with soybeans following small grains.

Figure 97 provides the distribution of average nitrogen fertilizer rate in the NW BMP region for soybeans following small grains. Nitrogen rates are only from commercial fertilizer.

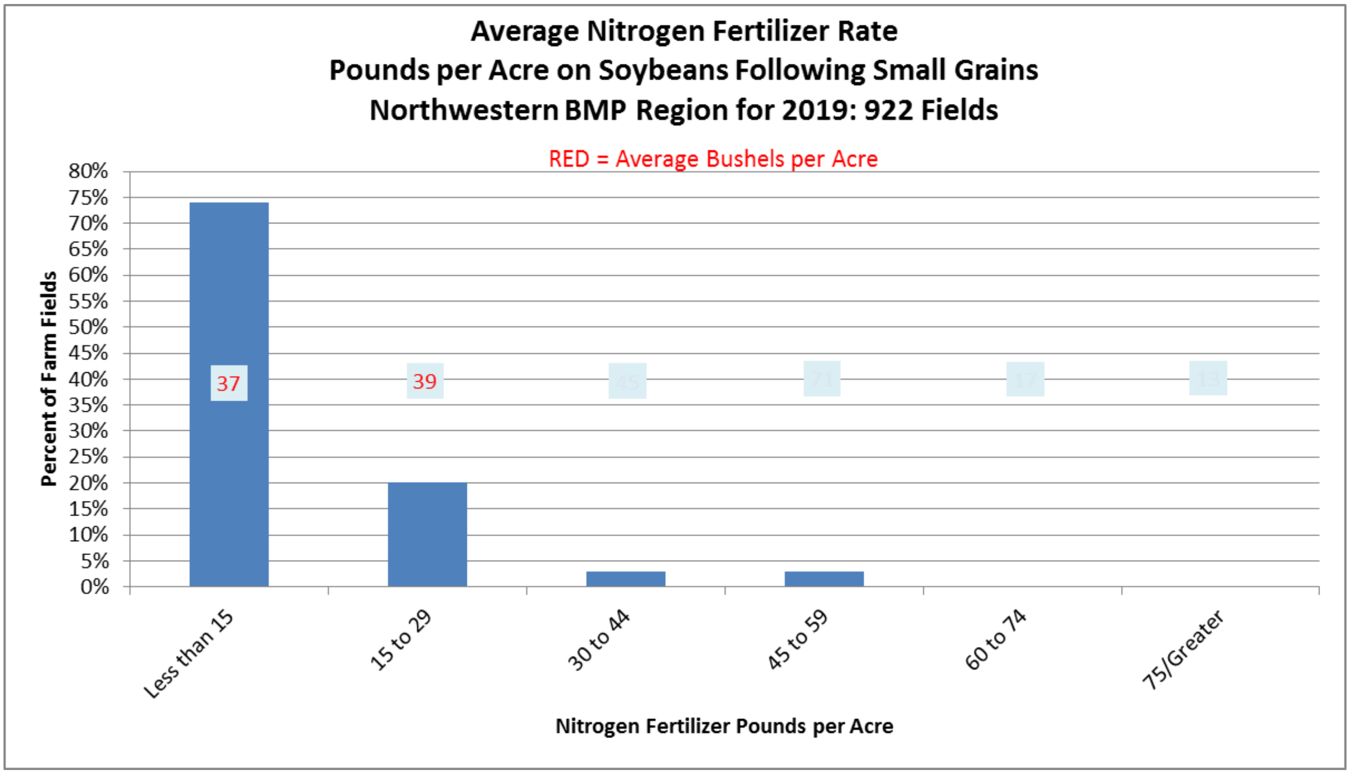

Figure 97. Average nitrogen fertilizer rate on soybeans following small grains in the NW BMP region for 2019: 922 fields

In the NW BMP region, the percent of fertilized soybeans fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; and the average nutrient rate across all fertilized fields of soybeans following small grains are shown in Table 196.

Table 196. Average fertilizer rate in the NW BMP region for soybeans following small grains

Nutrients Applied	Percent of Fertilized Soybean Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Soybean Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Soybean Fields Pounds per Acre
Nitrogen	94	13	37	12
Phosphorus	92	41	37	37
Potassium	73	46	37	33
Sulfur	20	8	39	2

Irrigated and Non-irrigated Sandy Soils BMP Region: Soybeans Following Small Grains

There were 94 fields that were represented in the IRR BMP region for soybeans following small grains analysis. Figure 98 details the location, average rate of nitrogen, phosphorus, potassium, and sulfur fertilizer for soybeans following small grains in the IRR BMP region.[91]

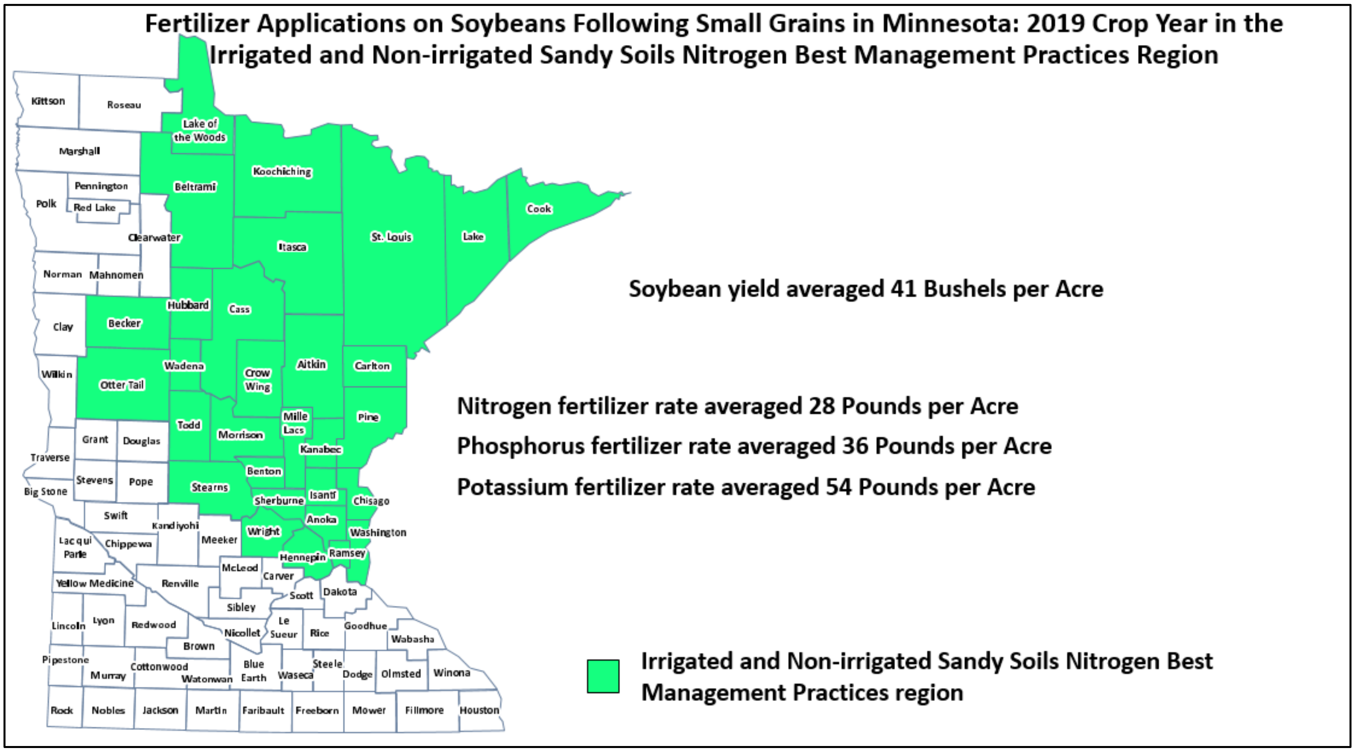

Figure 98. The average fertilizer rate for soybeans following small grains in the IRR BMP region

[91] The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2019 soybean crop. Of the respondents that applied commercial fertilizer, 90% applied nitrogen, 90% applied phosphorus, and 89% applied potassium on fields with soybeans following small grains. Less than five respondents reported applying sulfur.

Figure 99 provides the distribution of average nitrogen fertilizer rate in the IRR BMP region for soybeans following small grains. Nitrogen rates are only from commercial fertilizer.

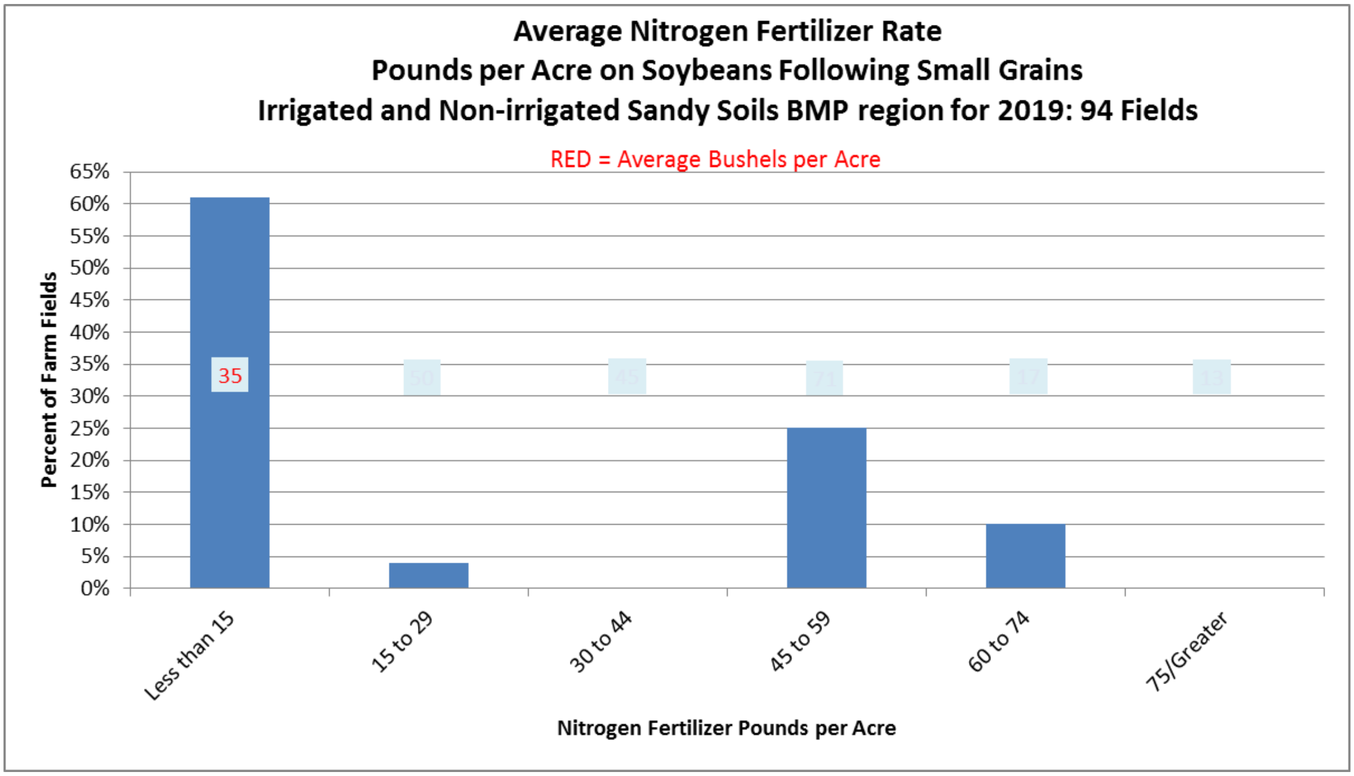

Figure 99. Average nitrogen fertilizer rate on soybeans following small grains in the IRR BMP region for 2019: 94 fields

In the IRR BMP region, the percent of fertilized soybeans fields that had commercial fertilizer applied with nitrogen, phosphorus, potassium, or sulfur; pounds per acre of actual nutrients; and the average nutrient rate across all fertilized fields of soybeans following small grains are shown in Table 197.

Table 197. Average fertilizer rate in the IRR BMP region for soybeans following small grains

Nutrients Applied	Percent of Fertilized Soybean Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Soybean Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Soybean Fields Pounds per Acre
Nitrogen	90	28	45	25
Phosphorus	90	36	41	32
Potassium	89	54	41	48
Sulfur	**	**	**	**

** Less than five responses

Statewide: Soybeans Following Other Crops

Statewide, less than five responses had soybeans following other crops: therefore, no BMP region had five or more responses for reporting.

Manure Applications and Management on Corn and Soybeans

2019 Manure Use Practices Summary and Highlights

Manure is a valuable source of nitrogen (and other nutrients) for Minnesota farmers. The primary purpose of this portion of the survey was to obtain an understanding of basic manure management practices associated with corn and soybean production.

This report summarized statistically weighted survey results for a number of important practices associated with manure use on Minnesota's 2019 corn and soybean acres. There were 10,415 represented corn producers with 2,935,103 acres and 1,456 represented soybean producers with 153,930 manured acres, totaling 3,089,033 acres were analyzed in this report.[92]

[92] There were 481 corn producers with 124,685 acres and 68 soybean producers with 7,223 acres participated in the manure portion of the survey.

Data Reporting and Limitations

The primary purpose of this survey was to obtain an understanding of manure management practices used by Minnesota corn and soybean farmers.

Due to the simplified method used to collect what is typically considered complex data, it is imperative that the reader understand the limitations of the data sets. Farmers that grew corn or soybeans 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 statistical weight to each operation based standard protocol for NASS, data can better represent all Minnesota farmers with these two crops.

The NASS developed a sampling population of 7,600 farms by randomly drawing from its entire database of all corn and soybean producers in Minnesota. There were 549 respondents that were statistically weighted to represent 11,871 farmers that applied manure sometime between the fall of 2018 and the spring of 2019 for the 2019 growing season. All corn and soybean growers were asked basic questions regarding manure use and management.

Statewide Manure Applications and Management on Corn

Information on manure management was gathered on the operator's largest corn field for the 2019 growing season. Information about management on all corn acres was not collected in this section of the survey. Manure applications on crops other than corn were not collected in this section of the survey. Typically, in Minnesota, a large proportion of manure is applied for the corn crop. Manure is generally applied after the previous crop is harvested and before a corn crop is planted, usually in the fall or spring. Manure information was collected at the same time as pesticide and commercial nitrogen fertilizer information during the survey, thus limiting the amount of information that could be gathered due to time constraints for the respondent. If manure was not used, then the survey was concluded.

Participants who grew corn were asked if they had a corn field that was applied with manure. If yes, they were then asked the acreage of their largest corn field applied with manure, the average yield of the corn field during the past three corn crops, and if the whole field was applied with manure.

Table 198 details the BMP regions where the total number represented corn acres were planted for the 2019 corn crop by farmers who applied manure to their fields (CMQ- 1 and CMQ-4). All fields that had corn planted in 2019 without manure are excluded from the following analysis.

Table 198. Summary of respondents and corresponding corn acres applied with manure by BMP region for the 2019 crop year

BMP Region	Number of Respondents	Number of Corn Acres Applied with at Least Some Manure[93]
Northwest	309	55,649
Irrigated and Non-irrigated Sandy Soils	2,967	366,725
Southwestern and West Central	2,879	1,189,879
South Central	2,547	922,799
Southeastern	1,714	400,051
Statewide	**10,415**	**2,935,103**

[93] The survey questions asked about the farmer's manure applications on their largest field. Manure applications may have been applied to multiple fields, but the survey did not ask about the total number of manured acres.

Table 199 details the number of represented operations that had at least one field with manure applied for the 2019 corn crop (CMQ-1).

Table 199. Percent of respondents that applied manure on their corn acres

BMP Region	Corn Field Applied with Manure	Percent of Respondents
Northwest	Yes	23
Northwest	No	77
Irrigated and Non-irrigated Sandy Soils	Yes	50
Irrigated and Non-irrigated Sandy Soils	No	50
Southwestern and West Central	Yes	35
Southwestern and West Central	No	65
South Central	Yes	34
South Central	No	66
Southeastern	Yes	50
Southeastern	No	50
Statewide	**Yes**	**40**
Statewide	**No**	**60**

Table 200 details the previous crop planted before the 2019 corn crop by BMP region and the corresponding corn yield over the last three corn crops (CMQ-2, CMQ-3, and CMQ-5).

Table 200. Percent of corn acres by previous crop and the corresponding yields in manured fields

BMP Region	Previous Crop	Percent of Manured Fields	Average Corn Yield Bushels per Acre
Northwest	Soybeans	41	147
Northwest	Corn	25	111
Northwest	Corn/Alfalfa	6	129
Northwest	Alfalfa	9	153
Northwest	Small Grains	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	33	170
Irrigated and Non-irrigated Sandy Soils	Corn	26	161
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	23	158
Irrigated and Non-irrigated Sandy Soils	Alfalfa	8	135
Irrigated and Non-irrigated Sandy Soils	Small Grains	5	137
Irrigated and Non-irrigated Sandy Soils	Other	5	132
Southwestern and West Central	Soybeans	59	186
Southwestern and West Central	Corn	23	183
Southwestern and West Central	Corn/Alfalfa	6	179
Southwestern and West Central	Alfalfa	5	158
Southwestern and West Central	Small Grains	5	176
Southwestern and West Central	Other	**	**
South Central	Soybeans	58	192
South Central	Corn	24	185
South Central	Corn/Alfalfa	7	154
South Central	Alfalfa	**	**
South Central	Small Grains	4	148
South Central	Other	**	**
Southeastern	Soybeans	40	204
Southeastern	Corn	32	187
Southeastern	Corn/Alfalfa	11	147
Southeastern	Alfalfa	8	164
Southeastern	Small Grains	**	**
Southeastern	Other	**	**
Statewide	**Soybeans**	**44**	**186**
Statewide	**Corn**	**27**	**176**
Statewide	**Corn/Alfalfa**	**11**	**158**
Statewide	**Alfalfa**	**7**	**149**
Statewide	**Small Grains**	**7**	**155**
Statewide	**Other**	**4**	**150**

** Less than five responses

Table 201 details average corn field size where manure is applied, average yield over the last three corn crops, and percent of fields with complete manure coverage. Fields without manure were excluded from this analysis (CMQ-4, CMQ-5, and CMQ-6). The average corn yield represents all corn fields that had complete manure coverage for the 2019 corn crop.

Table 201. Acres of the average corn field by BMP region, average yield over the last three corn crops for corn fields with 100 percent manure coverage and percent of corn fields with complete manure coverage

BMP Region	Average Size of Corn Field in Acres	Average Corn Yield Bushels per Acre	Percent of Largest Manured Fields with Complete Manure Coverage
Northwest	35	136	76
Irrigated and Non-irrigated Sandy Soils	36	161	82
Southwestern and West Central	95	184	87
South Central	82	185	80
Southeastern	30	183	87
Statewide	**63**	**177**	**84**

Table 202 details all corn fields with manure or with manure and commercial nitrogen fertilizer and average yield for the last three corn crops regardless of the percent of manure coverage on the corn field for the 2019 corn crop. (CMQ-5).

Table 202. Average corn yield over the last three corn crops on corn fields applied with manure or manure and commercial nitrogen fertilizer

BMP Region	Average Corn Yield Bushels per Acre
Northwest	141
Irrigated and Non-irrigated Sandy Soils	158
Southwestern and West Central	183
South Central	184
Southeastern	184
Statewide	**175**

Table 203 details the main source of manure applied on the corn field for the 2019 corn crop (CMQ-7).

Table 203. The main source of manure applied to the corn field by livestock type

BMP Region	Main Source of Manure	Percent of Respondents
Northwest	Dairy	13
Northwest	Beef	74
Northwest	Hog	**
Northwest	Other	**
Irrigated and Non-irrigated Sandy Soils	Dairy	41
Irrigated and Non-irrigated Sandy Soils	Beef	44
Irrigated and Non-irrigated Sandy Soils	Hog	**
Irrigated and Non-irrigated Sandy Soils	Poultry	10
Irrigated and Non-irrigated Sandy Soils	Other	1
Southwestern and West Central	Dairy	17
Southwestern and West Central	Beef	43
Southwestern and West Central	Hog	31
Southwestern and West Central	Poultry	6
Southwestern and West Central	Other	**
South Central	Dairy	24
South Central	Beef	24
South Central	Hog	40
South Central	Poultry	12
South Central	Other	**
Southeastern	Dairy	40
Southeastern	Beef	50
Southeastern	Hog	**
Southeastern	Other	**
Southeastern	Don't Know	**
Statewide	**Dairy**	**29**
Statewide	**Beef**	**41**
Statewide	**Hog**	**20**
Statewide	**Poultry**	**7**
Statewide	**Other**	**2**
Statewide	**Don’t know**	**

** Less than five responses

Table 204 details the main consistency of manure applied on the corn field was liquid or solid for the 2019 corn crop (CMQ-8).

Table 204. The main consistency of manure applied to the corn field was liquid or solid

BMP Region	Main Consistency of Manure	Percent of Respondents
Northwest	Solid	89
Northwest	Liquid	11
Irrigated and Non-irrigated Sandy Soils	Solid	67
Irrigated and Non-irrigated Sandy Soils	Liquid	33
Southwestern and West Central	Solid	58
Southwestern and West Central	Liquid	42
South Central	Solid	49
South Central	Liquid	51
Southeastern	Solid	74
Southeastern	Liquid	26
Statewide	**Solid**	**62**
Statewide	**Liquid**	**38**

Table 205 details the average rate of liquid manure applied in gallons per acre (CMQ-8A).

Table 205. Average manure application rate on corn fields applied with liquid manure

BMP Region	Average Manure Application Rate Gallons per Acre
Northwest	**
Irrigated and Non-irrigated Sandy Soils	7,795
Southwestern and West Central	5,165
South Central	4,558
Southeastern	6,475
Statewide	**5,778**

**Less than five responses

Table 206 details the average rate of solid manure applied in tons per acre (CMQ-8B).

Table 206. Average manure application rate on corn fields applied with solid manure

BMP Region	Average Manure Application Rate Tons per Acre
Northwest	5.52
Irrigated and Non-irrigated Sandy Soils	4.54
Southwestern and West Central	6.11
South Central	4.86
Southeastern	4.75
Statewide	**5.13**

Table 207 details the percent of respondents that applied manure on a specific date as to when the manure was applied in regards to the general season (CMQ-9).

Table 207. Seasonal timing for corn fields applied with manure on a specific date

BMP Region	Approximate Date of the Manure Application	Percent of Respondents
Northwest	All Year	3
Northwest	Summer 2018	2
Northwest	Fall 2018	65
Northwest	Winter 2018	2
Northwest	Spring 2019	28
Irrigated and Non-irrigated Sandy Soils	All Year	2
Irrigated and Non-irrigated Sandy Soils	Summer 2018	1
Irrigated and Non-irrigated Sandy Soils	Fall 2018	39
Irrigated and Non-irrigated Sandy Soils	Winter 2018	11
Irrigated and Non-irrigated Sandy Soils	Spring 2019	47
Southwestern and West Central	Summer 2018	1
Southwestern and West Central	Fall 2018	67
Southwestern and West Central	Winter 2018	10
Southwestern and West Central	Spring 2019	22
South Central	Summer 2018	3
South Central	Fall 2018	75
South Central	Winter 2018	7
South Central	Spring 2019	15
Southeastern	Fall 2018	52
Southeastern	Winter 2018	12
Southeastern	Spring 2019	36
Statewide	**All Year**	**1**
Statewide	**Summer 2018**	**1**
Statewide	**Fall 2018**	**58**
Statewide	**Winter 2018**	**10**
Statewide	**Spring 2019**	**30**

Table 208 details the average amount of nitrogen applied per acre by type of livestock manure when the farmer knew the amount of nitrogen in the manure applied (CMQ-7 and CMQ-10).

Table 208. Average amount of nitrogen applied per acre from manure by livestock type when the farmer knew the amount of nitrogen in the manure source

BMP Region	Animal Type	Average Nitrogen Rate Applied from Manure in Pounds per Acre
Northwest	All	100
Northwest	Dairy	**
Northwest	Beef	89
Northwest	Hog	**
Northwest	Other	**
Irrigated and Non-irrigated Sandy Soils	All	127
Irrigated and Non-irrigated Sandy Soils	Dairy	141
Irrigated and Non-irrigated Sandy Soils	Beef	94
Irrigated and Non-irrigated Sandy Soils	Hog	**
Irrigated and Non-irrigated Sandy Soils	Poultry	119
Southwestern and West Central	All	119
Southwestern and West Central	Dairy	132
Southwestern and West Central	Beef	104
Southwestern and West Central	Hog	124
Southwestern and West Central	Poultry	136
Southwestern and West Central	Other	**
South Central	All	104
South Central	Dairy	96
South Central	Beef	65
South Central	Hog	129
South Central	Poultry	71
Southeastern	All	105
Southeastern	Dairy	106
Southeastern	Beef	77
Southeastern	Hog	**
Southeastern	Don't Know	**
Statewide	**All**	**114**
Statewide	**Dairy**	**121**
Statewide	**Beef**	**89**
Statewide	**Hog**	**130**
Statewide	**Poultry**	**103**
Statewide	**Other**	**
Statewide	**Don't Know**	**

** Less than five responses

Average Nitrogen Rate from Manure Applications

Figure 100 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure[94] regardless of whether additional commercial nitrogen fertilizer was applied to the largest corn field. The rates do not include nitrogen from additional commercial nitrogen fertilizer applied to the 2019 corn crop (CMQ-7 and CMQ-10).

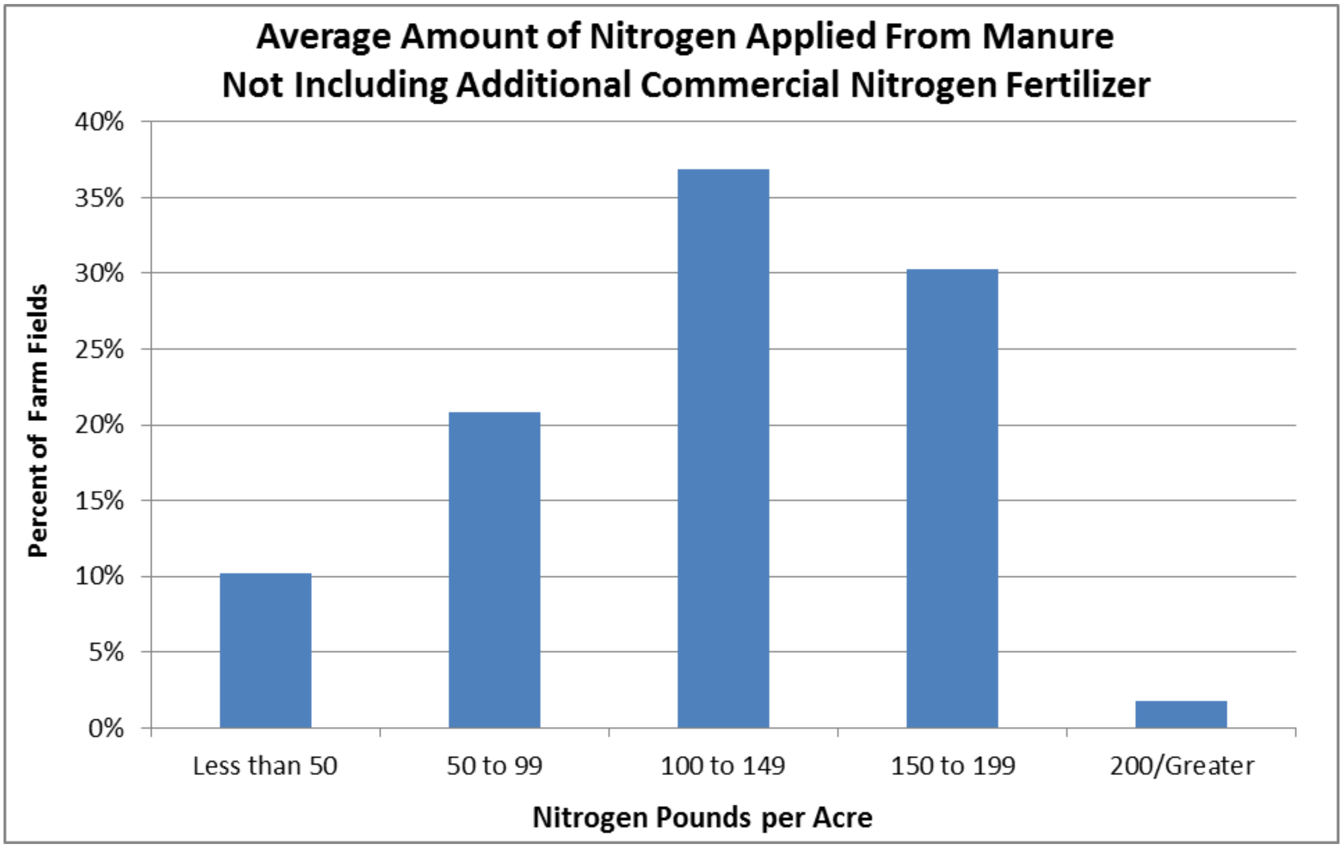

Figure 100. Average nitrogen rates applied to fields from manure and does not include additional commercial nitrogen fertilizer in Minnesota for 2019: 6,314 fields

[94] Manure is from all manure sources

Figure 101 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure regardless of whether additional commercial nitrogen fertilizer was applied to the largest corn field. The rates do not include nitrogen from additional commercial nitrogen fertilizer applied to the 2019 corn crop (CMQ-7 and CMQ-10).

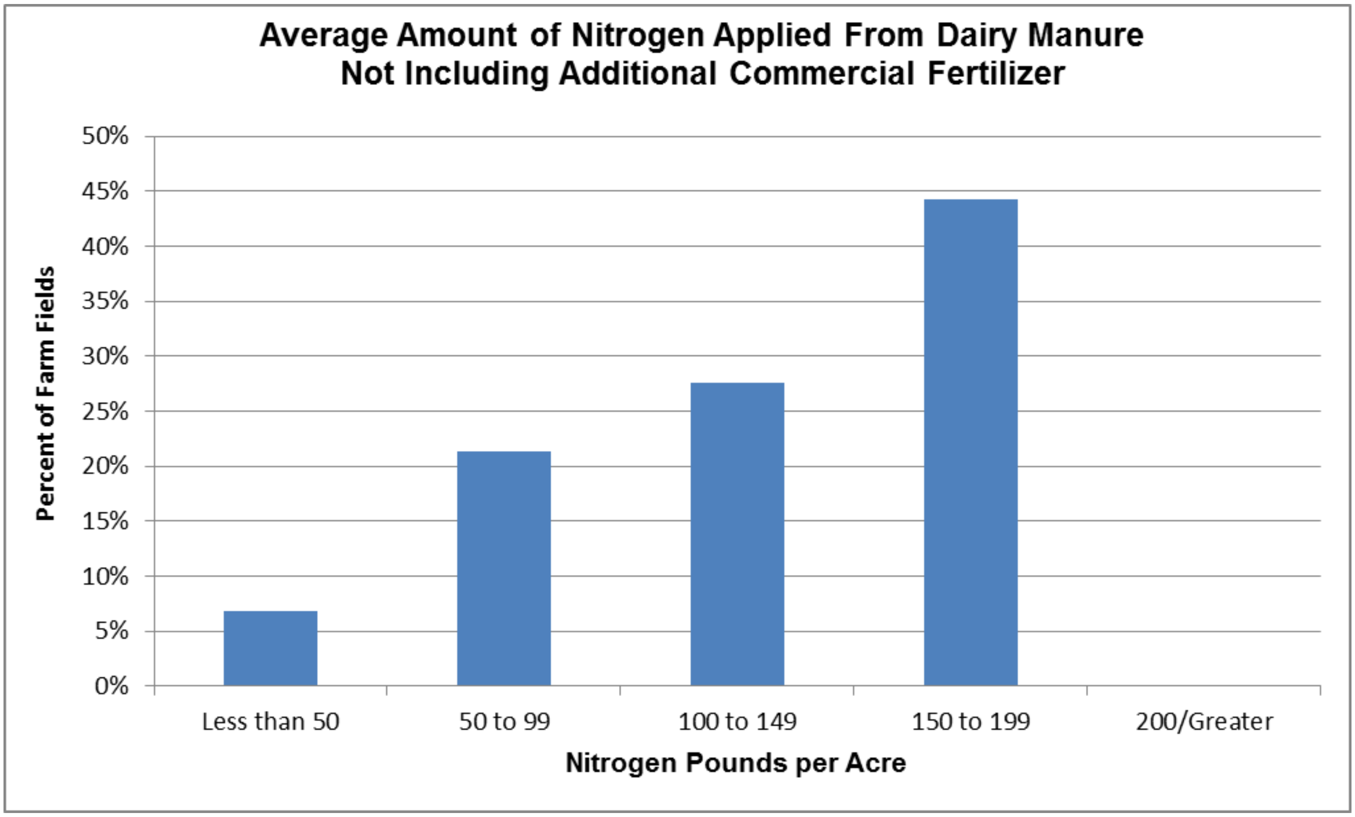

Figure 101. Average nitrogen rates applied to fields from dairy manure and does not include additional commercial nitrogen fertilizer in Minnesota for 2019: 2,171 fields

Figure 102 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure regardless of whether additional commercial nitrogen fertilizer was applied to the largest corn field. The rates do not include nitrogen from additional commercial nitrogen fertilizer applied to the 2019 corn crop (CMQ-7 and CMQ-10).

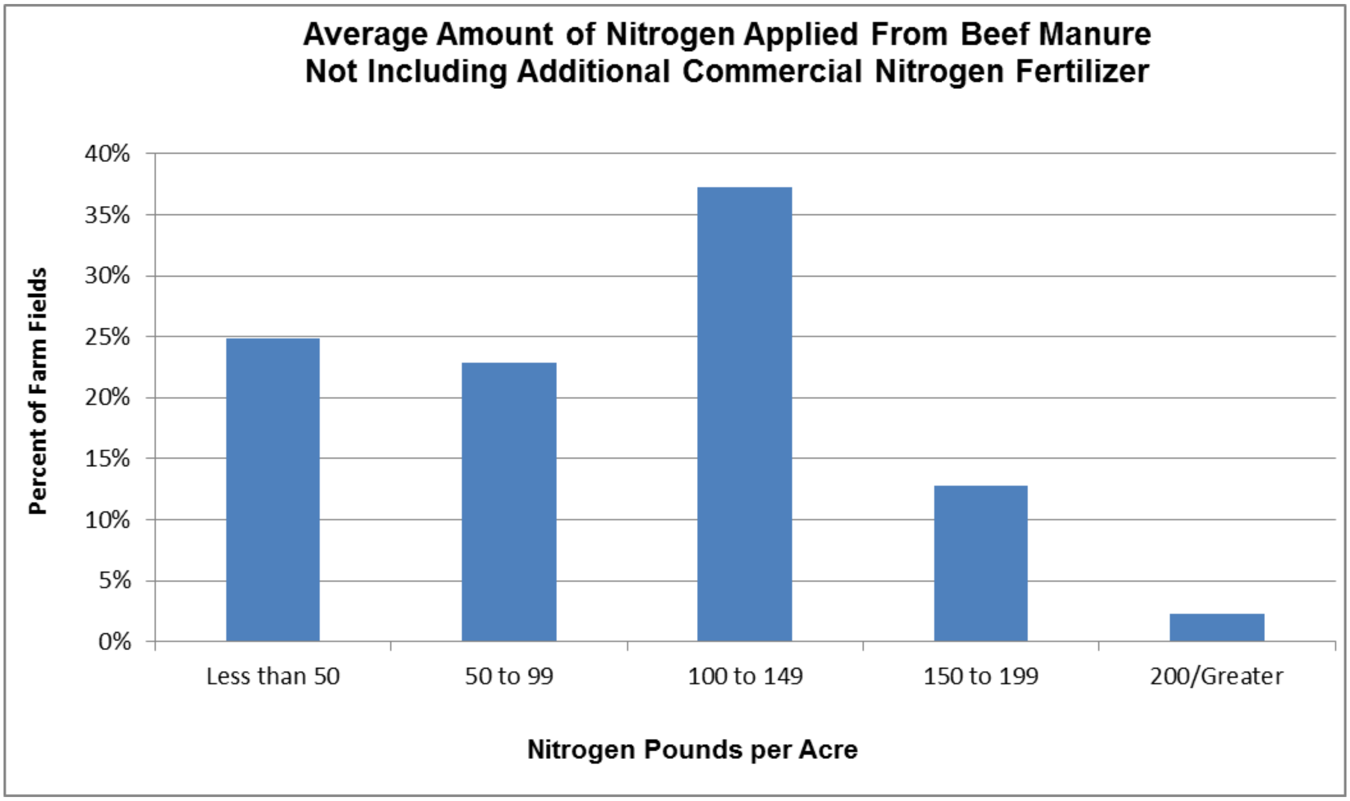

Figure 102. Average nitrogen rates applied to fields from beef manure and does not include additional commercial nitrogen fertilizer in Minnesota for 2019: 1,531 fields

Figure 103 details the distribution of average nitrogen rates in Minnesota from farmers that applied hog manure regardless of whether additional commercial nitrogen fertilizer was applied to the largest corn field. The rates do not include nitrogen from additional commercial nitrogen fertilizer applied to the 2019 corn crop (CMQ-7 and CMQ-10).

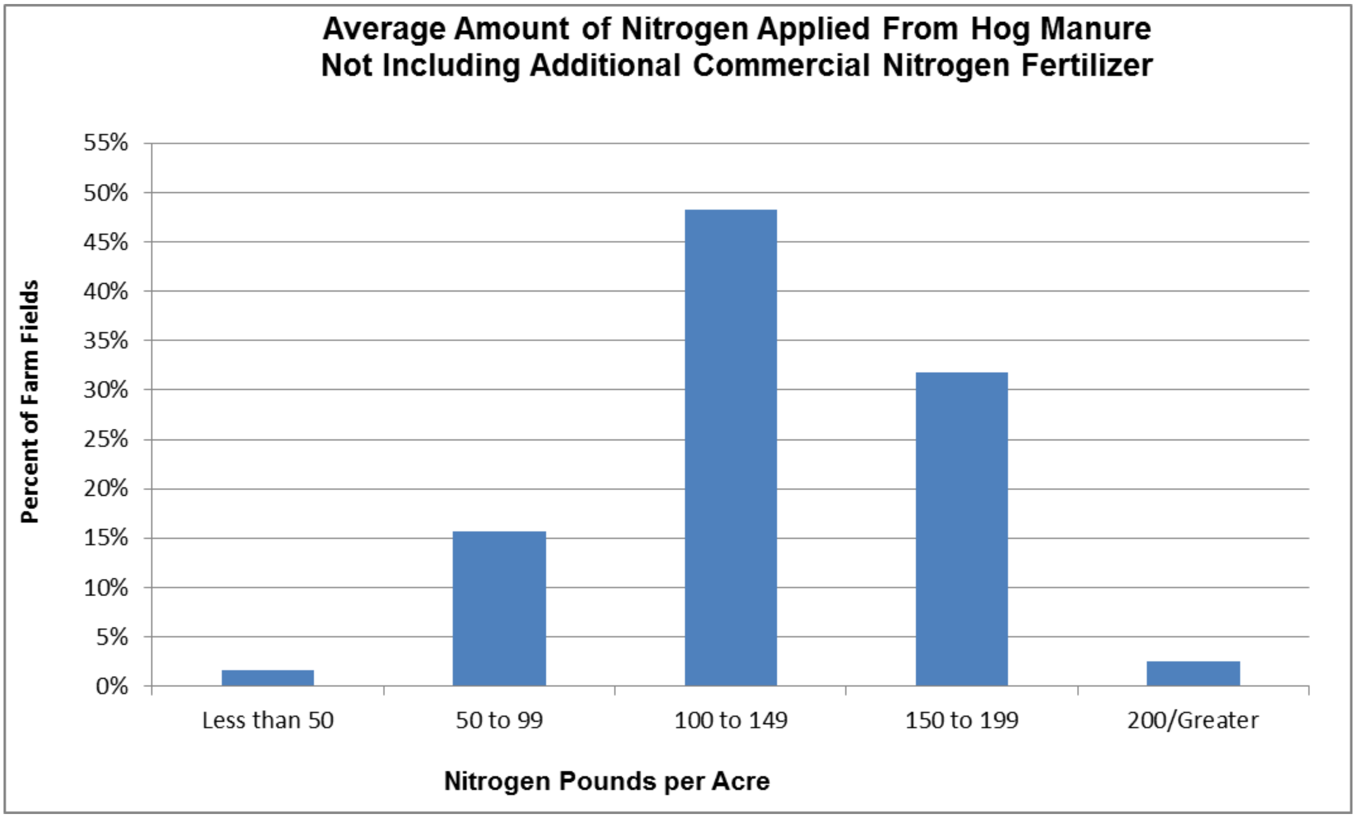

Figure 103. Average nitrogen rates applied to fields from hog manure and does not include additional commercial nitrogen fertilizer in Minnesota for 2019: 1,941 fields

Figure 104 details the distribution of average nitrogen rates in Minnesota from farmers that applied poultry manure regardless of whether additional commercial nitrogen fertilizer was applied to the largest corn field. The rates do not include nitrogen from additional commercial nitrogen fertilizer applied to the 2019 corn crop (CMQ-7 and CMQ-10).

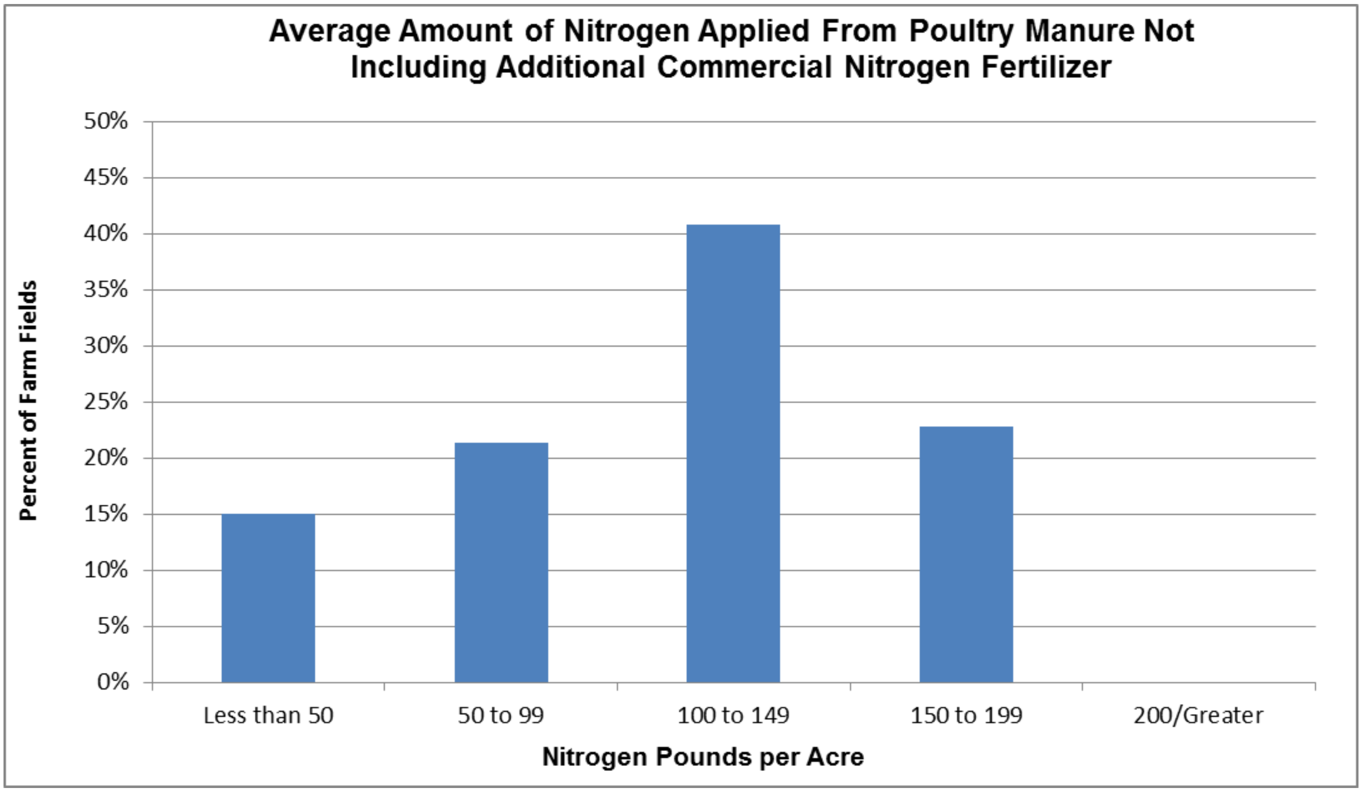

Figure 104. Average nitrogen rates applied to fields from poultry manure and does not include additional commercial nitrogen fertilizer in Minnesota for 2019: 544 fields

Less than five responses were reported for the average nitrogen rate regardless if additional commercial nitrogen fertilizer was applied to the 2019 corn crop from:

- Other sources of manure.

Average Nitrogen Rate from Manure and Commercial Nitrogen Fertilizer Applications

Figure 105 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and commercial nitrogen fertilizer (CMQ-5, CMQ-7, CMQ-10, CMQ-13, and CMQ-14). The average corn yield was 184 bushels per acre. The average nitrogen rate from manure was 106 pounds per acre, and the average commercial nitrogen fertilizer rate was 77 pounds per acre for an average total of 183 pounds of nitrogen per acre.

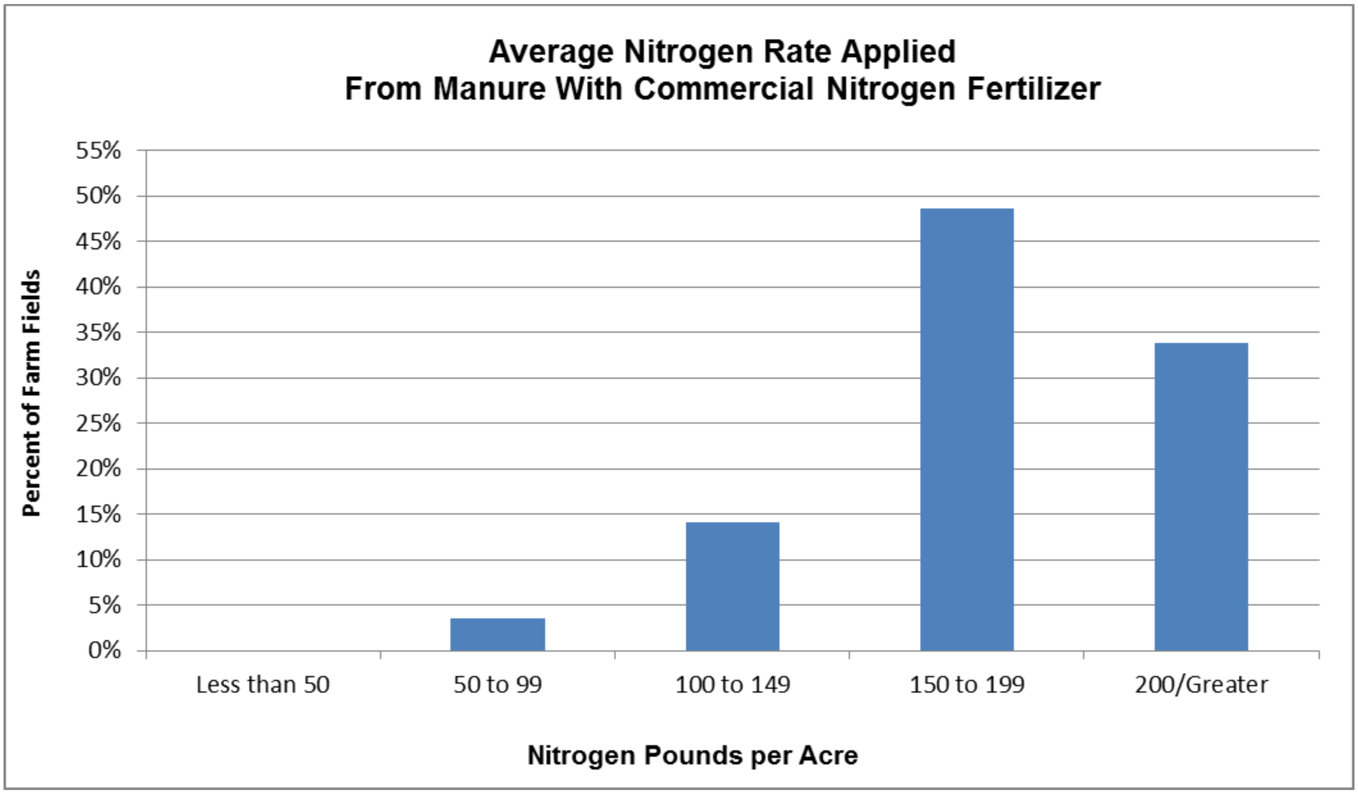

Figure 105. Average nitrogen rates applied to corn fields from manure and commercial nitrogen fertilizer in Minnesota for 2019: 4,556 fields

Figure 106 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure and commercial nitrogen fertilizer (CMQ-5, CMQ-7, CMQ-10, CMQ-13, and CMQ-14). The average corn yield was 184 bushels per acre. The average nitrogen rate from manure was 111 pounds per acre, and the average commercial nitrogen fertilizer rate was 67 pounds per acre for an average total of 178 pounds of nitrogen per acre.

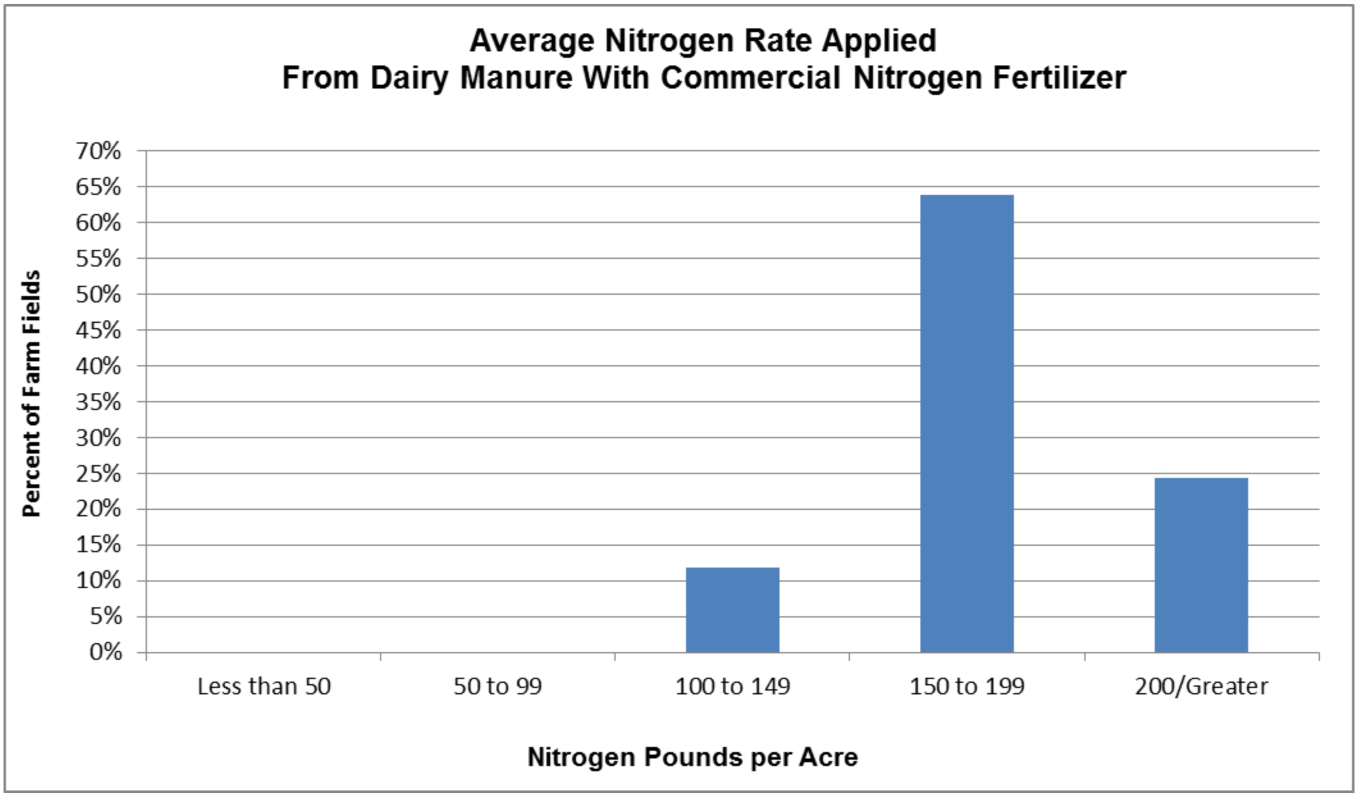

Figure 106. Average nitrogen rates applied to corn fields from dairy manure and commercial nitrogen fertilizer in Minnesota for 2019: 1,518 fields

Figure 107 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure and commercial nitrogen fertilizer (CMQ-5, CMQ-7, CMQ-10, CMQ-13, and CMQ-14). The average corn yield was 176 bushels per acre. The average nitrogen rate from manure was 86 pounds per acre, and the average commercial nitrogen fertilizer rate was 107 pounds per acre for an average total of 193 pounds of nitrogen per acre.

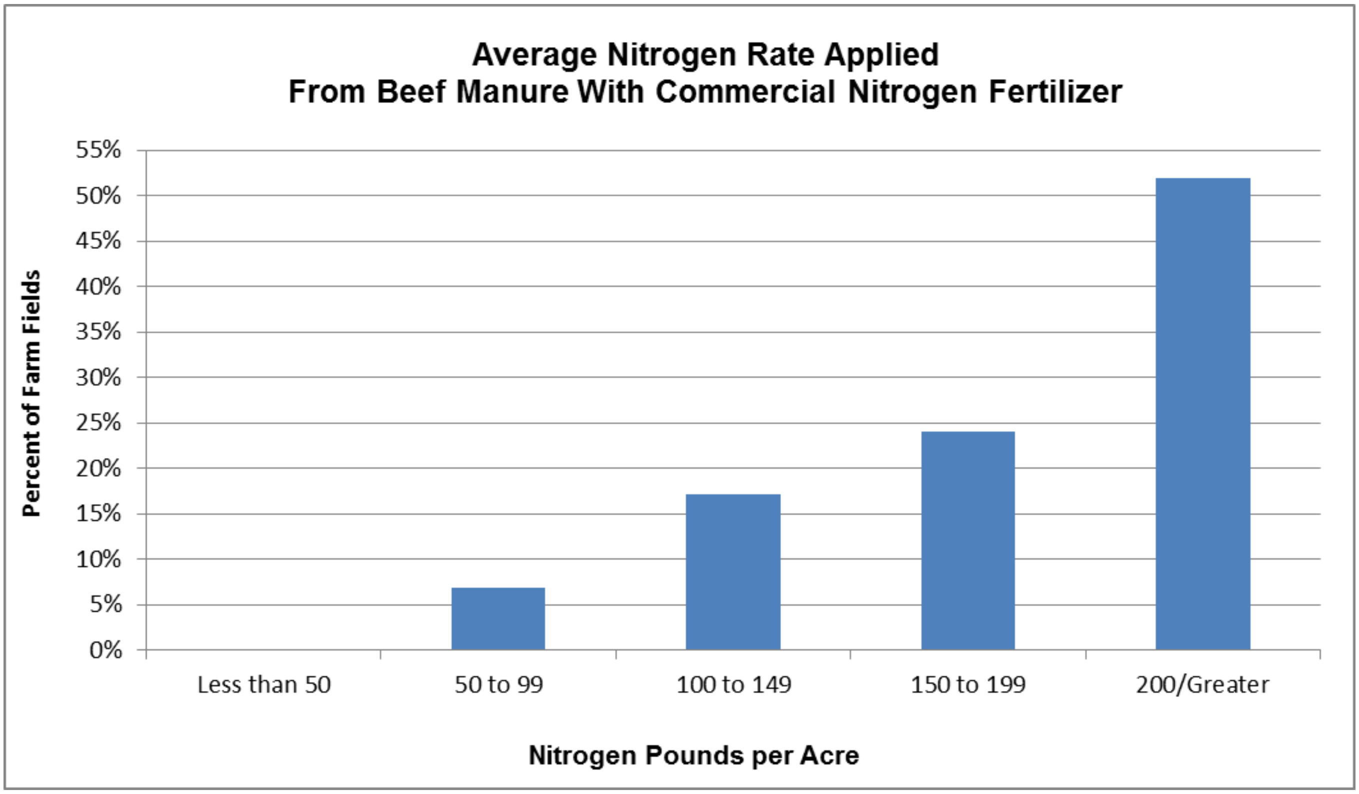

Figure 107. Average nitrogen rates applied to corn fields from beef manure and commercial nitrogen fertilizer in Minnesota for 2019: 1,262 fields

Figure 108 details the distribution of average nitrogen rates in Minnesota from farmers that applied hog manure and commercial nitrogen fertilizer (CMQ-5, CMQ-7, CMQ-10, CMQ-13, and CMQ-14). The average corn yield was 198 bushels per acre. The average nitrogen rate from manure was 121 pounds per acre, and the average commercial nitrogen fertilizer rate was 62 pounds per acre for an average total of 183 pounds of nitrogen per acre.

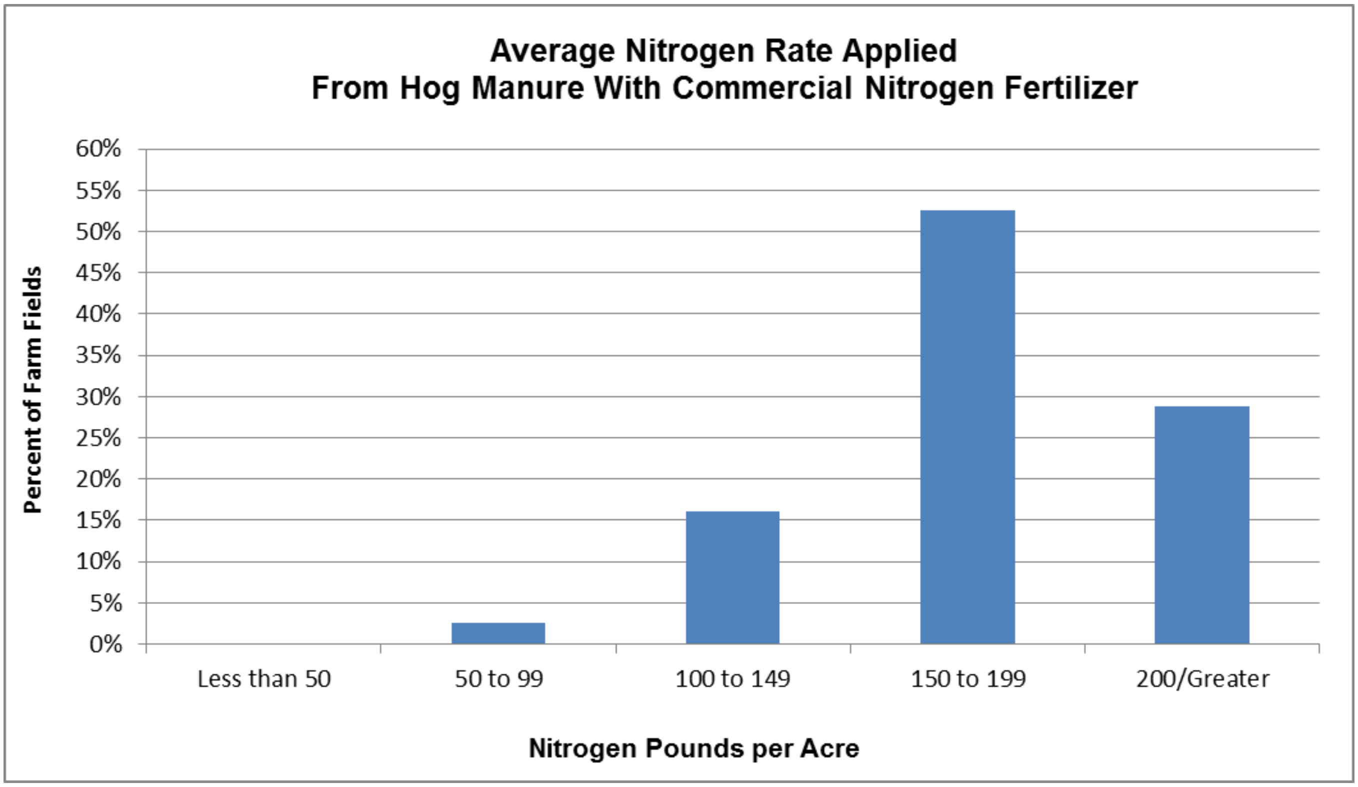

Figure 108. Average nitrogen rates applied to corn fields from hog manure and commercial nitrogen fertilizer in Minnesota for 2019: 1,232 fields

Figure 109 details the distribution of average nitrogen rates in Minnesota from farmers that applied poultry manure and commercial nitrogen fertilizer (CMQ-5, CMQ-7, CMQ-10, CMQ-13, and CMQ-14). The average corn yield was 178 bushels per acre. The average nitrogen rate from manure was 112 pounds per acre, and the average commercial nitrogen fertilizer rate was 66 pounds per acre for an average total of 178 pounds of nitrogen per acre.

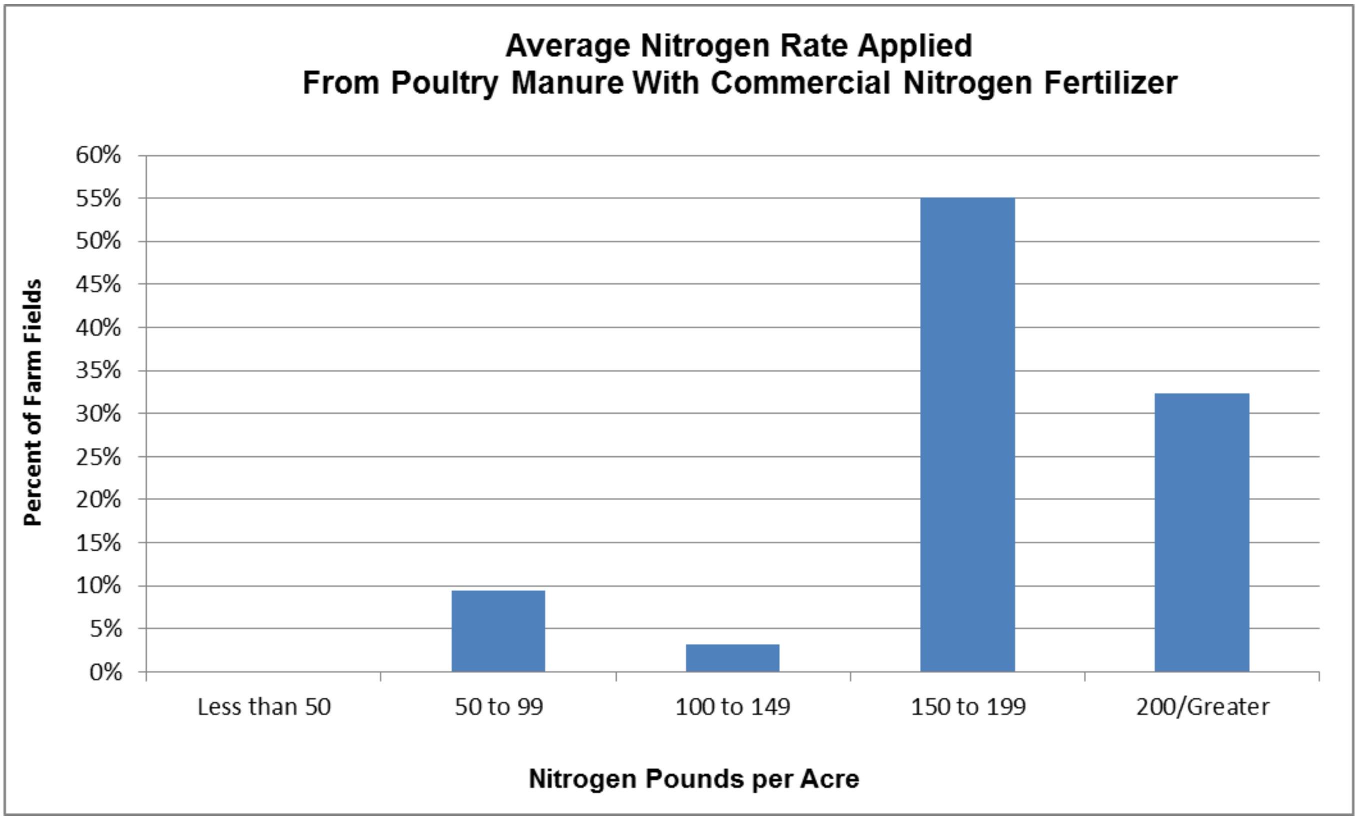

Figure 109. Average nitrogen rates applied to corn fields from poultry manure and commercial nitrogen fertilizer in Minnesota for 2019: 449 fields

Less than five responses were reported for the average nitrogen rate with additional commercial nitrogen fertilizer was applied to the 2019 corn crop from:

- Other sources of manure.

Nitrogen Rates and Average Corn Yields on Manured Fields

Table 209 details the nitrogen rates and corn yields by BMP region on corn following various crops (CMQ-2, CMQ-3, CMQ-5, CMQ-10, and CMQ-14). These are corn fields applied with manure[95] or manure and commercial nitrogen fertilizer.

Table 209. Average amount of nitrogen applied from manure or manure and commercial nitrogen fertilizer and corresponding corn yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Manure Only or Manure and Commercial Fertilizer Pounds per Acre	Average Corn Yield Bushels per Acre
Northwest	Soybeans	120	145
Northwest	Corn	**	**
Northwest	Corn/Alfalfa	**	**
Northwest	Alfalfa	116	153
Northwest	Small Grains	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	155	169
Irrigated and Non-irrigated Sandy Soils	Corn	125	157
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	131	155
Irrigated and Non-irrigated Sandy Soils	Alfalfa	158	139
Irrigated and Non-irrigated Sandy Soils	Small Grains	99	133
Irrigated and Non-irrigated Sandy Soils	Other	142	132
Southwestern and West Central	Soybeans	156	187
Southwestern and West Central	Corn	161	184
Southwestern and West Central	Corn/Alfalfa	**	**
Southwestern and West Central	Alfalfa	**	**
Southwestern and West Central	Small Grains	163	178
Southwestern and West Central	Other	**	**
South Central	Soybeans	168	193
South Central	Corn	154	185
South Central	Corn/Alfalfa	106	154
South Central	Alfalfa	**	**
South Central	Small Grains	126	148
South Central	Other	**	**
Southeastern	Soybeans	170	206
Southeastern	Corn	159	193
Southeastern	Corn/Alfalfa	91	146
Southeastern	Alfalfa	**	**
Southeastern	Small Grains	**	**
Southeastern	Other	**	**
Statewide	**Soybeans**	**161**	**188**
Statewide	**Corn**	**148**	**179**
Statewide	**Corn/Alfalfa**	**127**	**156**

[95] Manure is from all manure sources

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Manure Only or Manure and Commercial Fertilizer Pounds per Acre	Average Corn Yield Bushels per Acre
Statewide	**Alfalfa**	**138**	**155**
Statewide	**Small Grains**	**129**	**153**
Statewide	**Other**	**144**	**146**

** Less than five responses

Table 210 details the nitrogen rates and corn yields by BMP region on corn following various crops (CMQ-2, CMQ-3, CMQ-5, and CMQ-10). These are corn fields applied with manure and no commercial fertilizer.

Table 210. Average amount of nitrogen applied from manure and no commercial nitrogen fertilizer and corresponding corn yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Manure Only Pounds per Acre	Average Corn Yield Bushels per Acre
Northwest	Soybeans	**	**
Northwest	Corn	**	**
Northwest	Small Grains	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	166	180
Irrigated and Non-irrigated Sandy Soils	Corn	139	146
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	134	154
Irrigated and Non-irrigated Sandy Soils	Small Grains	**	**
Southwestern and West Central	Soybeans	117	193
Southwestern and West Central	Corn	166	187
Southwestern and West Central	Corn/Alfalfa	**	**
Southwestern and West Central	Small Grains	**	**
South Central	Soybeans	139	203
South Central	Corn	**	**
South Central	Corn/Alfalfa	**	**
South Central	Alfalfa	**	**
South Central	Small Grains	**	**
South Central	Other	**	**
Southeastern	Soybeans	**	**
Southeastern	Corn	**	**
Southeastern	Alfalfa	**	**
Southeastern	Other	**	**
Statewide	**Soybeans**	**143**	**193**
Statewide	**Corn**	**159**	**168**
Statewide	**Corn/Alfalfa**	**118**	**145**
Statewide	**Alfalfa**	**	**
Statewide	**Small Grains**	**135**	**153**
Statewide	**Other**	**	**

** Less than five responses

Table 211 details the nitrogen rates and corn yields by BMP region on corn following various crops (CMQ-2, CMQ-3, CMQ-5, CMQ-10, and CMQ-14). These are corn fields applied with manure and commercial nitrogen fertilizer.

Table 211. Average amount of nitrogen applied from manure and commercial nitrogen fertilizer and corresponding corn yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied From Manure and Commercial Fertilizer Pounds per Acre	Average Corn Yield Bushels per Acre
Northwest	Soybeans	115	142
Northwest	Corn	**	**
Northwest	Corn/Alfalfa	**	**
Northwest	Alfalfa	116	153
Irrigated and Non-irrigated Sandy Soils	Soybeans	151	165
Irrigated and Non-irrigated Sandy Soils	Corn	122	159
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	130	155
Irrigated and Non-irrigated Sandy Soils	Alfalfa	158	139
Irrigated and Non-irrigated Sandy Soils	Small Grains	93	134
Irrigated and Non-irrigated Sandy Soils	Other	142	132
Southwestern and West Central	Soybeans	164	186
Southwestern and West Central	Corn	158	183
Southwestern and West Central	Corn/Alfalfa	**	**
Southwestern and West Central	Alfalfa	**	**
Southwestern and West Central	Small Grains	169	180
Southwestern and West Central	Other	**	**
South Central	Soybeans	174	191
South Central	Corn	153	190
South Central	Corn/Alfalfa	132	179
South Central	Alfalfa	**	**
South Central	Small Grains	**	**
South Central	Other	**	**
Southeastern	Soybeans	167	204
Southeastern	Corn	159	195
Southeastern	Corn/Alfalfa	91	146
Southeastern	Alfalfa	**	**
Southeastern	Small Grains	**	**
Statewide	**Soybeans**	**165**	**187**
Statewide	**Corn**	**146**	**181**
Statewide	**Corn/Alfalfa**	**130**	**160**
Statewide	**Alfalfa**	**146**	**157**
Statewide	**Small Grains**	**127**	**153**
Statewide	**Other**	**155**	**141**

** Less than five responses

Table 212 details the nitrogen rates and corn yields by BMP region on corn following various crops (CMQ-2, CMQ-3, CMQ-5, CMQ-7, CMQ-10, and CMQ-14). These are corn fields applied with dairy manure or dairy manure and commercial nitrogen fertilizer.

Table 212. Average amount of nitrogen applied from dairy manure or dairy manure and commercial nitrogen fertilizer and corresponding corn yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Dairy Manure Only or Dairy Manure and Commercial Fertilizer Pounds per Acre	Average Corn Yield Bushels per Acre
Northwest	Soybeans	**	**
Northwest	Corn/Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	174	170
Irrigated and Non-irrigated Sandy Soils	Corn	144	162
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	135	163
Irrigated and Non-irrigated Sandy Soils	Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	**	**
Irrigated and Non-irrigated Sandy Soils	Other	**	**
Southwestern and West Central	Soybeans	155	194
Southwestern and West Central	Corn	159	192
Southwestern and West Central	Corn/Alfalfa	**	**
Southwestern and West Central	Alfalfa	**	**
Southwestern and West Central	Small Grains	**	**
South Central	Soybeans	173	197
South Central	Corn	160	182
South Central	Corn/Alfalfa	115	169
Southeastern	Soybeans	158	206
Southeastern	Corn	180	197
Southeastern	Corn/Alfalfa	**	**
Southeastern	Alfalfa	**	**
Southeastern	Other	**	**
Statewide	**Soybeans**	**166**	**189**
Statewide	**Corn**	**159**	**182**
Statewide	**Corn/Alfalfa**	**129**	**169**
Statewide	**Alfalfa**	**	**
Statewide	**Small Grains**	**	**
Statewide	**Other**	**	**

** Less than five responses

Table 213 details the nitrogen rates and corn yields by BMP region on corn following various crops (CMQ-2, CMQ-3, CMQ-5, CMQ-7, and CMQ-10). These are corn fields applied with dairy manure and no commercial fertilizer.

Table 213. Average amount of nitrogen applied from dairy manure and no commercial nitrogen fertilizer and corresponding corn yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied From Dairy Manure Only Pounds per Acre	Average Corn Yield Bushels per Acre
Northwest	Soybeans	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	**	**
Irrigated and Non-irrigated Sandy Soils	Corn	**	**
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	140	154
Irrigated and Non-irrigated Sandy Soils	Small Grains	**	**
Southwestern and West Central	Soybeans	**	**
Southwestern and West Central	Corn	**	**
Southwestern and West Central	Corn/Alfalfa	**	**
Southwestern and West Central	Small Grains	**	**
South Central	Soybeans	**	**
South Central	Corn/Alfalfa	**	**
Southeastern	Soybeans	**	**
Southeastern	Corn	**	**
Southeastern	Other	**	**
Statewide	**Soybeans**	**168**	**189**
Statewide	**Corn**	**164**	**178**
Statewide	**Corn/Alfalfa**	**130**	**153**
Statewide	**Small Grains**	**	**
Statewide	**Other**	**	**

** Less than five responses

Table 214 details the nitrogen rates and corn yields by BMP region on corn following various crops (CMQ-2, CMQ-3, CMQ-5, CMQ-7, CMQ-10, and CMQ-14). These are corn fields applied with dairy manure and commercial nitrogen fertilizer.

Table 214. Average amount of nitrogen applied from dairy manure and commercial nitrogen fertilizer and corresponding corn yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Dairy Manure and Commercial Fertilizer Pounds per Acre	Average Corn Yield Bushels per Acre
Northwest	Soybeans	**	**
Northwest	Corn/Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	181	164
Irrigated and Non-irrigated Sandy Soils	Corn	143	161
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	131	169
Irrigated and Non-irrigated Sandy Soils	Small Grains	**	**
Irrigated and Non-irrigated Sandy Soils	Other	**	**
Southwestern and West Central	Soybeans	153	192
Southwestern and West Central	Corn	155	196
Southwestern and West Central	Alfalfa	**	**
Southwestern and West Central	Small Grains	**	**
South Central	Soybeans	175	195
South Central	Corn	160	182
South Central	Corn/Alfalfa	136	182
Southeastern	Soybeans	154	204
Southeastern	Corn	184	201
Southeastern	Corn/Alfalfa	**	**
Southeastern	Alfalfa	**	**
Statewide	**Soybeans**	**165**	**189**
Statewide	**Corn**	**159**	**182**
Statewide	**Corn/Alfalfa**	**128**	**176**
Statewide	**Alfalfa**	**	**
Statewide	**Small Grains**	**	**
Statewide	**Other**	**	**

** Less than five responses

Table 215 details the nitrogen rates and corn yields by BMP region on corn following various crops (CMQ-2, CMQ-3, CMQ-5, CMQ-7, CMQ-10, and CMQ-14). These are corn fields applied with beef manure or beef manure and commercial nitrogen fertilizer.

Table 215. Average amount of nitrogen applied from beef manure or beef manure and commercial nitrogen fertilizer and corresponding corn yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Beef Manure Only or Beef Manure and Commercial Fertilizer Pounds per Acre	Average Corn Yield Bushels per Acre
Northwest	Soybeans	113	154
Northwest	Corn	**	**
Northwest	Corn/Alfalfa	**	**
Northwest	Alfalfa	116	153
Irrigated and Non-irrigated Sandy Soils	Soybeans	135	165
Irrigated and Non-irrigated Sandy Soils	Corn	112	155
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	125	139
Irrigated and Non-irrigated Sandy Soils	Alfalfa	108	146
Irrigated and Non-irrigated Sandy Soils	Small Grains	101	136
Irrigated and Non-irrigated Sandy Soils	Other	**	**
Southwestern and West Central	Soybeans	156	179
Southwestern and West Central	Corn	161	167
Southwestern and West Central	Alfalfa	**	**
Southwestern and West Central	Small Grains	**	**
Southwestern and West Central	Other	**	**
South Central	Soybeans	133	172
South Central	Corn	171	174
South Central	Corn/Alfalfa	**	**
South Central	Small Grains	**	**
South Central	Other	**	**
Southeastern	Soybeans	170	201
Southeastern	Corn	145	191
Southeastern	Corn/Alfalfa	**	**
Southeastern	Alfalfa	**	**
Southeastern	Other	**	**
Statewide	**Soybeans**	**149**	**178**
Statewide	**Corn**	**142**	**171**
Statewide	**Corn/Alfalfa**	**99**	**123**
Statewide	**Alfalfa**	**130**	**159**
Statewide	**Small Grains**	**120**	**154**
Statewide	**Other**	**174**	**162**

** Less than five responses

Table 216 details the nitrogen rates and corn yields by BMP region on corn following various crops (CMQ-2, CMQ-3, CMQ-5, CMQ-7, and CMQ-10). These are corn fields applied with beef manure and no commercial fertilizer.

Table 216. Average amount of nitrogen applied from beef manure and no commercial nitrogen fertilizer and corresponding corn yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied From Beef Manure Only Pounds per Acre	Average Corn Yield Bushels per Acre
Northwest	Soybeans	**	**
Northwest	Corn/Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Corn	**	**
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	**	**
Southwestern and West Central	Corn	**	**
South Central	Corn	**	**
South Central	Corn/Alfalfa	**	**
South Central	Small Grains	**	**
Southeastern	Alfalfa	**	**
Statewide	**Soybeans**	**	**
Statewide	**Corn**	**151**	**132**
Statewide	**Corn/Alfalfa**	**	**
Statewide	**Alfalfa**	**	**
Statewide	**Small Grains**	**	**

** Less than five responses

Table 217 details the nitrogen rates and corn yields by BMP region on corn following various crops (CMQ-2, CMQ-3, CMQ-5, CMQ-7, CMQ-10, and CMQ-14). These are corn fields applied with beef manure and commercial nitrogen fertilizer.

Table 217. Average amount of nitrogen applied from beef manure and commercial nitrogen fertilizer and corresponding corn yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Beef Manure and Commercial Fertilizer Pounds per Acre	Average Corn Yield Bushels per Acre
Northwest	Soybeans	**	**
Northwest	Corn	**	**
Northwest	Corn/Alfalfa	**	**
Northwest	Alfalfa	116	153
Irrigated and Non-irrigated Sandy Soils	Soybeans	135	165
Irrigated and Non-irrigated Sandy Soils	Corn	105	158
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	130	139
Irrigated and Non-irrigated Sandy Soils	Alfalfa	108	146
Irrigated and Non-irrigated Sandy Soils	Small Grains	101	136
Irrigated and Non-irrigated Sandy Soils	Other	**	**
Southwestern and West Central	Soybeans	156	179
Southwestern and West Central	Corn	163	168
Southwestern and West Central	Alfalfa	**	**
Southwestern and West Central	Small Grains	**	**
Southwestern and West Central	Other	**	**
South Central	Soybeans	133	172
South Central	Corn	173	188
South Central	Corn/Alfalfa	**	**
South Central	Small Grains	**	**
South Central	Other	**	**
Southeastern	Soybeans	170	201
Southeastern	Corn	145	191
Southeastern	Corn/Alfalfa	**	**
Southeastern	Alfalfa	**	**
Southeastern	Small Grains	**	**
Statewide	**Soybeans**	**150**	**179**
Statewide	**Corn**	**141**	**176**
Statewide	**Corn/Alfalfa**	**110**	**122**
Statewide	**Alfalfa**	**139**	**161**
Statewide	**Small Grains**	**125**	**157**
Statewide	**Other**	**174**	**162**

** Less than five responses

Table 218 details the nitrogen rates and corn yields by BMP region on corn following various crops (CMQ-2, CMQ-3, CMQ-5, CMQ-7, CMQ-10, and CMQ-14). These are corn fields applied with hog manure or hog manure and commercial nitrogen fertilizer.

Table 218. Average amount of nitrogen applied from hog manure or hog manure and commercial nitrogen fertilizer and corresponding corn yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Hog Manure Only or Hog Manure and Commercial Fertilizer Pounds per Acre	Average Corn Yield Bushels per Acre
Northwest	Small Grains	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	135	165
Irrigated and Non-irrigated Sandy Soils	Other	**	**
Southwestern and West Central	Soybeans	146	194
Southwestern and West Central	Corn	162	194
Southwestern and West Central	Corn/Alfalfa	**	**
Southwestern and West Central	Small Grains	**	**
South Central	Soybeans	181	200
South Central	Corn	**	**
South Central	Corn/Alfalfa	**	**
South Central	Small Grains	**	**
Southeastern	Soybeans	**	**
Statewide	**Soybeans**	**168**	**198**
Statewide	**Corn**	**142**	**202**
Statewide	**Corn/Alfalfa**	**	**
Statewide	**Small Grains**	**	**
Statewide	**Other**	**	**

** Less than five responses

Table 219 details the nitrogen rates and corn yields by BMP region on corn following various crops (CMQ-2, CMQ-3, CMQ-5, CMQ-7, and CMQ-10). These are corn fields applied with hog manure and no commercial fertilizer.

Table 219. Average amount of nitrogen applied from hog manure and no commercial nitrogen fertilizer and corresponding corn yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied From Hog Manure Only Pounds per Acre	Average Corn Yield Bushels per Acre
Northwest	Small Grains	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	**	**
Irrigated and Non-irrigated Sandy Soils	Other	**	**
Southwestern and West Central	Soybeans	146	194
Southwestern and West Central	Corn	162	194
Southwestern and West Central	Corn/Alfalfa	**	**
Southwestern and West Central	Small Grains	**	**
South Central	Soybeans	181	200
South Central	Corn	**	**
South Central	Corn/Alfalfa	**	**
South Central	Small Grains	**	**
Southeastern	Soybeans	**	**
Statewide	**Soybeans**	**135**	**194**
Statewide	**Corn**	**171**	**200**
Statewide	**Corn/Alfalfa**	**	**
Statewide	**Small Grains**	**	**

** Less than five responses

Table 220 details the nitrogen rates and corn yields by BMP region on corn following various crops (CMQ-2, CMQ-3, CMQ-5, CMQ-7, CMQ-10, and CMQ-14). These are corn fields applied with hog manure and commercial nitrogen fertilizer.

Table 220. Average amount of nitrogen applied from hog manure and commercial nitrogen fertilizer and corresponding corn yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Hog Manure and Commercial Fertilizer Pounds per Acre	Average Corn Yield Bushels per Acre
Irrigated and Non-irrigated Sandy Soils	Other	**	**
Southwestern and West Central	Soybeans	173	196
Southwestern and West Central	Corn	**	**
Southwestern and West Central	Corn/Alfalfa	**	**
South Central	Soybeans	188	200
South Central	Corn	**	**
South Central	Small Grains	**	**
Southeastern	Soybeans	**	**
Statewide	**Soybeans**	**184**	**200**
Statewide	**Corn**	**126**	**203**
Statewide	**Corn/Alfalfa**	**	**
Statewide	**Small Grains**	**	**
Statewide	**Other**	**	**

** Less than five responses

Table 221 details the nitrogen rates and corn yields by BMP region on corn following various crops (CMQ-2, CMQ-3, CMQ-5, CMQ-7, CMQ-10, and CMQ-14). These are corn fields applied with poultry manure or poultry manure and commercial nitrogen fertilizer.

Table 221. Average amount of nitrogen applied from poultry manure or poultry manure and commercial nitrogen fertilizer and corresponding corn yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Poultry Manure Only or Poultry Manure and Commercial Fertilizer Pounds per Acre	Average Corn Yield Bushels per Acre
Irrigated and Non-irrigated Sandy Soils	Soybeans	**	**
Irrigated and Non-irrigated Sandy Soils	Corn	**	**
Irrigated and Non-irrigated Sandy Soils	Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	**	**
Irrigated and Non-irrigated Sandy Soils	Other	**	**
Southwestern and West Central	Soybeans	190	195
South Central	Soybeans	143	188
South Central	Alfalfa	**	**
South Central	Small Grains	**	**
South Central	Other	**	**
Statewide	**Soybeans**	**163**	**188**
Statewide	**Corn**	**	**
Statewide	**Alfalfa**	**	**
Statewide	**Small Grains**	**	**
Statewide	**Other**	**	**

** Less than five responses

Less than five responses were reported for the average nitrogen rate from poultry manure applied to the 2019 corn crop from:

- Poultry manure with no additional commercial nitrogen fertilizer following all crops.

Table 222 details the nitrogen rates and corn yields by BMP region on corn following various crops (CMQ-2, CMQ-3, CMQ-5, CMQ-7, CMQ-10, and CMQ-14). These are corn fields applied with poultry manure and commercial nitrogen fertilizer.

Table 222. Average amount of nitrogen applied from poultry manure and commercial nitrogen fertilizer and corresponding corn yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Poultry Manure and Commercial Fertilizer Pounds per Acre	Average Corn Yield Bushels per Acre
Irrigated and Non-irrigated Sandy Soils	Soybeans	**	**
Irrigated and Non-irrigated Sandy Soils	Corn	**	**
Irrigated and Non-irrigated Sandy Soils	Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	**	**
Irrigated and Non-irrigated Sandy Soils	Other	**	**
Southwestern and West Central	Soybeans	190	195
South Central	Soybeans	167	181
South Central	Alfalfa	**	**
South Central	Small Grains	**	**
South Central	Other	**	**
Statewide	**Soybeans**	**175**	**186**
Statewide	**Corn**	**	**
Statewide	**Alfalfa**	**	**
Statewide	**Small Grains**	**	**
Statewide	**Other**	**	**

** Less than five responses

Less than five responses were reported for the average nitrogen rate from other sources of manure applied to the 2019 corn crop from:

- Other sources of manure with no additional commercial nitrogen fertilizer and additional commercial nitrogen fertilizer following all crops.
- Other sources of manure with no additional commercial nitrogen fertilizer following all crops.
- Other sources of manure with additional commercial nitrogen fertilizer following all crops.

Manure Application from All Manure Sources for Corn following All Crops

Figure 110 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure[96] or applied manure and commercial nitrogen fertilizer to corn following soybeans (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 188 bushels per acre. The average nitrogen rate applied from manure was 93 pounds per acre, and the average commercial nitrogen fertilizer rate was 68 pounds per acre for an average of 161 pounds of nitrogen per acre.

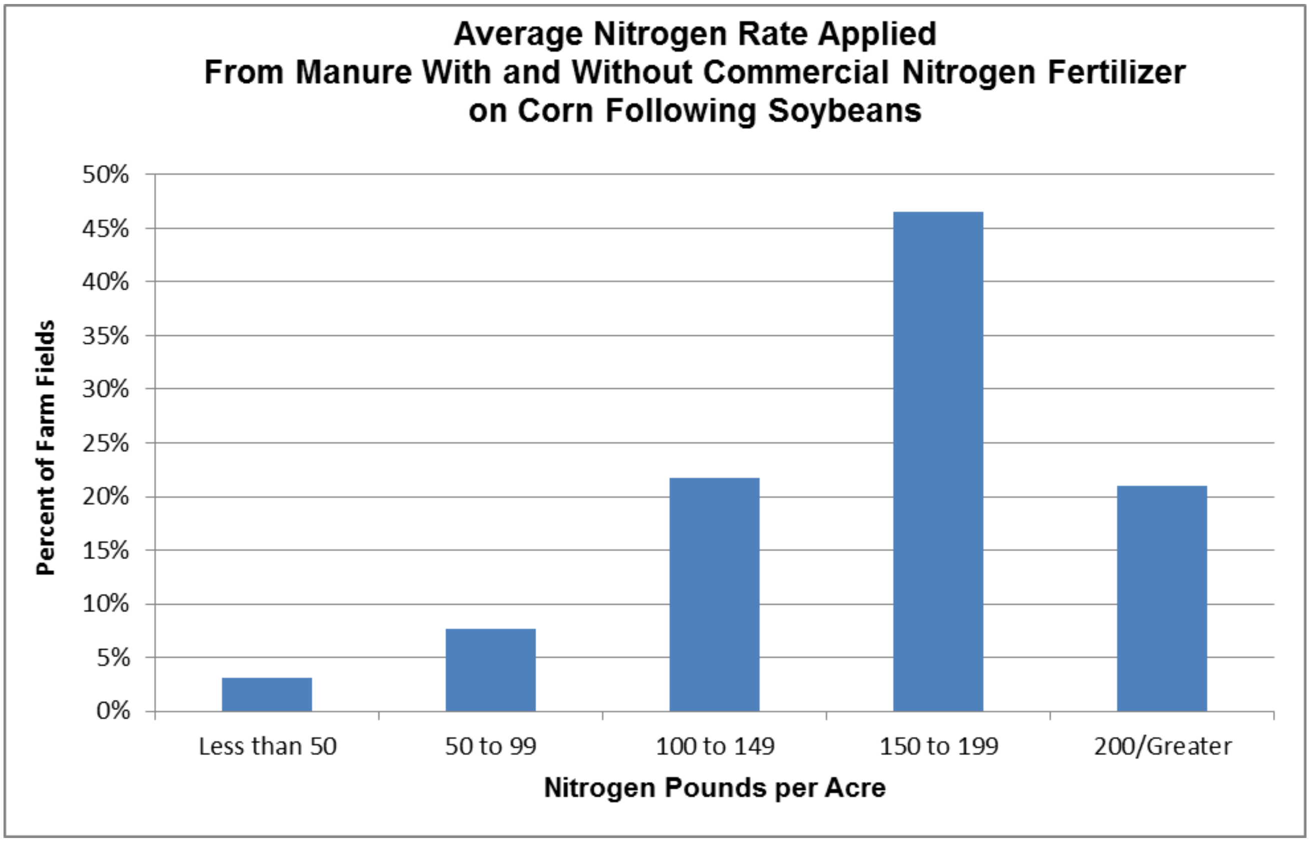

Figure 110. Average nitrogen rates applied to corn following soybeans from manure or manure and commercial nitrogen fertilizer in Minnesota for 2019: 4,325 fields

[96] Manure is from all manure sources

Figure 111 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and no commercial nitrogen fertilizer to corn following soybeans (CMQ-2, CMQ-7, and CMQ-10). The average corn yield was 193 bushels per acre. The average nitrogen rate applied from manure was 143 pounds per acre.

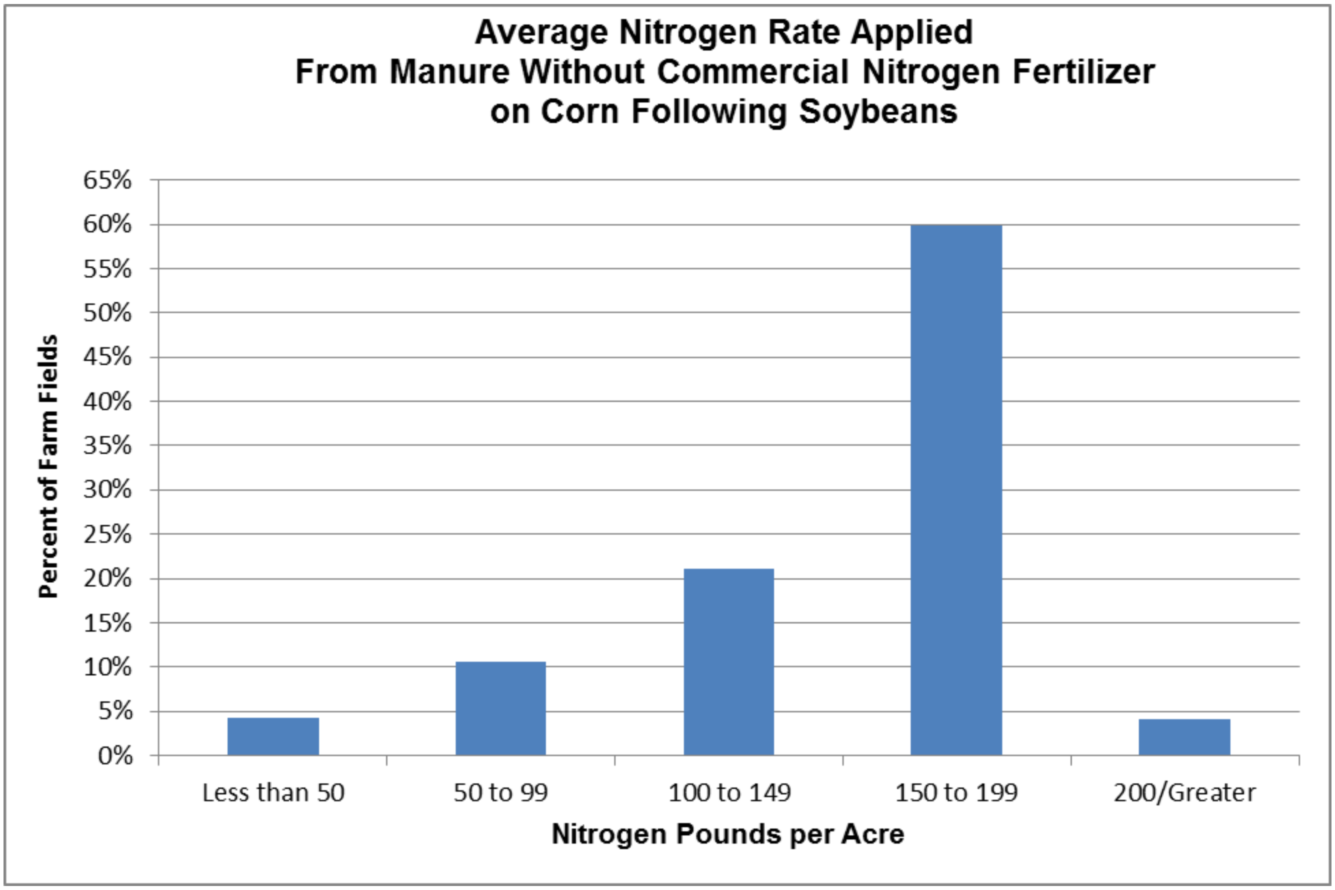

Figure 111. Average nitrogen rates applied to corn following soybeans from manure and no commercial nitrogen fertilizer in Minnesota for 2019: 784 fields

Figure 112 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and commercial nitrogen fertilizer to corn following soybeans (CMQ-2, CMQ-5, CMQ-10, and CMQ-14). The average corn yield was 187 bushels per acre. The average nitrogen rate applied from manure was 82 pounds per acre, and the average commercial nitrogen fertilizer rate was 83 pounds per acre for an average of 165 pounds of nitrogen per acre.

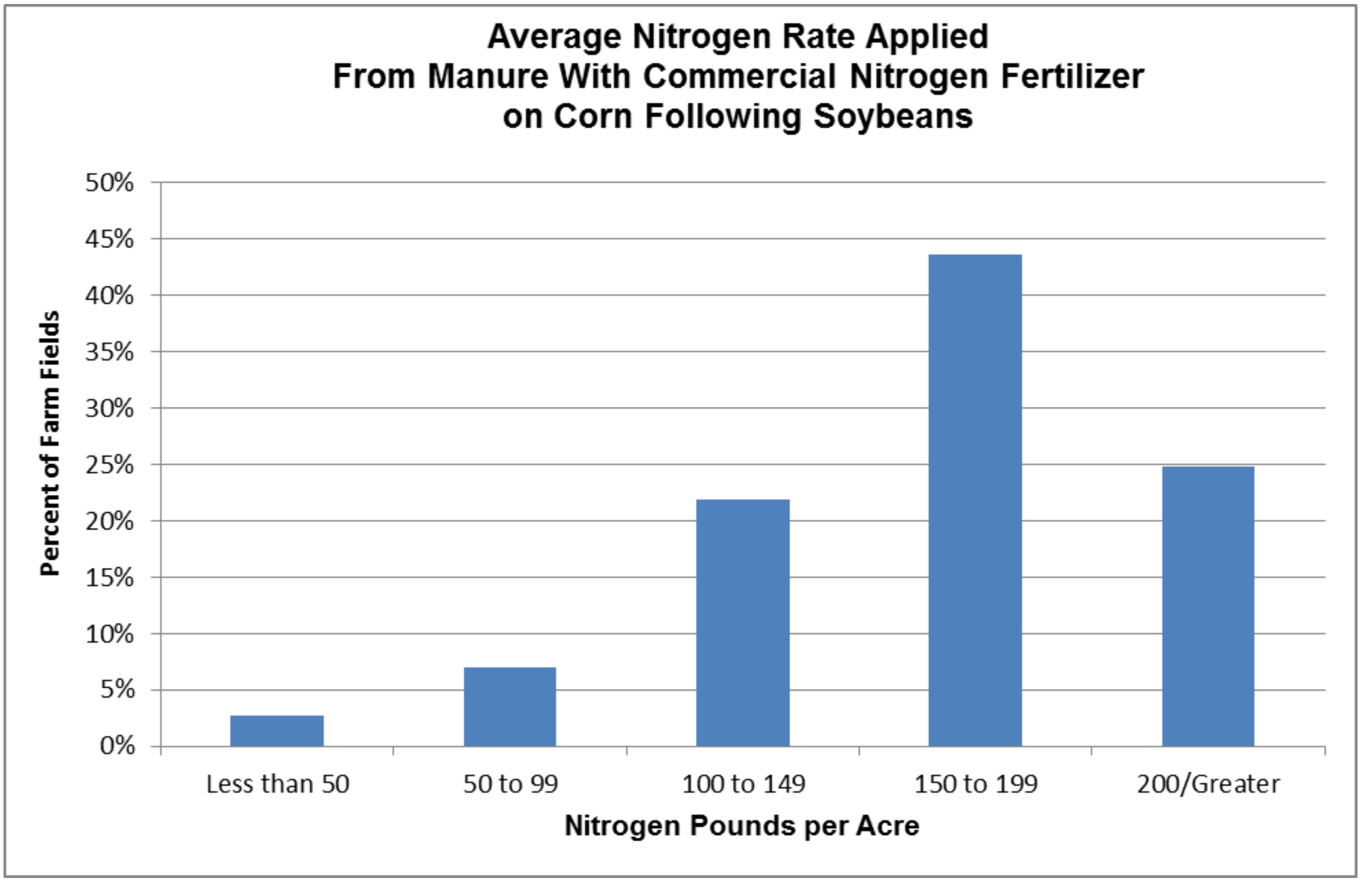

Figure 112. Average nitrogen rates applied to corn following soybeans from manure and commercial nitrogen fertilizer in Minnesota for 2019: 3,541 fields

Figure 113 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and commercial nitrogen fertilizer to corn following soybeans when the farmer did not know the nitrogen content of the manure application (CMQ-2, CMQ-5, CMQ-10, and CMQ-14). Therefore, manure nitrogen was not included in that analysis when the quantity of nitrogen from manure applied to the field is not known. The average corn yield was 183 bushels per acre. The average commercial nitrogen fertilizer rate was 112 pounds per acre.

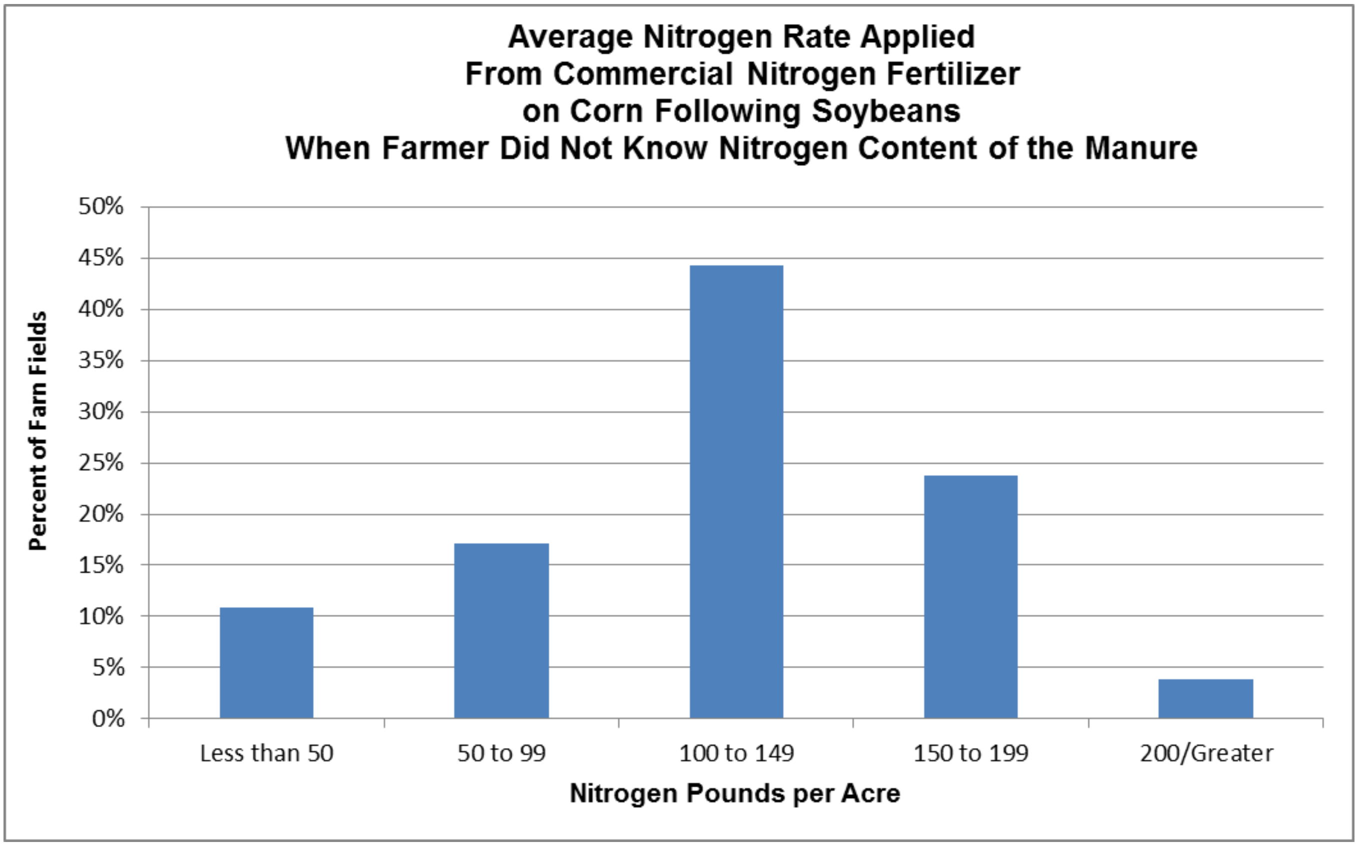

Figure 113. Average nitrogen rates applied to corn following soybeans from commercial nitrogen fertilizer in Minnesota for 2019 when the manure nitrogen content is unknown: 897 fields

Figure 114 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure or applied manure and commercial nitrogen fertilizer to corn following corn (CMQ-2, CMQ-3, CMQ-5, CMQ-10, and CMQ-14). The average corn yield was 180 bushels per acre. The average nitrogen rate applied from manure was 116 pounds per acre, and the average commercial nitrogen fertilizer rate was 59 pounds per acre for an average of 175 pounds of nitrogen per acre.

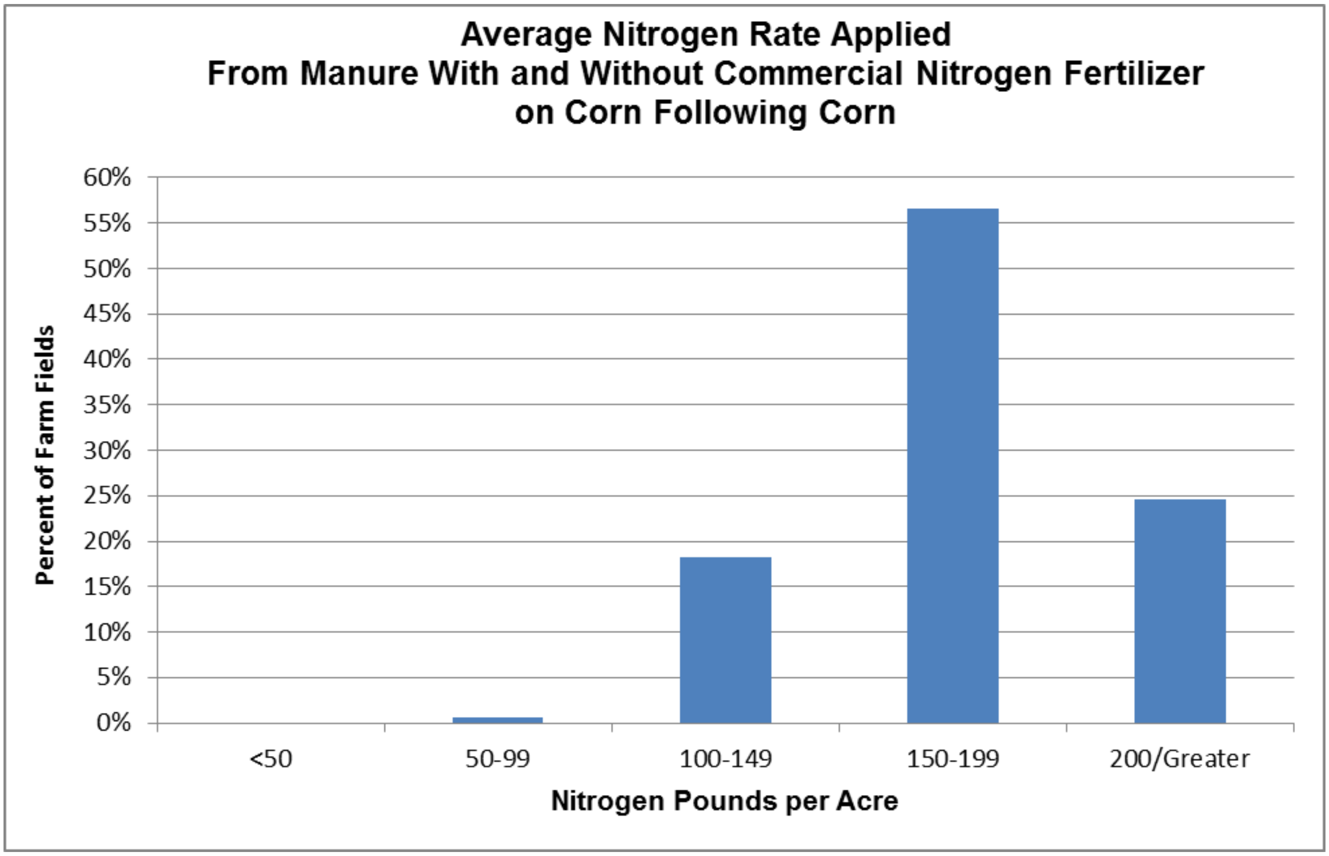

Figure 114. Average nitrogen rates applied to corn following corn from manure or manure and commercial nitrogen fertilizer in Minnesota for 2019: 1,488 fields

Figure 115 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and no commercial nitrogen fertilizer to corn following corn (CMQ-2, CMQ-3, CMQ-5, and CMQ-10). The average corn yield was 168 bushels per acre. The average nitrogen rate applied from manure was 159 pounds per acre.

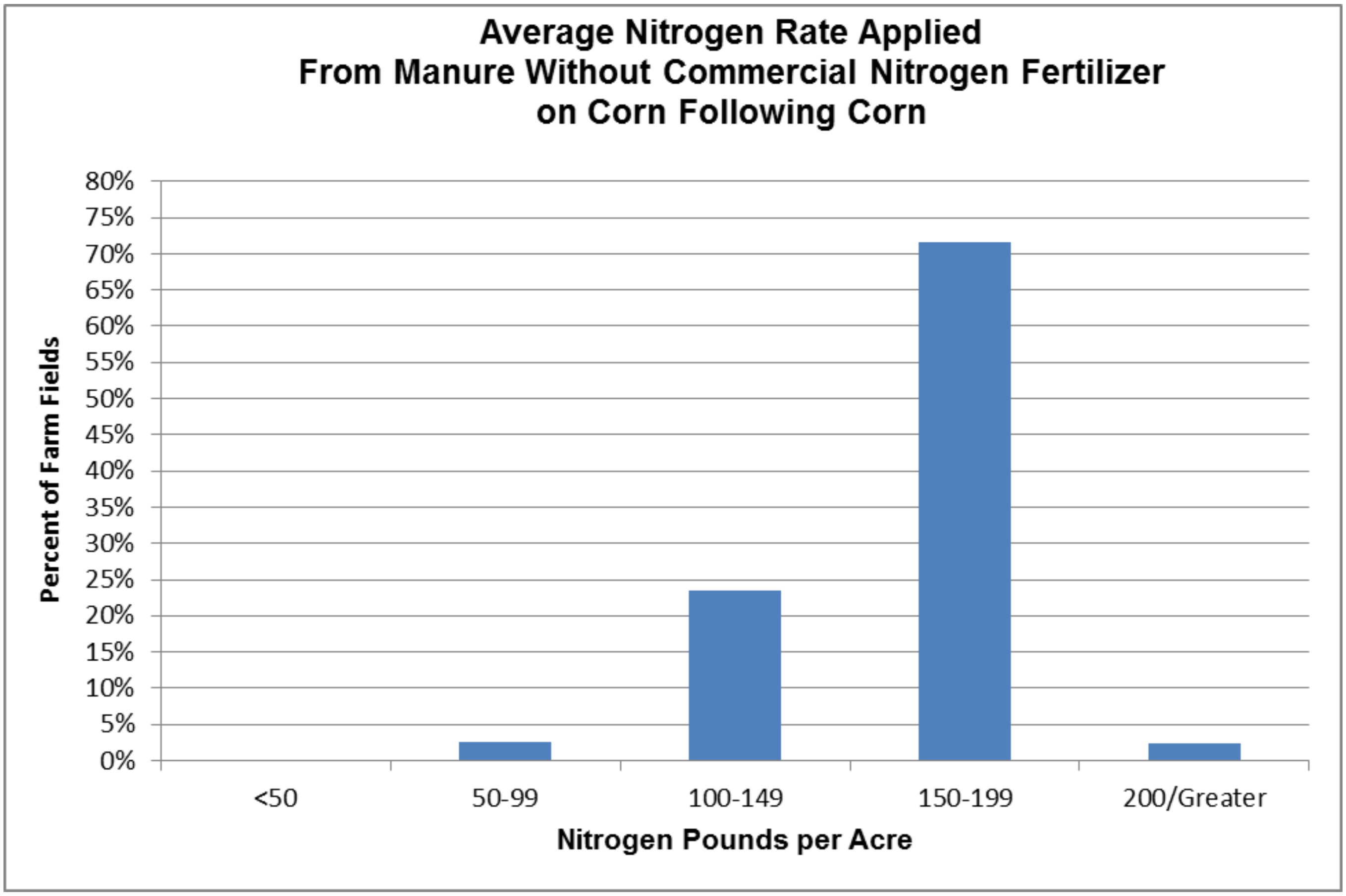

Figure 115. Average nitrogen rates applied to corn following corn from manure and no commercial nitrogen fertilizer in Minnesota for 2019: 363 fields

Figure 116 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and commercial nitrogen fertilizer to corn following corn (CMQ-2, CMQ-3, CMQ-5, CMQ-10, and CMQ-14). The average corn yield was 183 bushels per acre. The average nitrogen rate applied from manure was 103 pounds per acre, and the average commercial nitrogen fertilizer rate was 78 pounds per acre for an average of 181 pounds of nitrogen per acre.

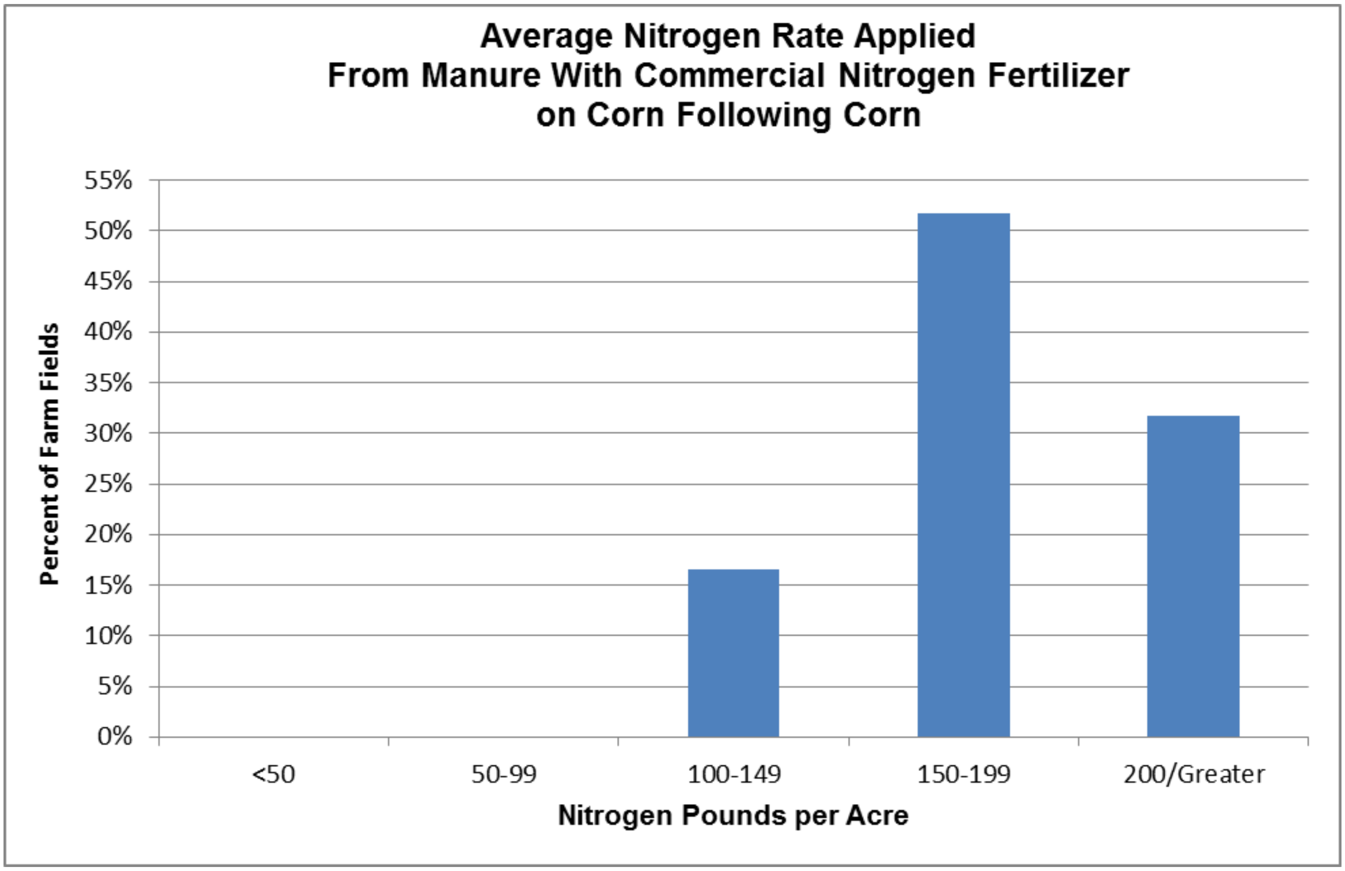

Figure 116. Average nitrogen rates applied to corn following corn from manure and commercial nitrogen fertilizer in Minnesota for 2019: 1,125 fields

Figure 117 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and commercial nitrogen fertilizer to corn following corn when the farmer did not know the nitrogen content of the manure application (CMQ-2, CMQ-3, CMQ-5, CMQ-10, and CMQ-14). Therefore, manure nitrogen was not included in that analysis when the quantity of nitrogen from manure applied to the field is not known. The average corn yield was 178 bushels per acre. The average commercial nitrogen fertilizer rate was 99 pounds per acre.

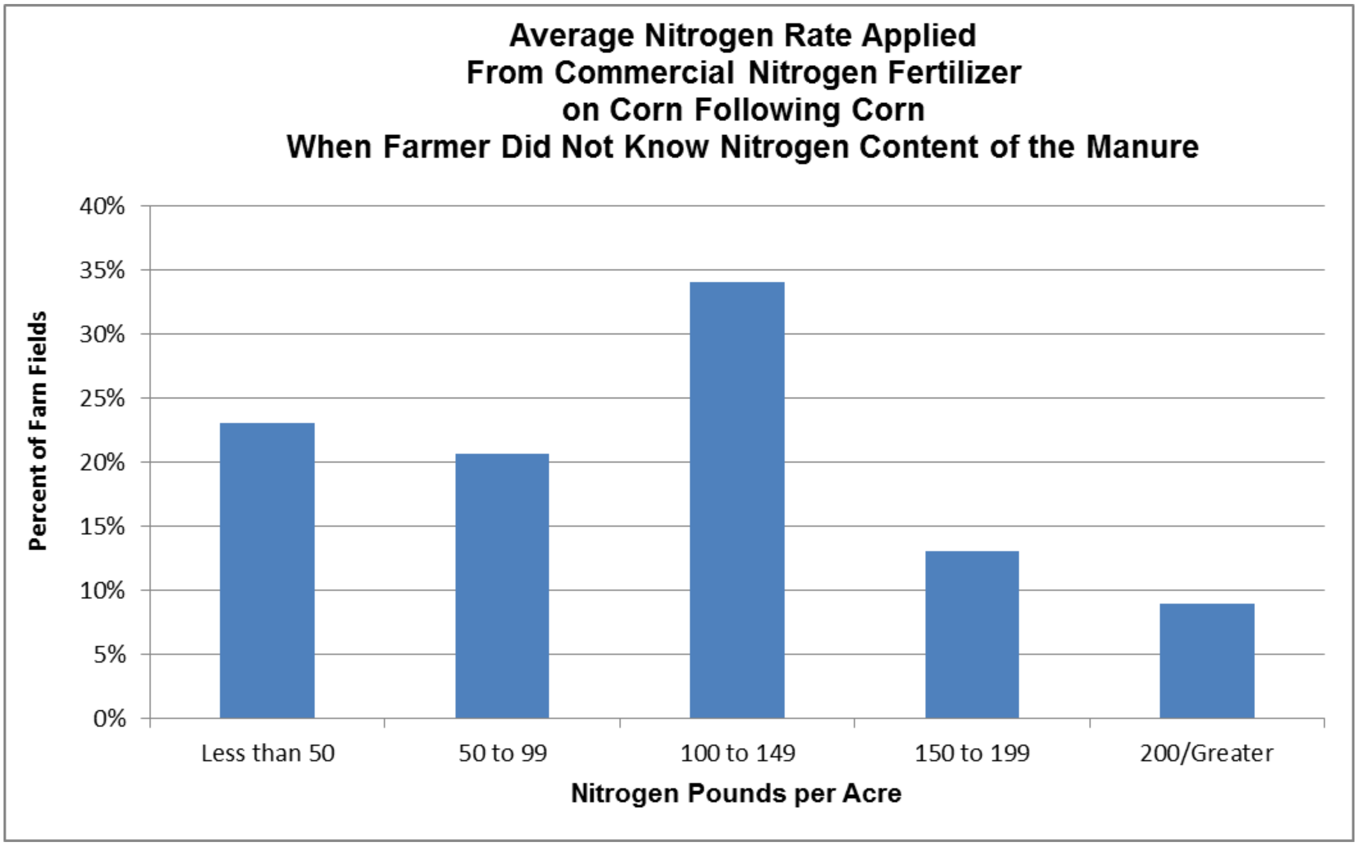

Figure 117. Average nitrogen rates applied to corn following corn from commercial nitrogen fertilizer in Minnesota for 2019 when the manure nitrogen content is unknown: 814 fields

Figure 118 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure or applied manure and commercial nitrogen fertilizer to corn following corn following alfalfa (CMQ-2, CMQ-3, CMQ-5, CMQ-10, and CMQ-14). The average corn yield was 167 bushels per acre. The average nitrogen rate applied from manure was 108 pounds per acre, and the average commercial nitrogen fertilizer rate was 44 pounds per acre for an average of 152 pounds of nitrogen per acre.

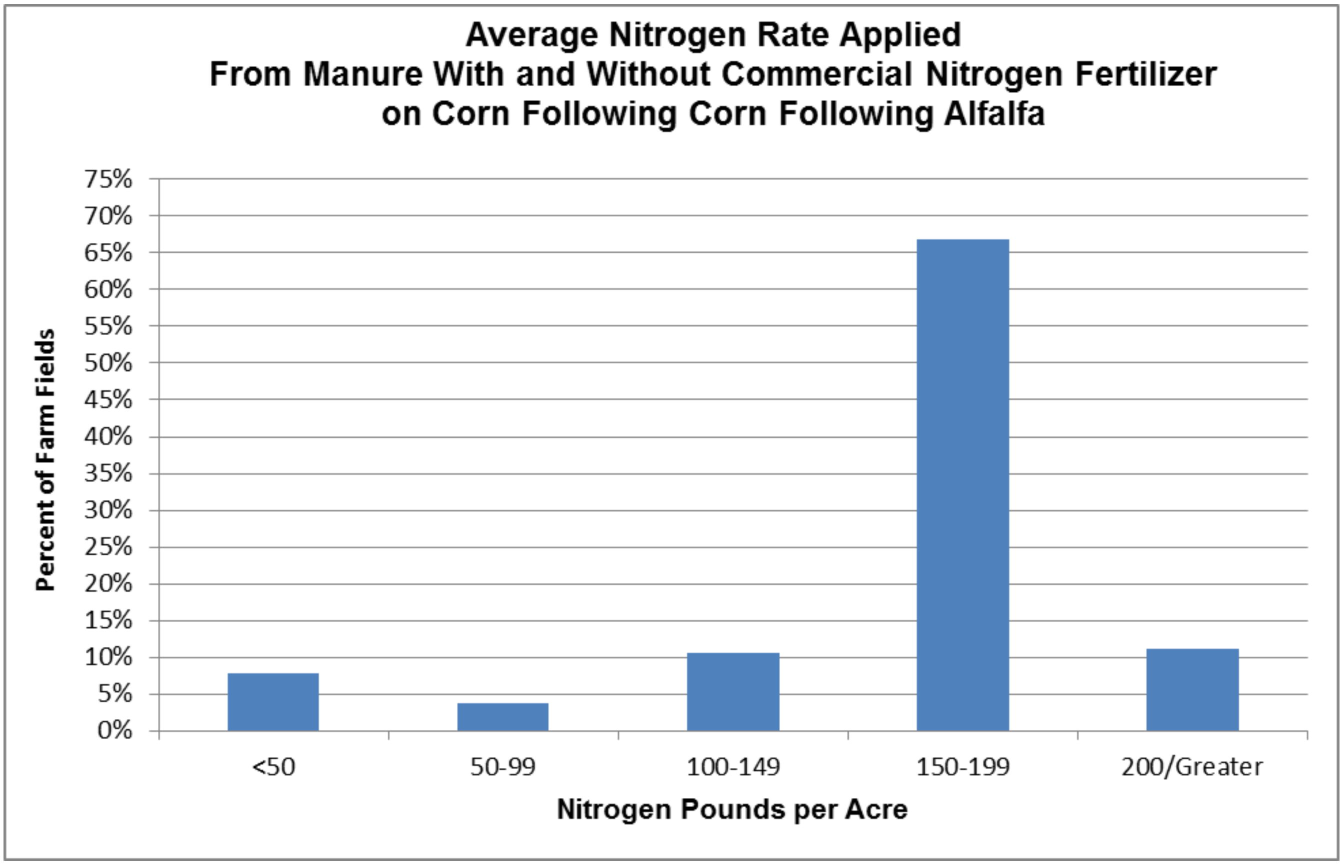

Figure 118. Average nitrogen rates applied to corn following corn following alfalfa from manure or manure and commercial nitrogen fertilizer in Minnesota for 2019: 698 fields

Figure 119 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and no commercial nitrogen fertilizer to corn following corn following alfalfa (CMQ-2, CMQ-3, CMQ-5, and CMQ-10). The average corn yield was 145 bushels per acre. The average nitrogen rate applied from manure was 118 pounds per acre.

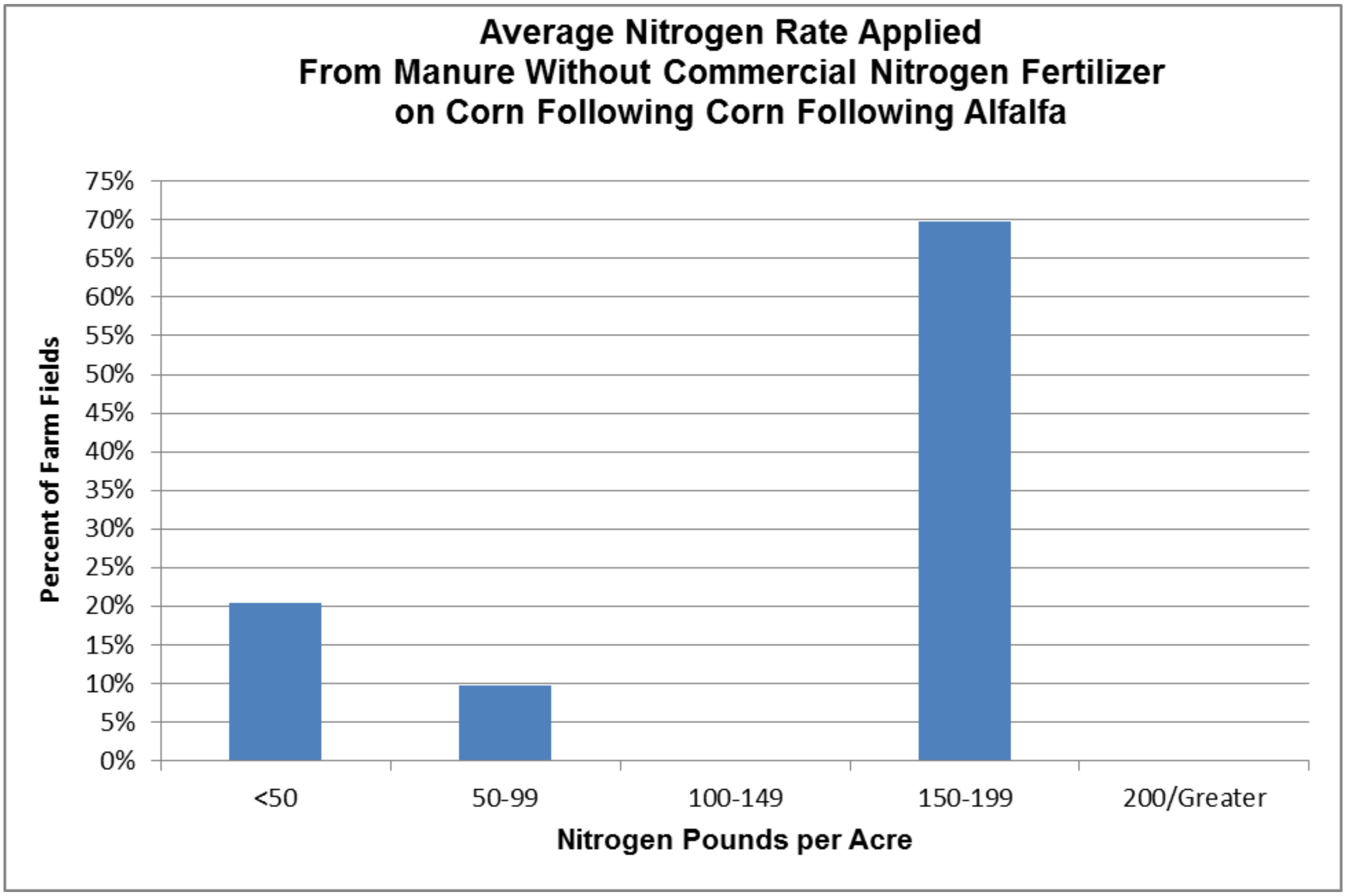

Figure 119. Average nitrogen rates applied to corn following corn following alfalfa from manure and no commercial nitrogen fertilizer in Minnesota for 2019: 266 fields

Figure 120 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and commercial nitrogen fertilizer to corn following corn following alfalfa (CMQ-2, CMQ-3, CMQ-5, CMQ-10 and CMQ-14). The average corn yield was 180 bushels per acre. The average nitrogen rate applied from manure was 102 pounds per acre, and the average commercial nitrogen fertilizer rate was 71 pounds per acre for an average of 173 pounds of nitrogen per acre.

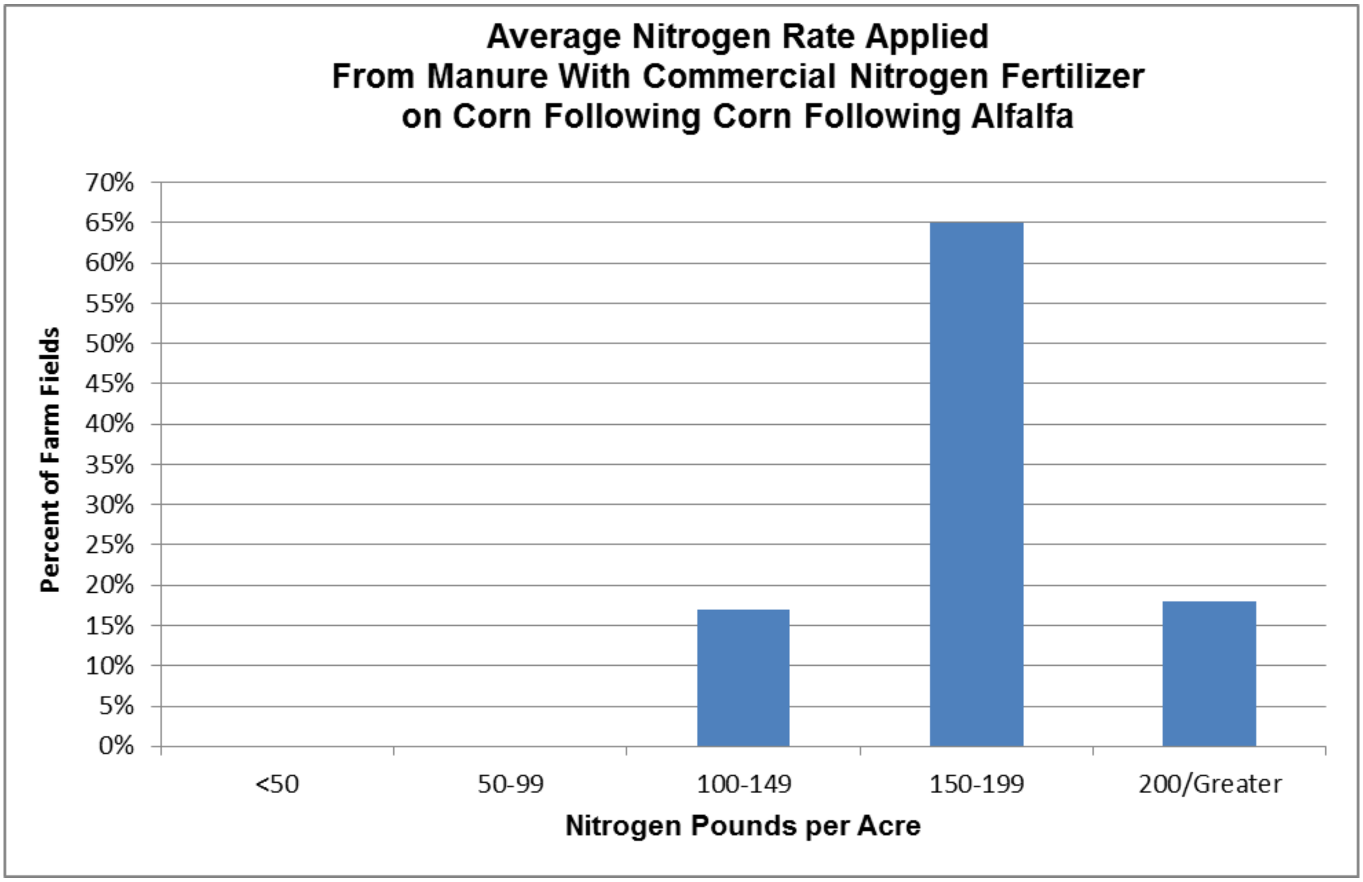

Figure 120. Average nitrogen rates applied to corn following corn following alfalfa from manure and commercial nitrogen fertilizer in Minnesota for 2019: 432 fields

Figure 121 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and commercial nitrogen fertilizer to corn following corn following alfalfa when the farmer did not know the nitrogen content of the manure application (CMQ-2, CMQ-3, CMQ-5, CMQ-10 and CMQ-14). Therefore, manure nitrogen was not included in that analysis when the quantity of nitrogen from manure applied to the field is not known. The average corn yield was 136 bushels per acre. The average commercial nitrogen fertilizer rate was 80 pounds per acre.

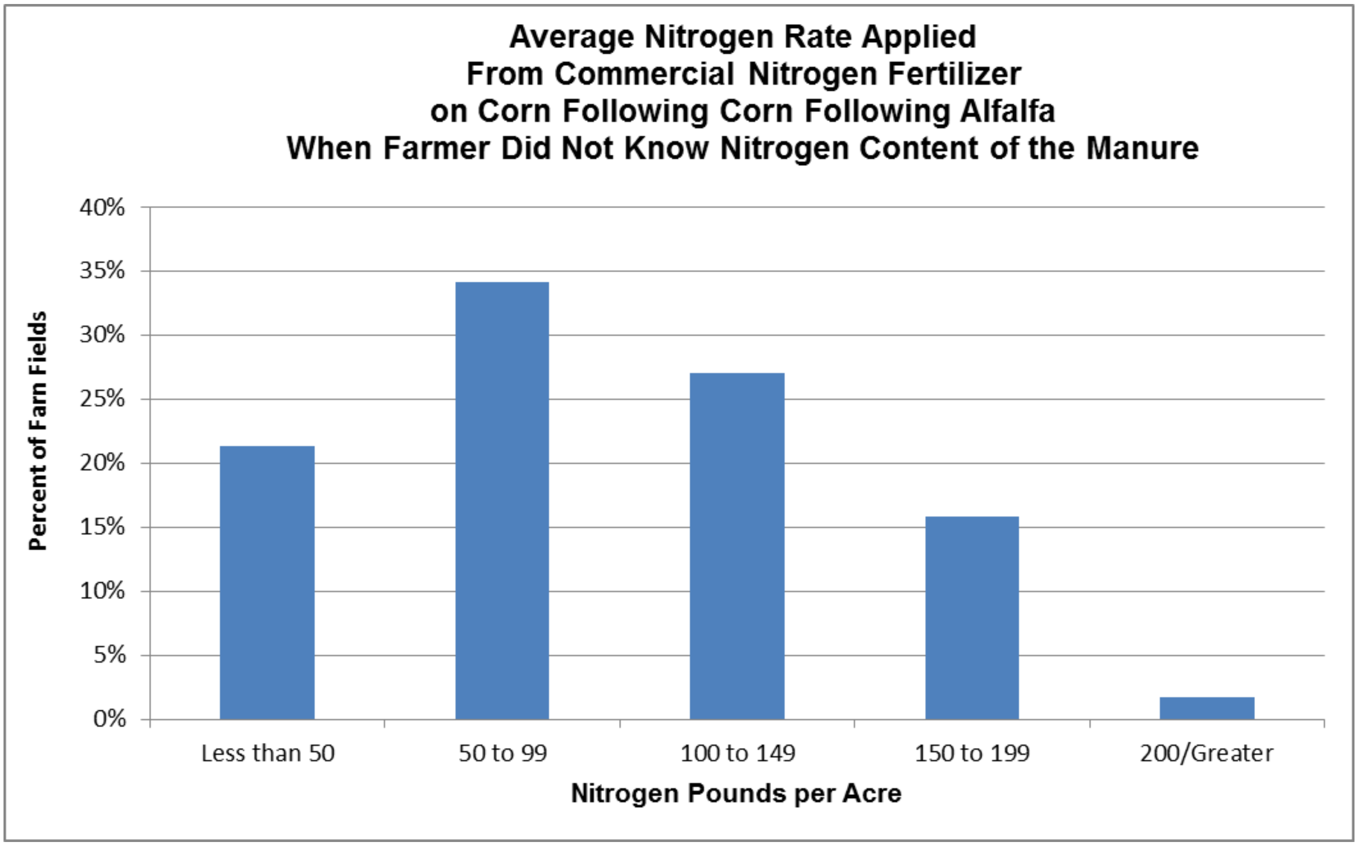

Figure 121. Average nitrogen rates applied to corn following corn following alfalfa from commercial nitrogen fertilizer in Minnesota for 2019 when the manure nitrogen content is unknown: 361 fields

Figure 122 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure or applied manure and commercial nitrogen fertilizer to corn following alfalfa (CMQ-2, CMQ-5, CMQ-10, and CMQ-14). The average corn yield was 153 bushels per acre. The average nitrogen rate applied from manure was 107 pounds per acre, and the average commercial nitrogen fertilizer rate was 70 pounds per acre for an average of 177 pounds of nitrogen per acre.

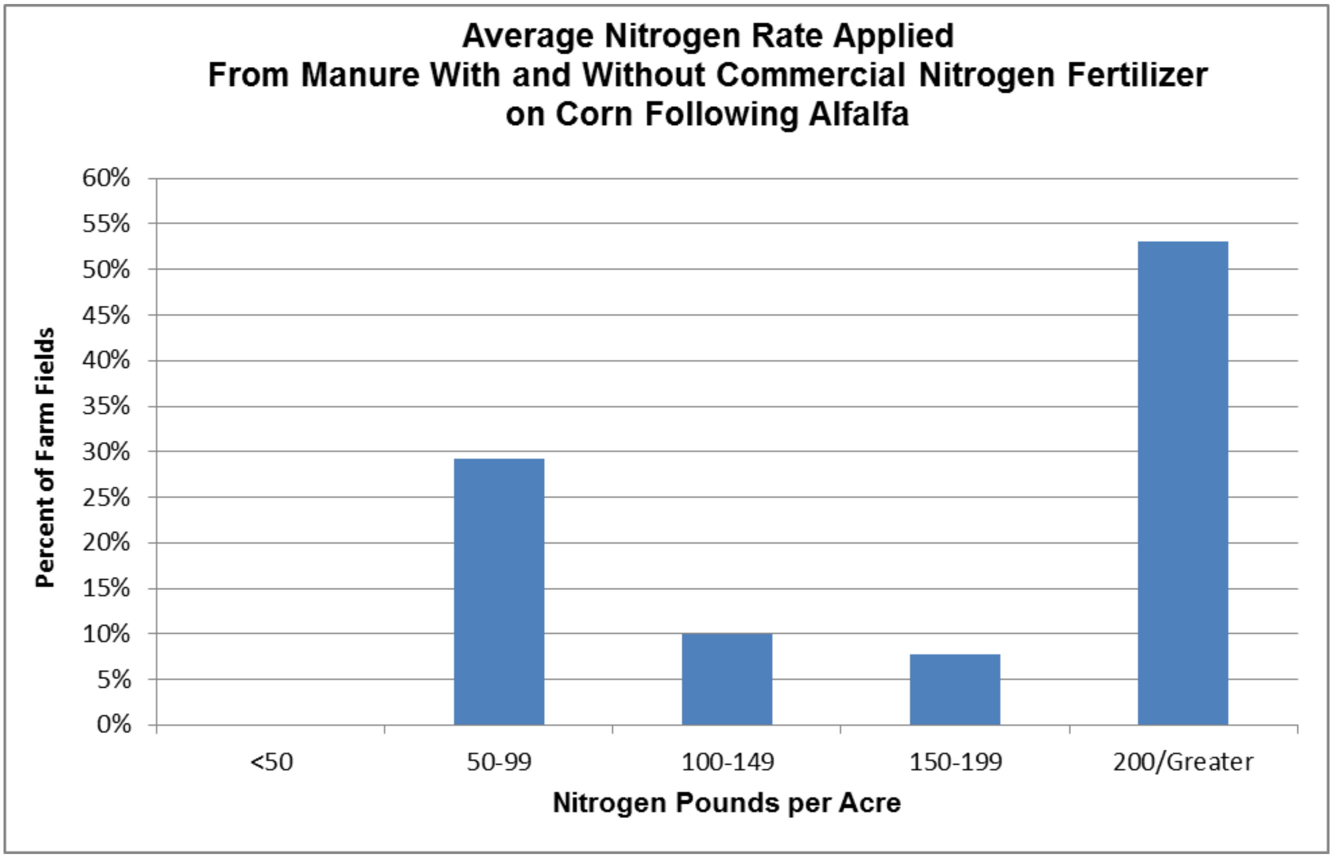

Figure 122. Average nitrogen rates applied to corn following alfalfa from manure or manure and commercial nitrogen fertilizer in Minnesota for 2019: 297 fields

Less than five responses reported manure nitrogen rates from:

- Corn following alfalfa without commercial nitrogen fertilizer.

Figure 123 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and commercial nitrogen fertilizer to corn following alfalfa (CMQ-2, CMQ-5, CMQ-10, and CMQ-14). The average corn yield was 156 bushels per acre. The average nitrogen rate applied from manure was 111 pounds per acre, and the average commercial nitrogen fertilizer rate was 87 pounds per acre for an average of 198 pounds of nitrogen per acre.

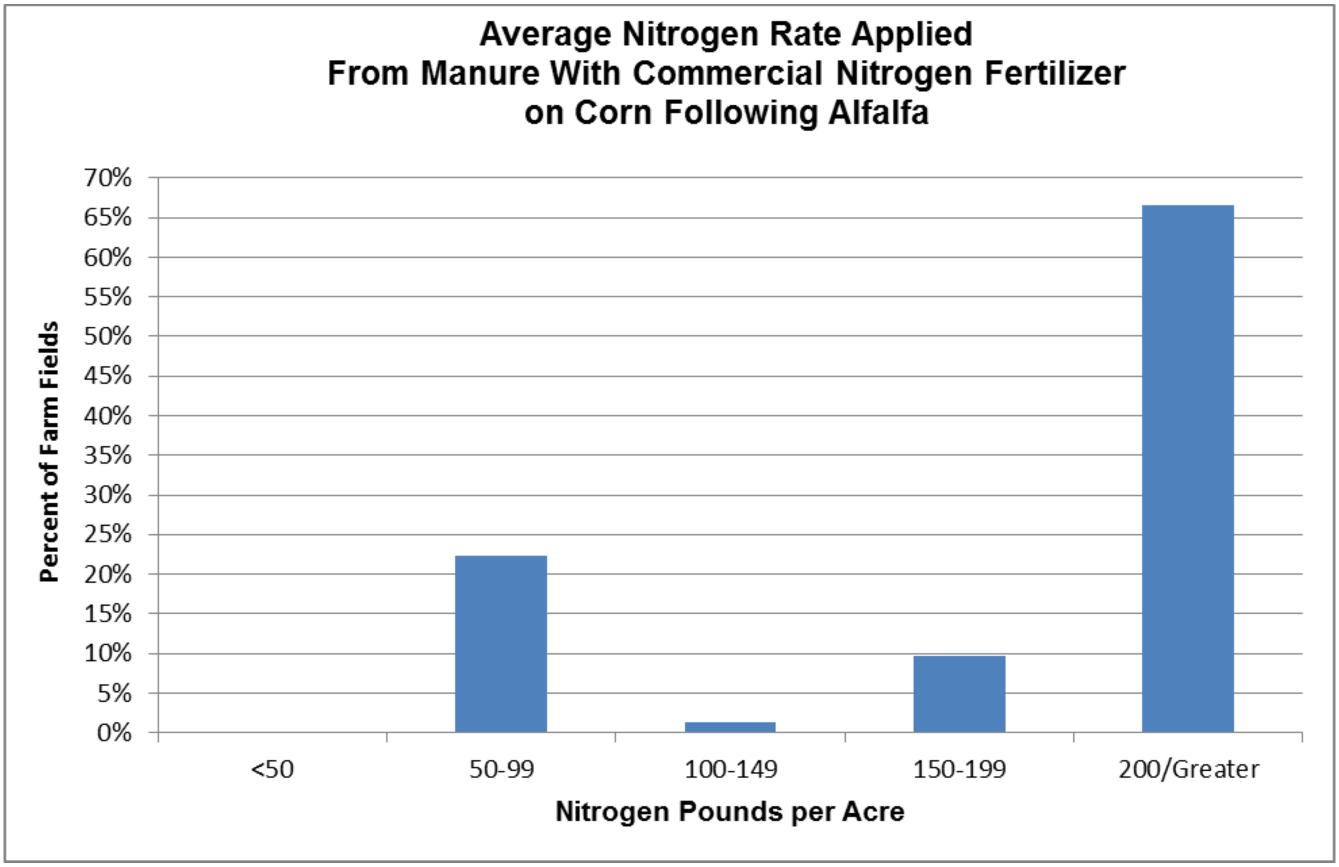

Figure 123. Average nitrogen rates applied to corn following alfalfa from manure and commercial nitrogen fertilizer in Minnesota for 2019: 237 fields

Figure 124 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and commercial nitrogen fertilizer to corn following alfalfa when the farmer did not know the nitrogen content of the manure application (CMQ-2, CMQ-5, CMQ-10 and CMQ-14). Therefore, manure nitrogen was not included in that analysis when the quantity of nitrogen from manure applied to the field is not known. The average corn yield was 159 bushels per acre. The average commercial nitrogen fertilizer rate was 48 pounds per acre.

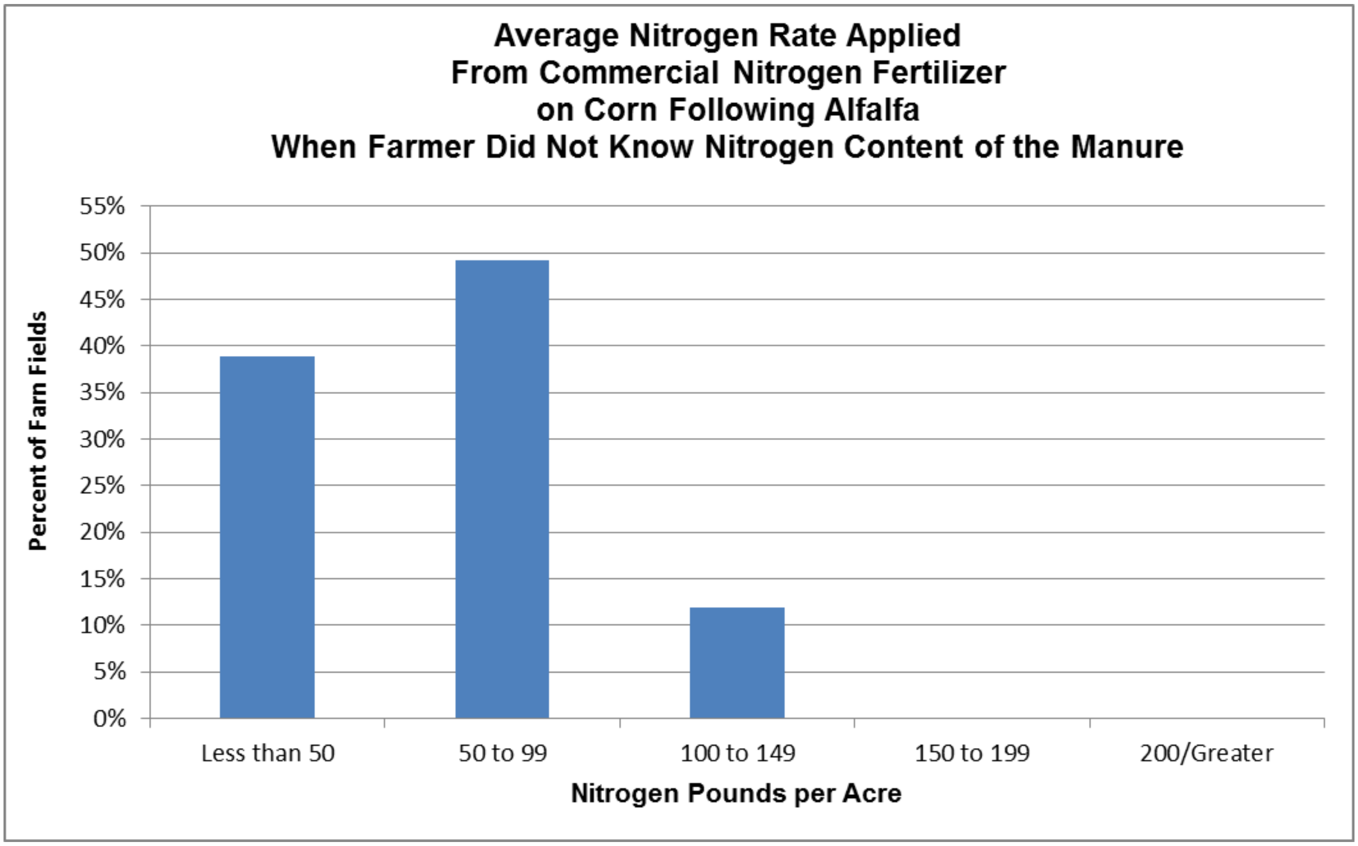

Figure 124. Average nitrogen rates applied to corn following alfalfa from commercial nitrogen fertilizer in Minnesota for 2019 when the manure nitrogen content is unknown: 126 fields

Figure 125 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure or applied manure and commercial nitrogen fertilizer to corn following small grains (CMQ-2, CMQ-5, CMQ-10, and CMQ-14). The average corn yield was 163 bushels per acre. The average nitrogen rate applied from manure was 114 pounds per acre, and the average commercial nitrogen fertilizer rate was 47 pounds per acre for an average of 161 pounds of nitrogen per acre.

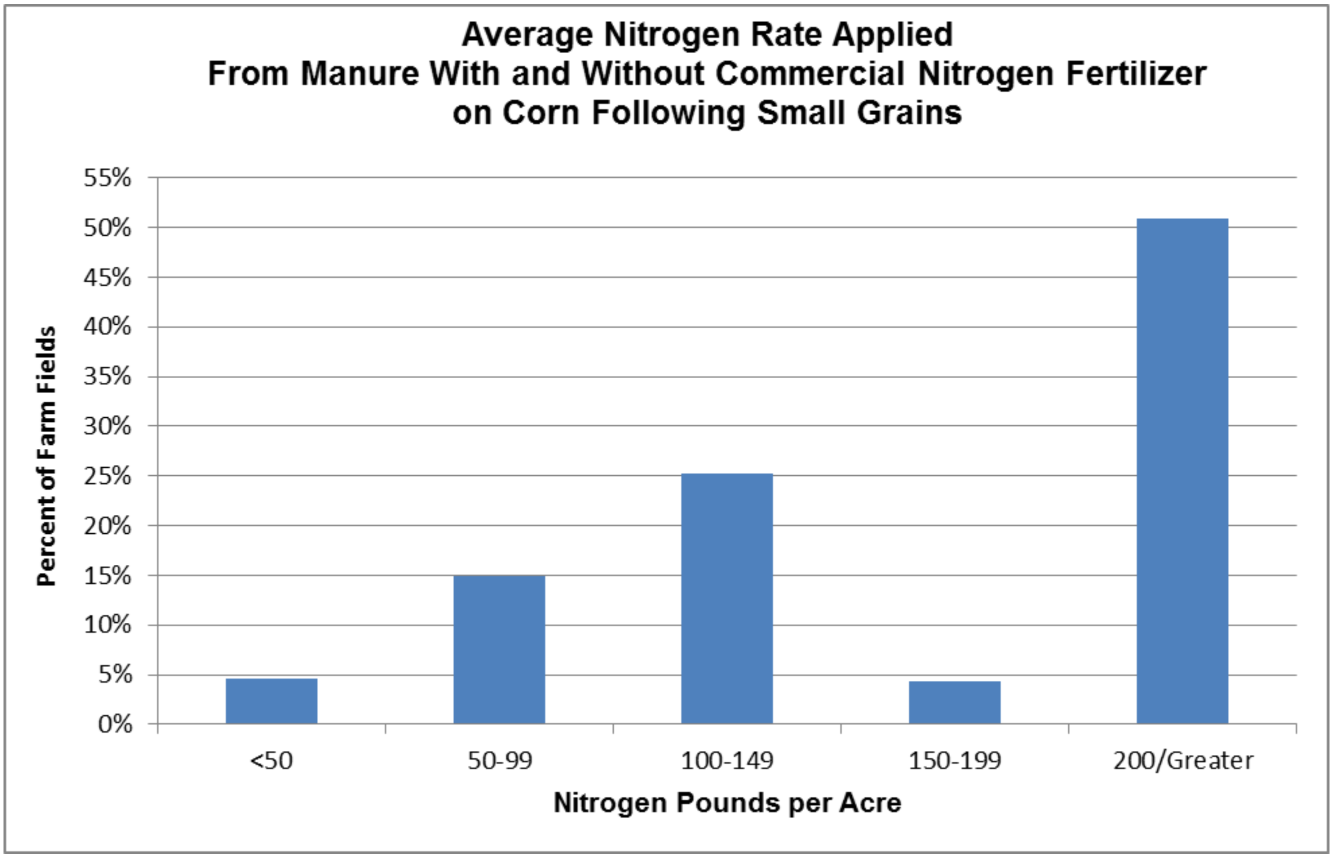

Figure 125. Average nitrogen rates applied to corn following corn following small grains from manure or manure and commercial nitrogen fertilizer in Minnesota for 2019: 268 fields

Figure 126 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and no commercial nitrogen fertilizer to corn following small grains (CMQ-2, CMQ-5, and CMQ-10). The average corn yield was 153 bushels per acre. The average nitrogen rate applied from manure was 135 pounds per acre.

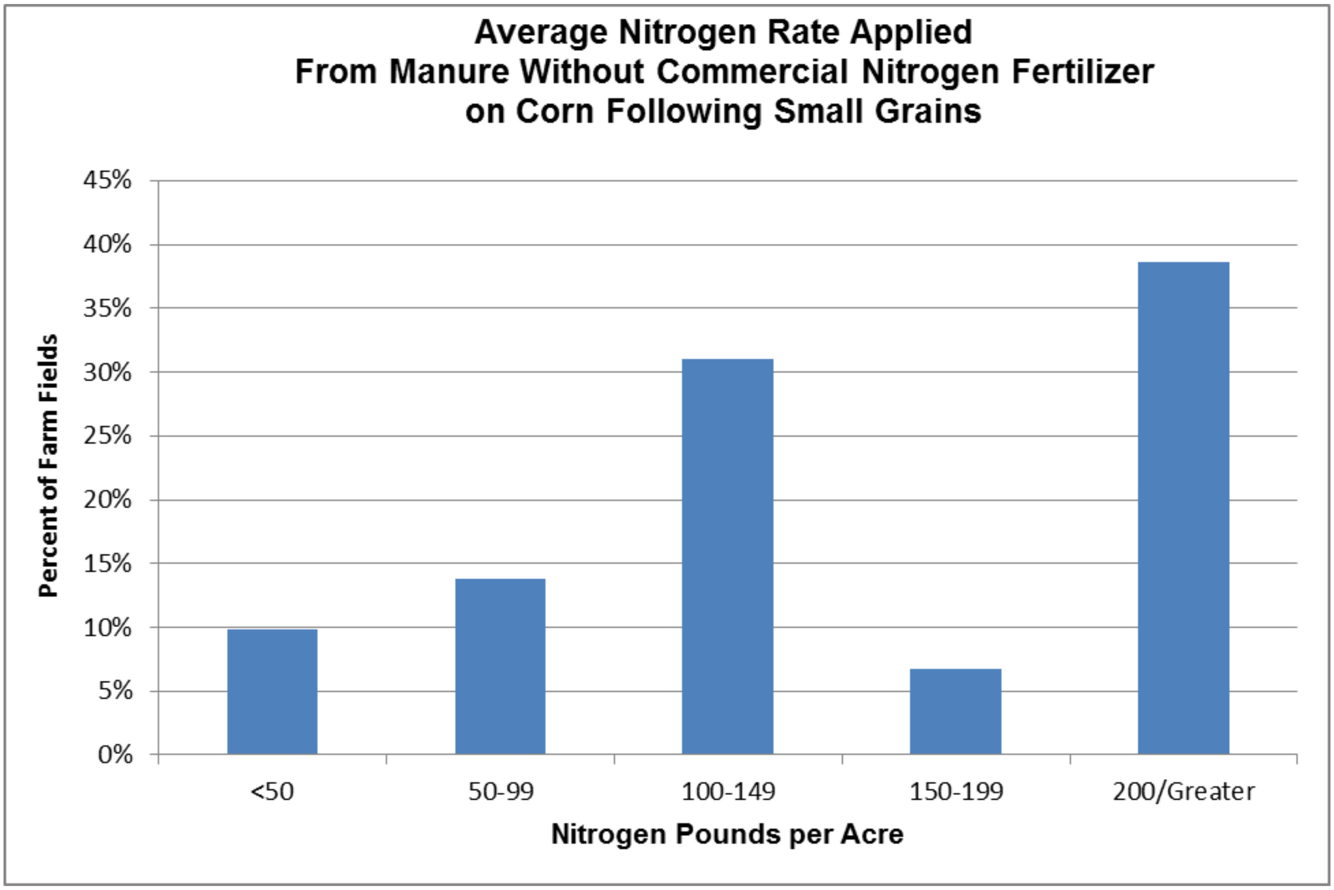

Figure 126. Average nitrogen rates applied to corn following small grains from manure and no commercial nitrogen fertilizer in Minnesota for 2019: 127 fields

Figure 127 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and commercial nitrogen fertilizer to corn following small grains (CMQ-2, CMQ-5, CMQ-10, and CMQ-14). The average corn yield was 172 bushels per acre. The average nitrogen rate applied from manure was 94 pounds per acre, and the average commercial nitrogen fertilizer rate was 89 pounds per acre for an average of 184 pounds of nitrogen per acre.

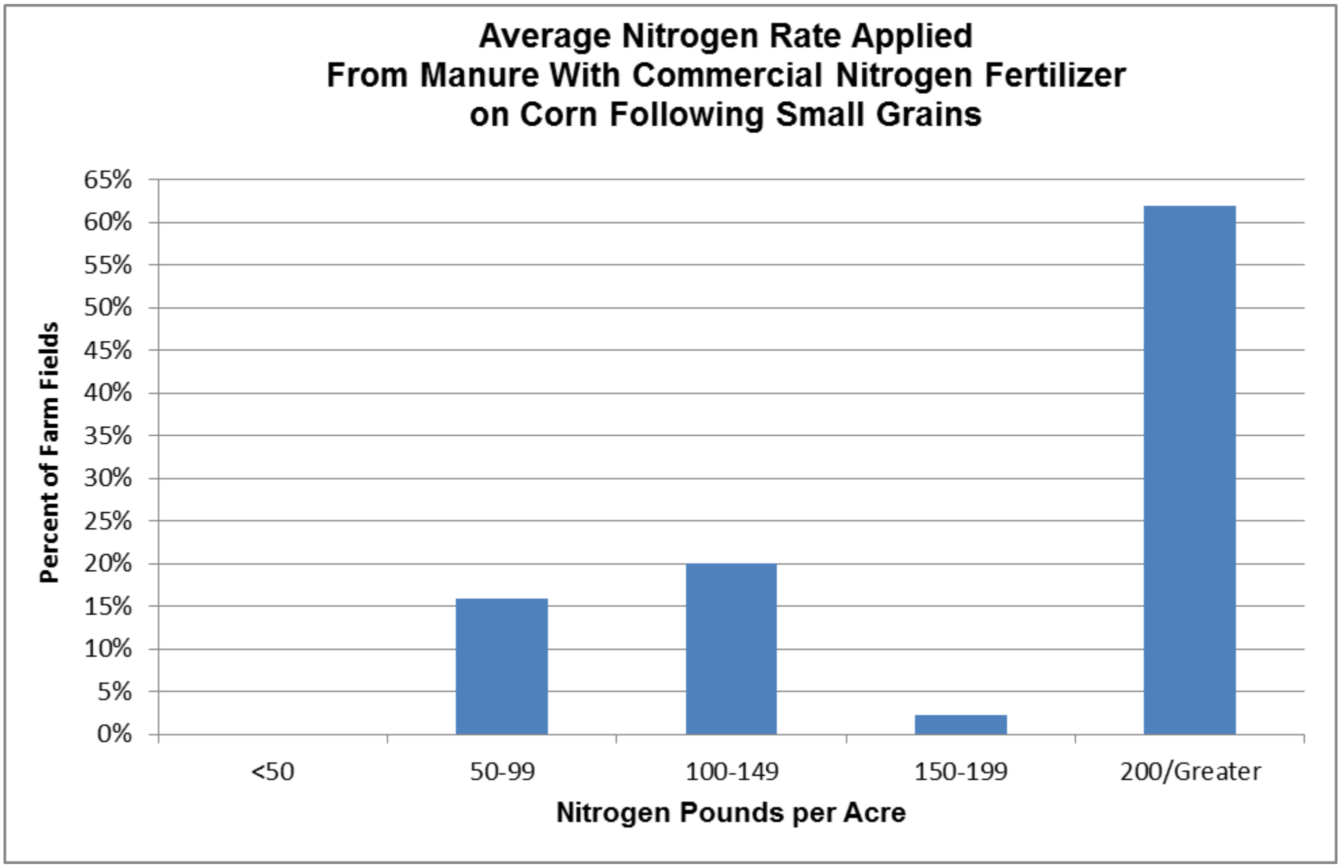

Figure 127. Average nitrogen rates applied to corn following small grains from manure and commercial nitrogen fertilizer in Minnesota for 2019: 141 fields

Figure 128 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and commercial nitrogen fertilizer to corn following small grains when the farmer did not know the nitrogen content of the manure application (CMQ-2, CMQ-5, CMQ-10 and CMQ-14). Therefore, manure nitrogen was not included in that analysis when the quantity of nitrogen from manure applied to the field is not known. The average corn yield was 139 bushels per acre. The average commercial nitrogen fertilizer rate was 82 pounds per acre.

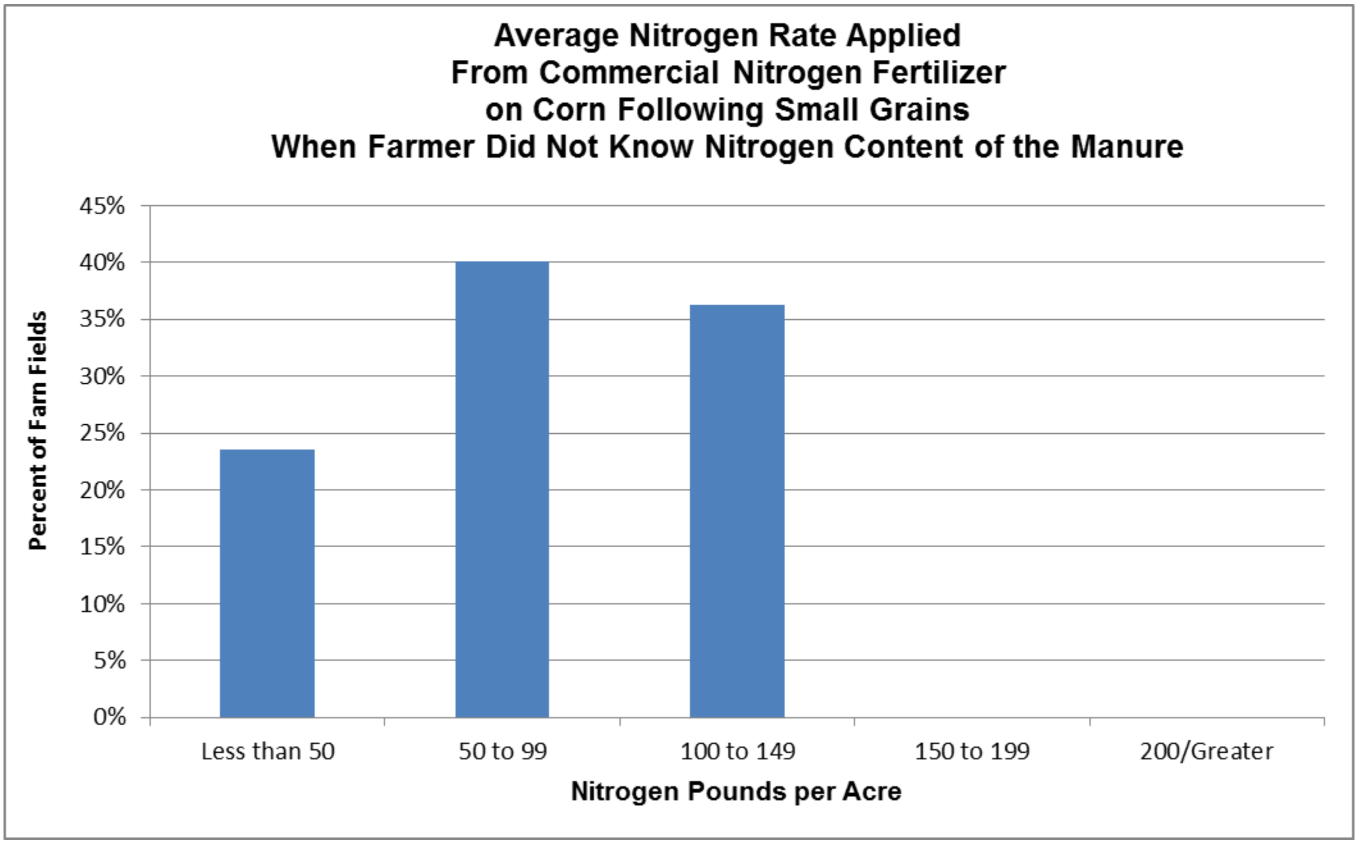

Figure 128. Average nitrogen rates applied to corn following small grains from commercial nitrogen fertilizer in Minnesota for 2019 when the manure nitrogen content is unknown: 179 fields

Figure 129 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure or applied manure and commercial nitrogen fertilizer to corn following other crops (CMQ-2, CMQ-5, CMQ-10 and CMQ-14). The average corn yield was 159 bushels per acre. The average nitrogen rate applied from manure was 111 pounds per acre, and the average commercial nitrogen fertilizer rate was 44 pounds per acre for an average of 155 pounds of nitrogen per acre.

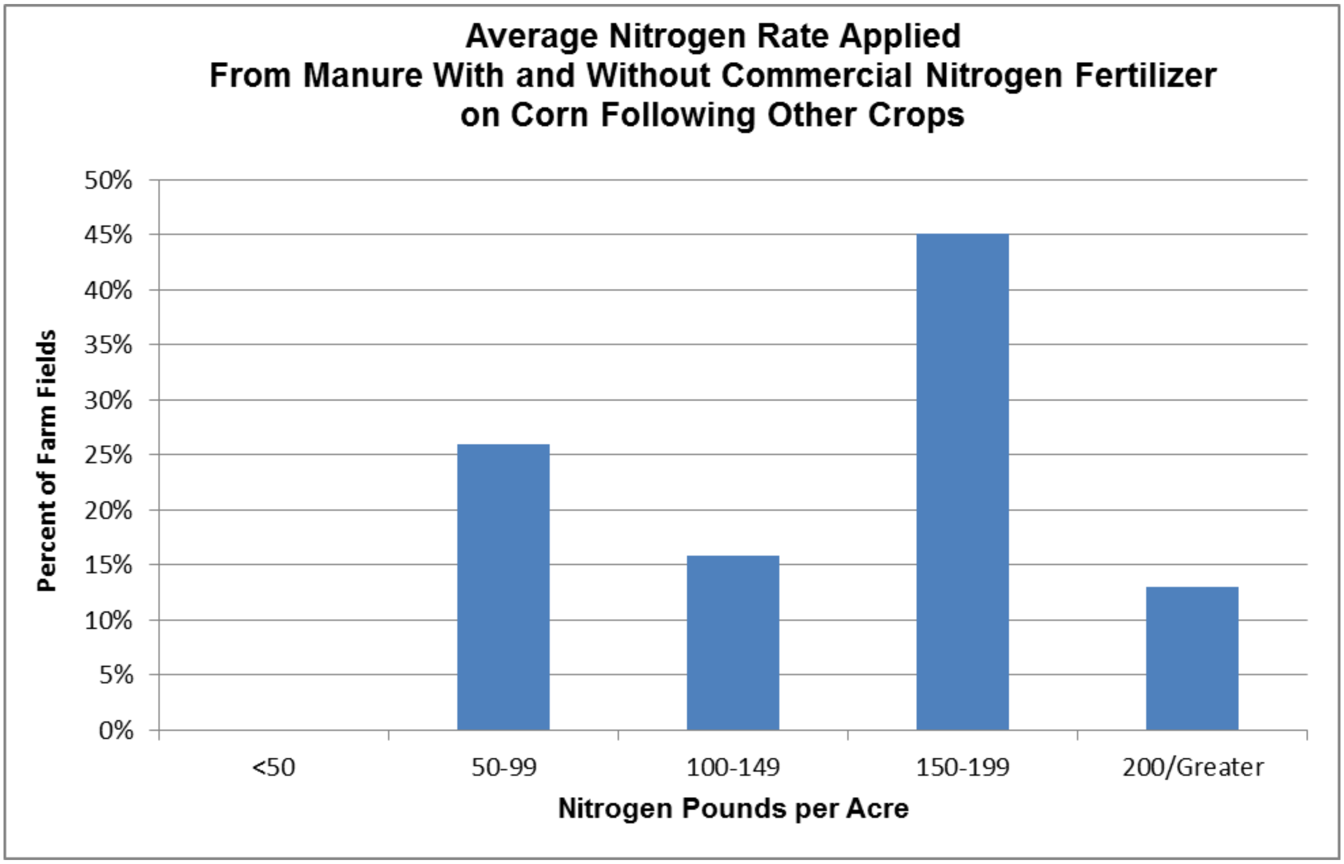

Figure 129. Average nitrogen rates applied to corn following other crops from manure or manure and commercial nitrogen fertilizer in Minnesota for 2019: 135 fields

Less than five responses reported nitrogen rates from manure and commercial nitrogen fertilizer to corn following other crops:

- When the farmer knew the amount of nitrogen in the manure with commercial nitrogen fertilizer.
- When the farmer knew the amount of nitrogen in the manure with no commercial nitrogen fertilizer.

Figure 130 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and commercial nitrogen fertilizer to corn following other crops when the farmer did not know the nitrogen content of the manure application (CMQ-2, CMQ-5, CMQ-10 and CMQ-14). Therefore, manure nitrogen was not included in that analysis when the quantity of nitrogen from manure applied to the field is not known. The average corn yield was 130 bushels per acre. The average commercial nitrogen fertilizer rate was 132 pounds per acre.

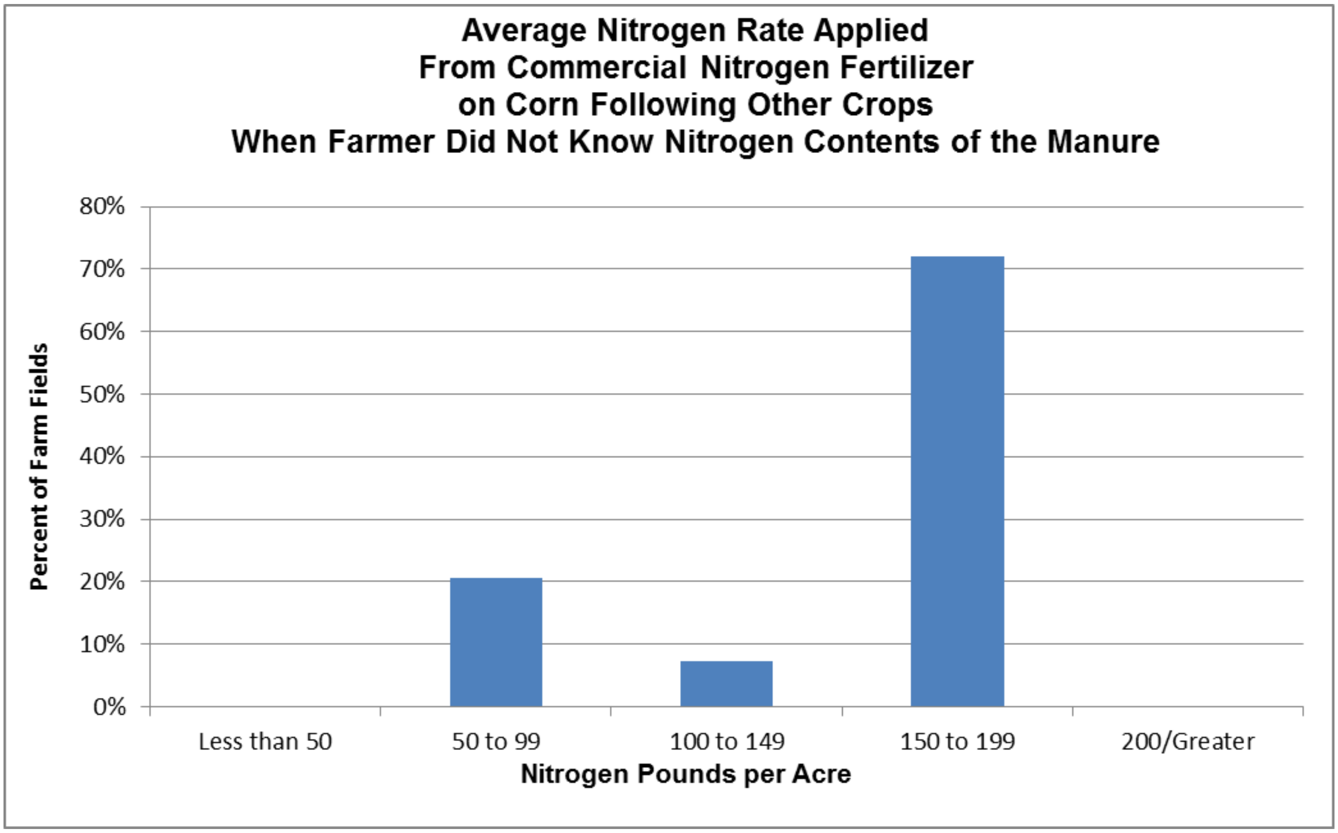

Figure 130. Average nitrogen rates applied to corn following other crops from commercial nitrogen fertilizer in Minnesota for 2019 when the manure nitrogen content is unknown: 117 fields

Nitrogen Applications from Dairy Manure for Corn following All Crops

Figure 131 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure or applied dairy manure and commercial nitrogen fertilizer to corn following soybeans (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 188 bushels per acre. The average nitrogen rate applied from dairy manure was 137 pounds per acre, and the average commercial nitrogen fertilizer rate was 39 pounds per acre for an average of 176 pounds of nitrogen per acre.

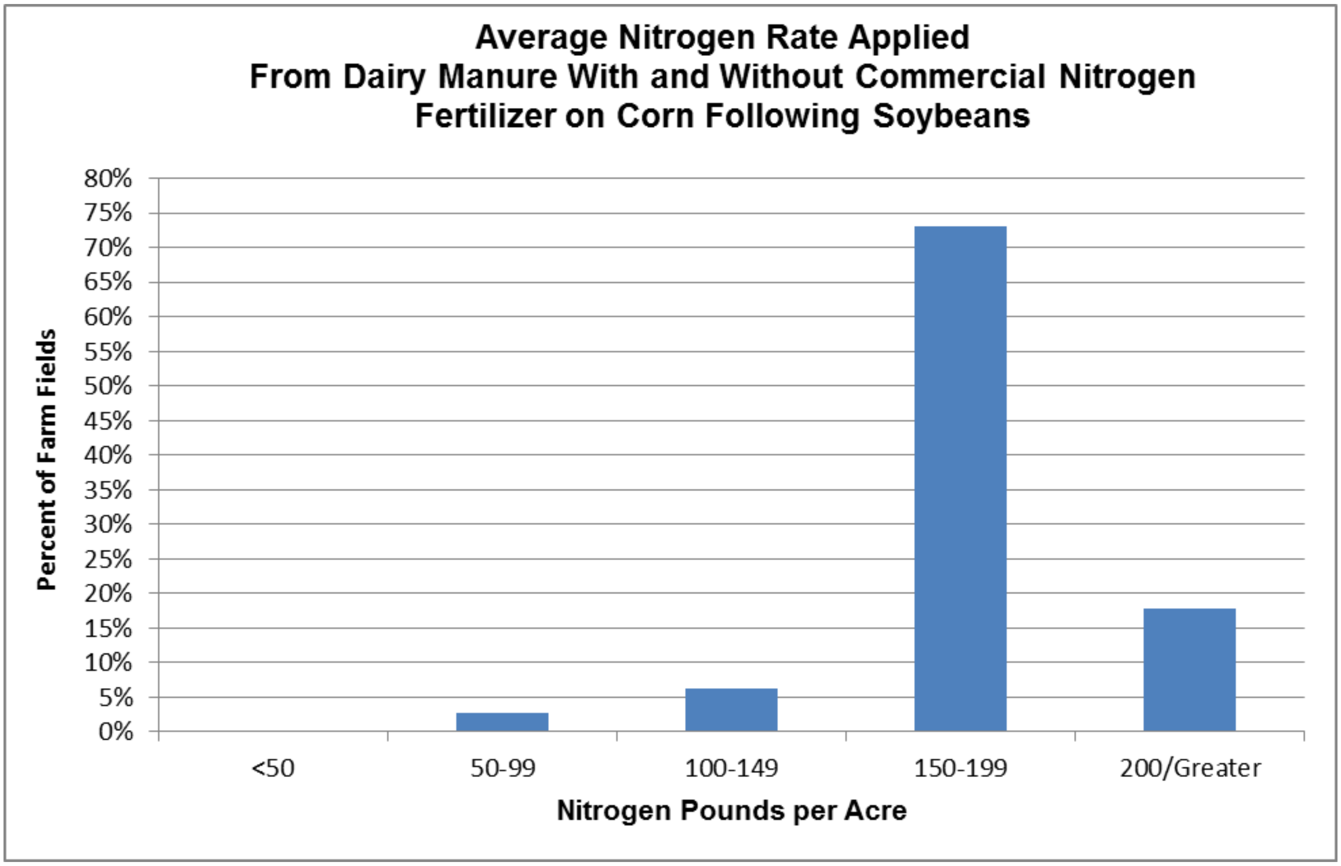

Figure 131. Average nitrogen rates applied to corn following soybeans from dairy manure or dairy manure and commercial nitrogen fertilizer in Minnesota for 2019: 864 fields

Figure 132 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure and no commercial nitrogen fertilizer to corn following soybeans (CMQ-2, CMQ-7, and CMQ-10). The average corn yield was 189 bushels per acre. The average nitrogen rate applied from dairy manure was 168 pounds per acre.

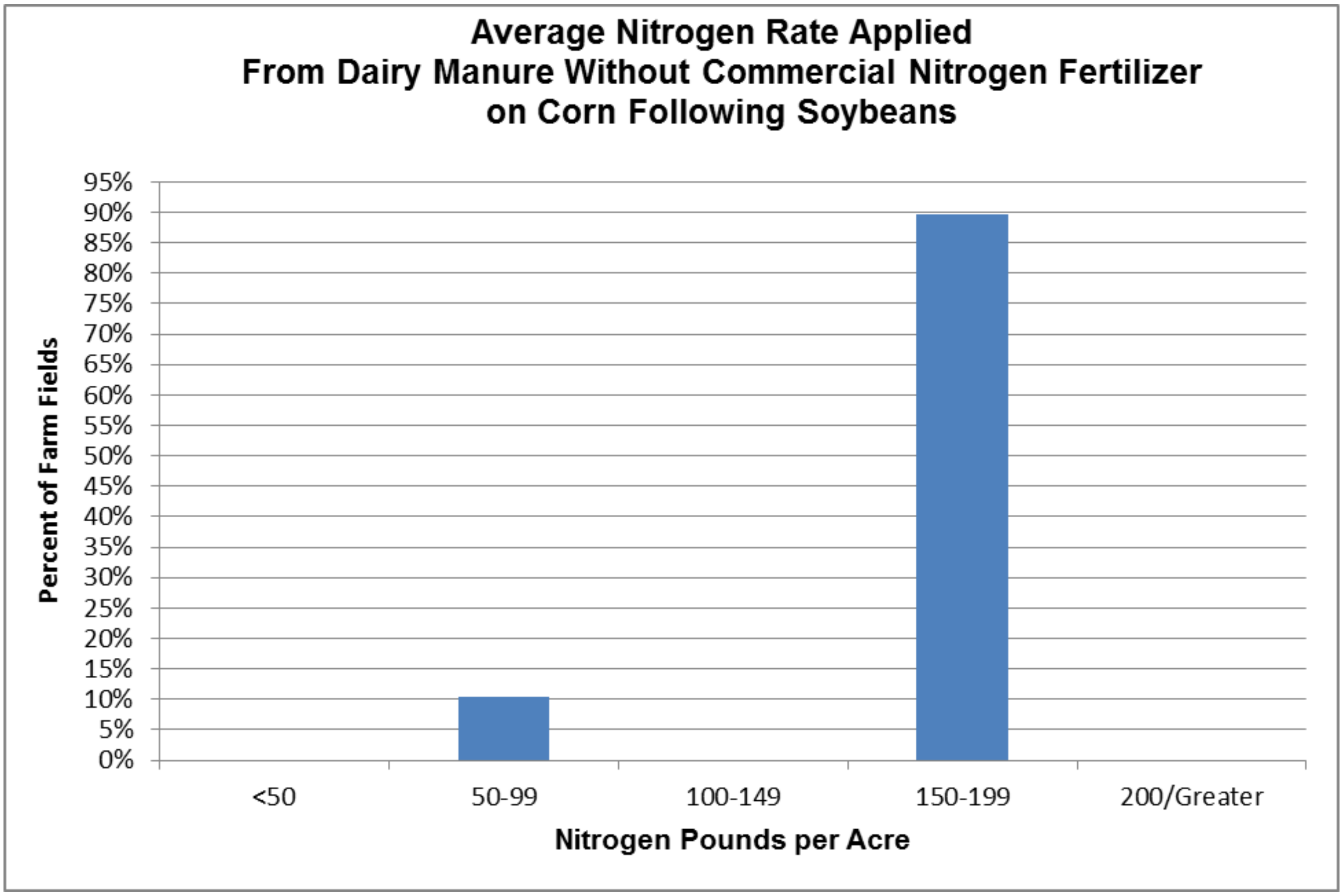

Figure 132. Average nitrogen rates applied to corn following soybeans from dairy manure and no commercial nitrogen fertilizer in Minnesota for 2019: 230 fields

Figure 133 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure and commercial nitrogen fertilizer to corn following soybeans (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 187 bushels per acre. The average nitrogen rate applied from dairy manure was 126 pounds per acre, and the average commercial nitrogen fertilizer rate was 53 pounds per acre for an average of 179 pounds of nitrogen per acre.

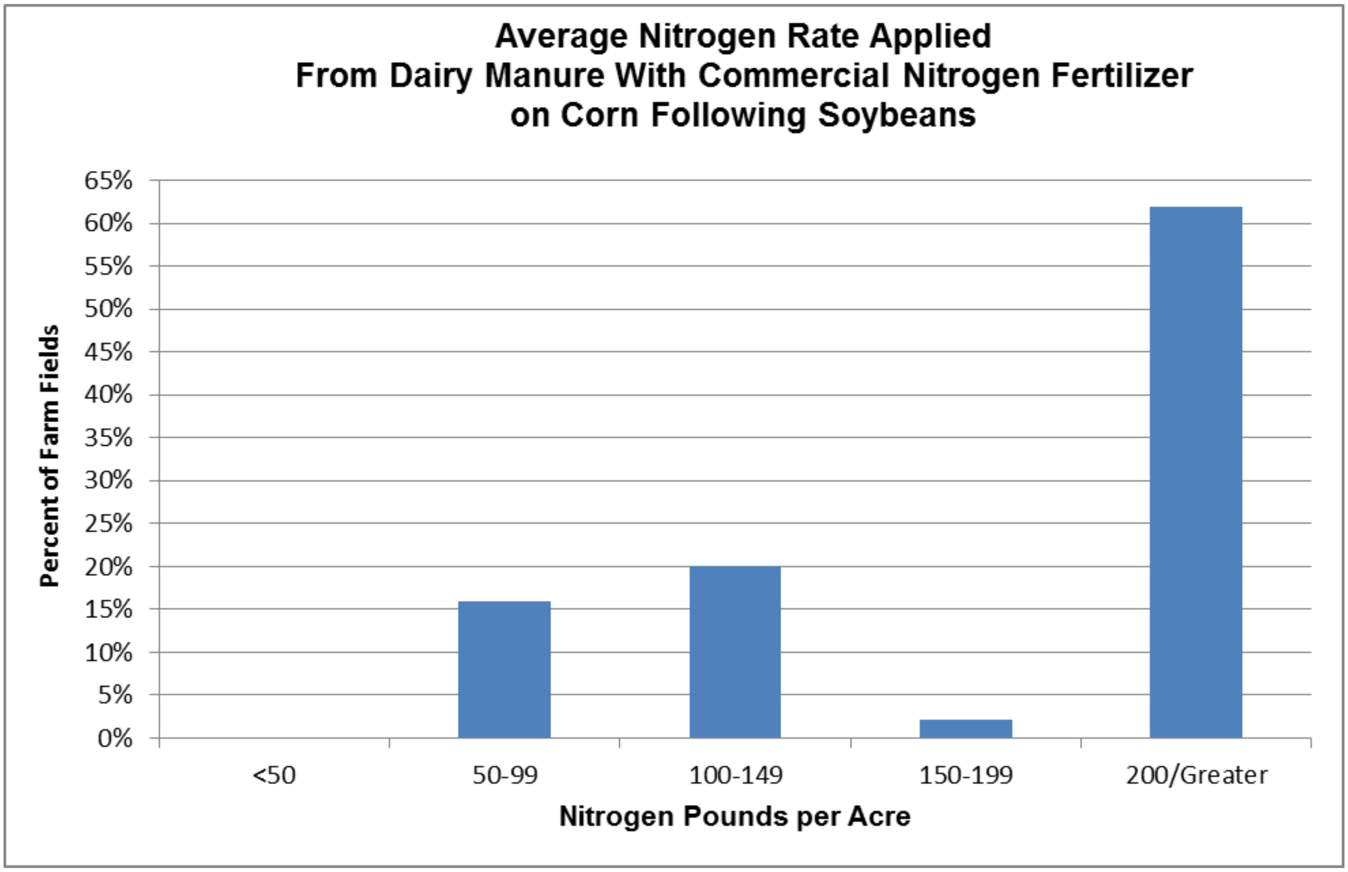

Figure 133. Average nitrogen rates applied to corn following soybeans from dairy manure and commercial nitrogen fertilizer in Minnesota for 2019: 634 fields

Figure 134 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure and commercial nitrogen fertilizer to corn following soybeans when the farmer did not know the nitrogen content of the dairy manure application (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). Therefore, dairy manure nitrogen was not included in that analysis when the quantity of nitrogen from dairy manure applied to the field is not known. The average corn yield was 200 bushels per acre. The average commercial nitrogen fertilizer rate was 75 pounds per acre.

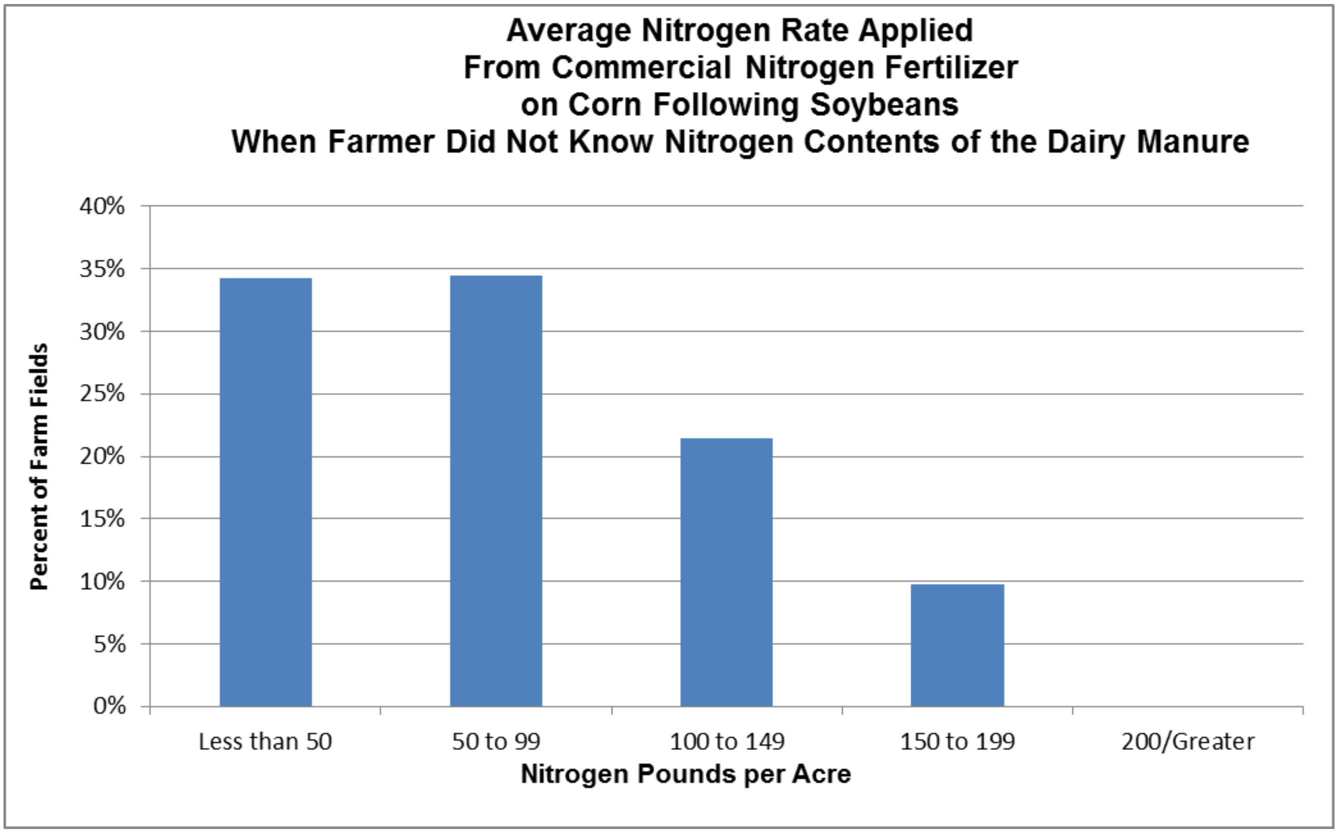

Figure 134. Average nitrogen rates applied to corn following soybeans from commercial nitrogen fertilizer in Minnesota for 2019 when the dairy manure nitrogen content is unknown: 98 fields

Figure 135 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure or applied dairy manure and commercial nitrogen fertilizer to corn following corn (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 182 bushels per acre. The average nitrogen rate applied from dairy manure was 111 pounds per acre, and the average commercial nitrogen fertilizer rate was 63 pounds per acre for an average of 174 pounds of nitrogen per acre.

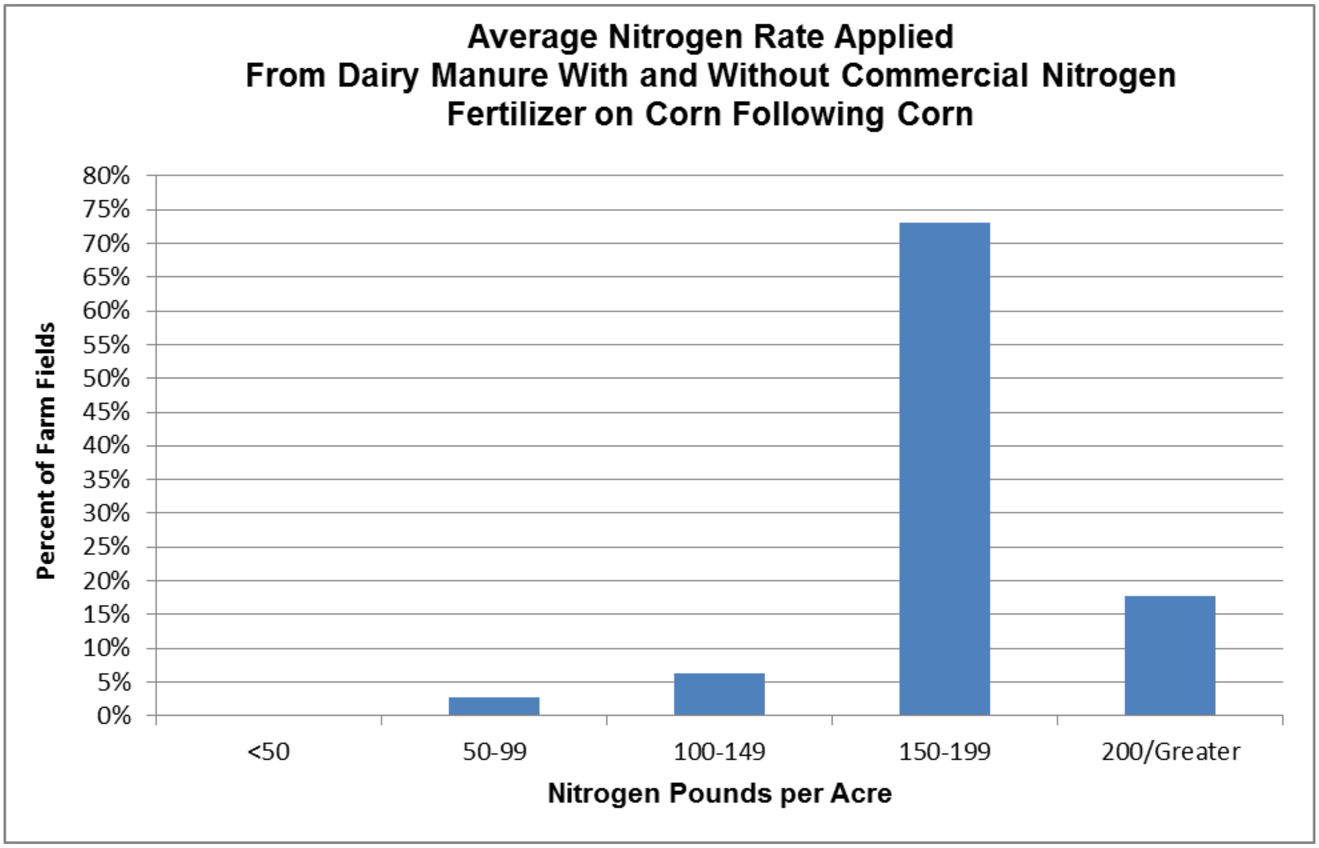

Figure 135. Average nitrogen rates applied to corn following corn from dairy manure or dairy manure and commercial nitrogen fertilizer in Minnesota for 2019: 750 fields

Figure 136 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure and no commercial nitrogen fertilizer to corn following corn (CMQ-2, CMQ-7, and CMQ-10). The average corn yield was 178 bushels per acre. The average nitrogen rate applied from dairy manure was 164 pounds per acre.

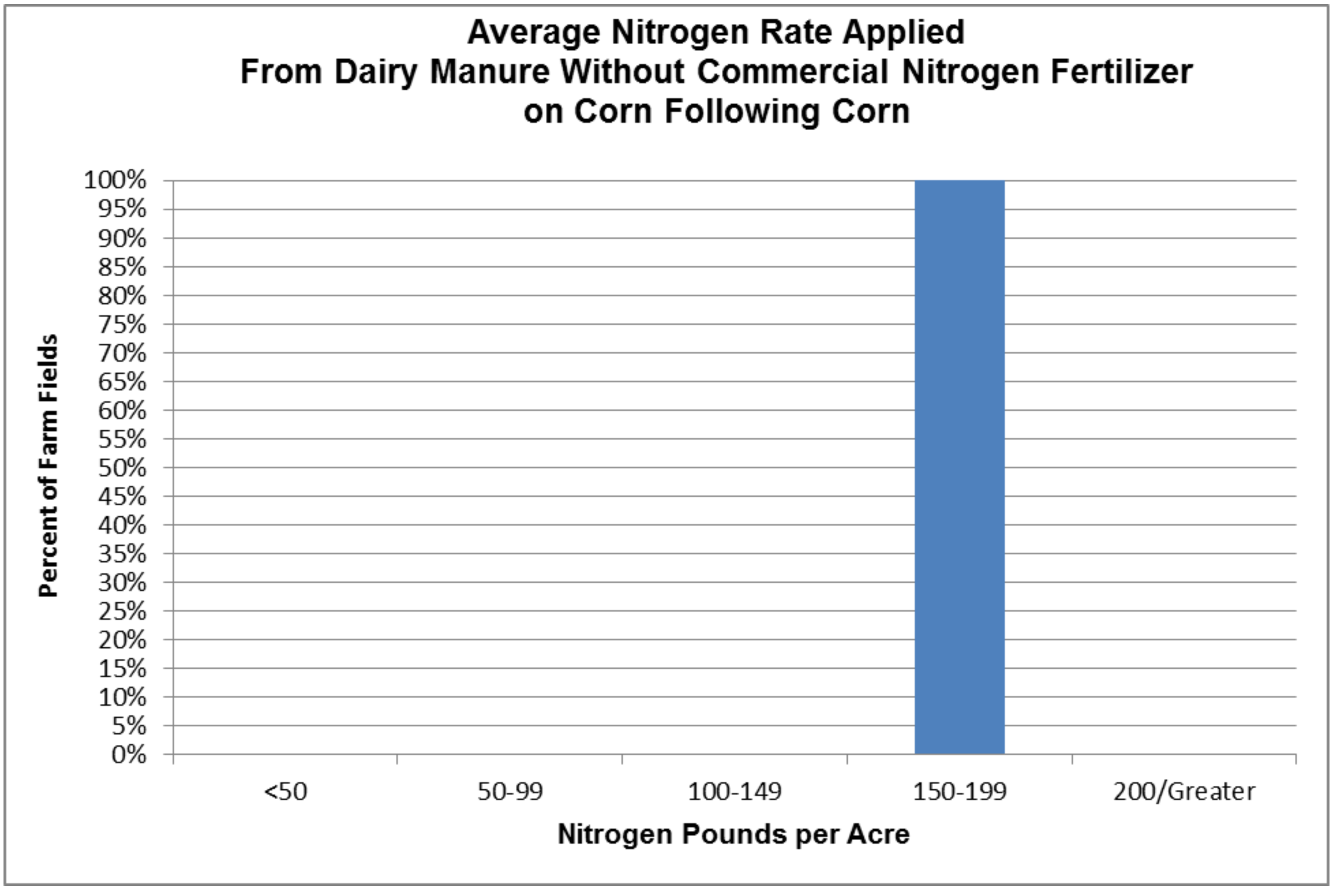

Figure 136. Average nitrogen rates applied to corn following corn from dairy manure and no commercial nitrogen fertilizer in Minnesota for 2019: 126 fields

Figure 137 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure and commercial nitrogen fertilizer to corn following corn (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 183 bushels per acre. The average nitrogen rate applied from dairy manure was 101 pounds per acre, and the average commercial nitrogen fertilizer rate was 75 pounds per acre for an average of 176 pounds of nitrogen per acre.

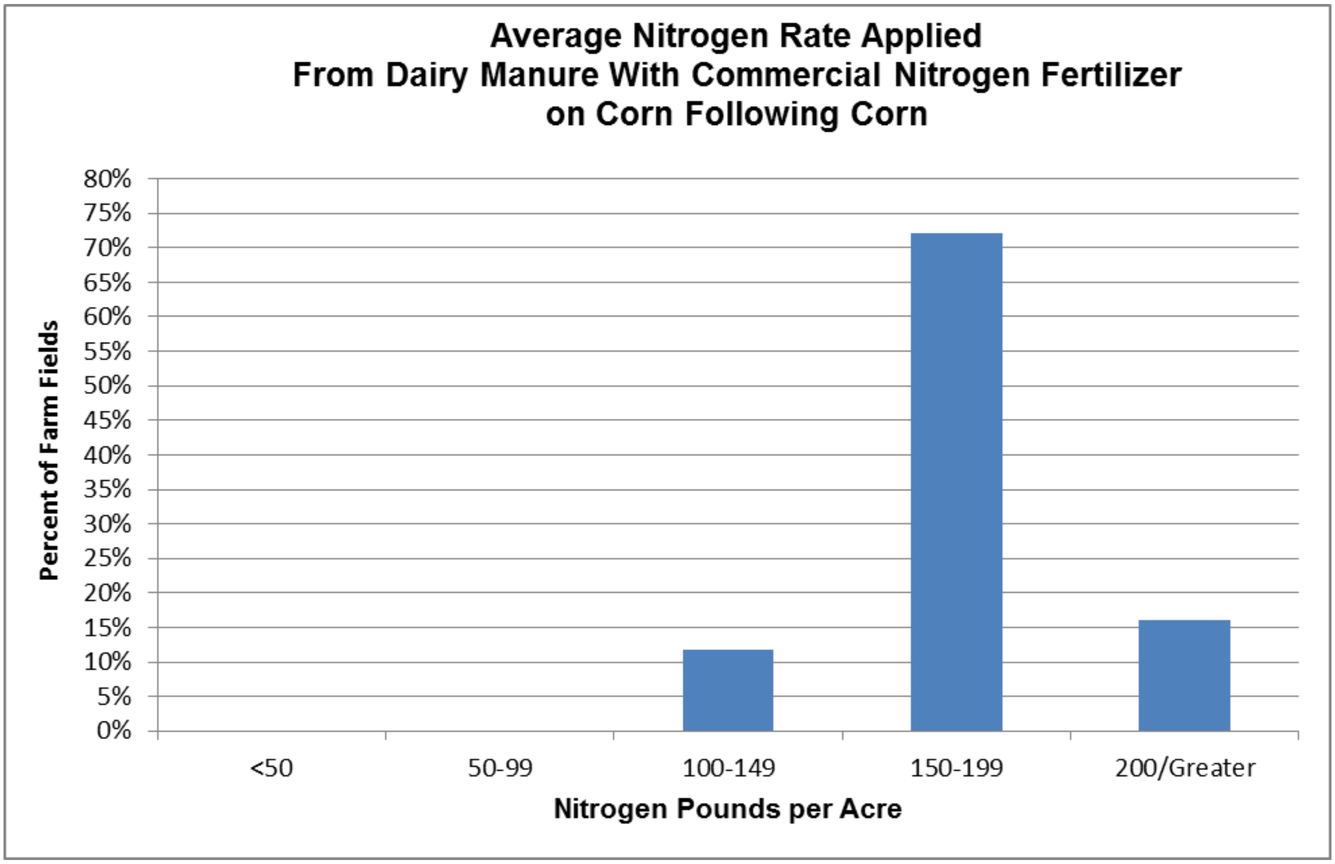

Figure 137. Average nitrogen rates applied to corn following corn from dairy manure and commercial nitrogen fertilizer in Minnesota for 2019: 624 fields

Figure 138 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure and commercial nitrogen fertilizer to corn following corn when the farmer did not know the nitrogen content of the dairy manure application (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). Therefore, dairy manure nitrogen was not included in that analysis when the quantity of nitrogen from dairy manure applied to the field is not known. The average corn yield was 179 bushels per acre. The average commercial nitrogen fertilizer rate was 93 pounds per acre.

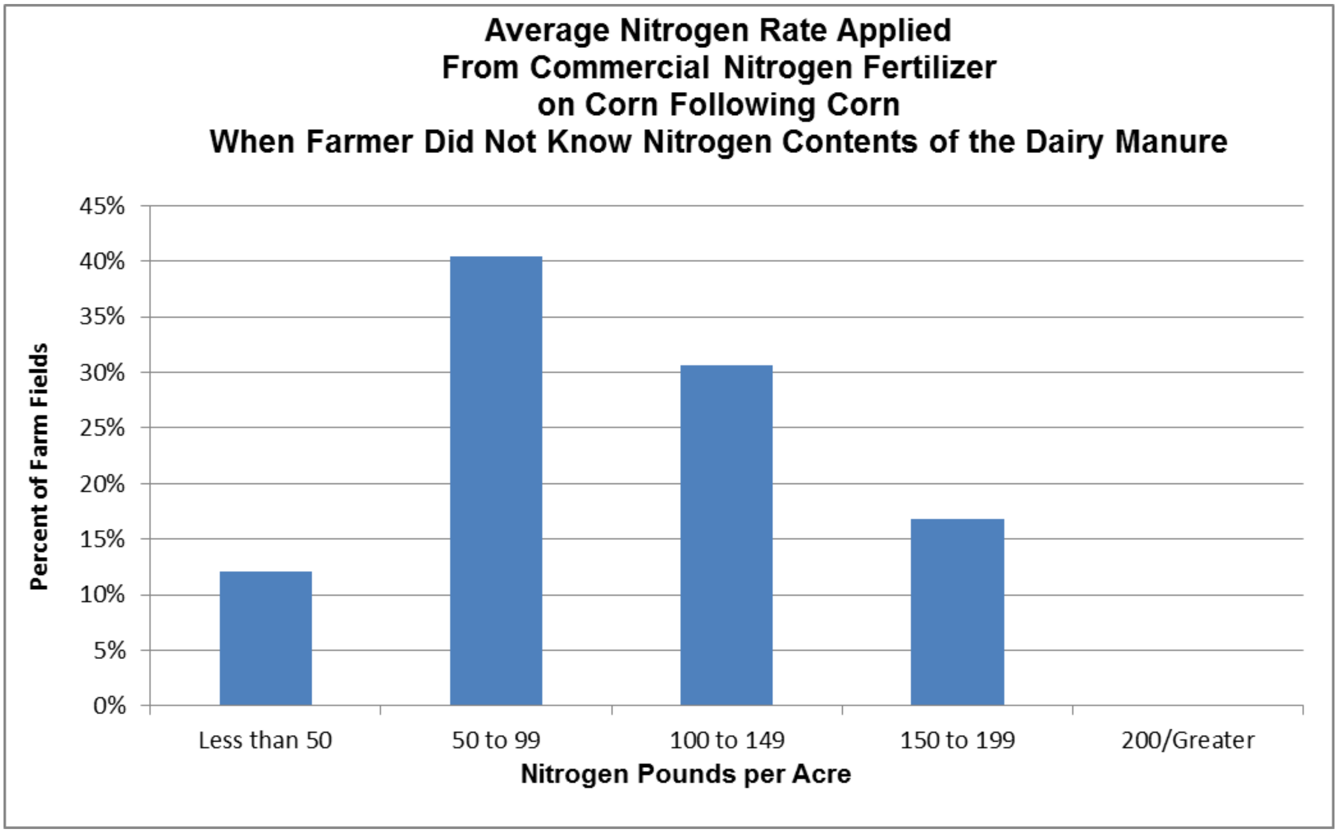

Figure 138. Average nitrogen rates applied to corn following corn from commercial nitrogen fertilizer in Minnesota for 2019 when the dairy manure nitrogen content is unknown: 168 fields

Figure 139 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure or applied dairy manure and commercial nitrogen fertilizer to corn following corn following alfalfa (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 167 bushels per acre. The average nitrogen rate applied from dairy manure was 113 pounds per acre, and the average commercial nitrogen fertilizer rate was 40 pounds per acre for an average of 153 pounds of nitrogen per acre.

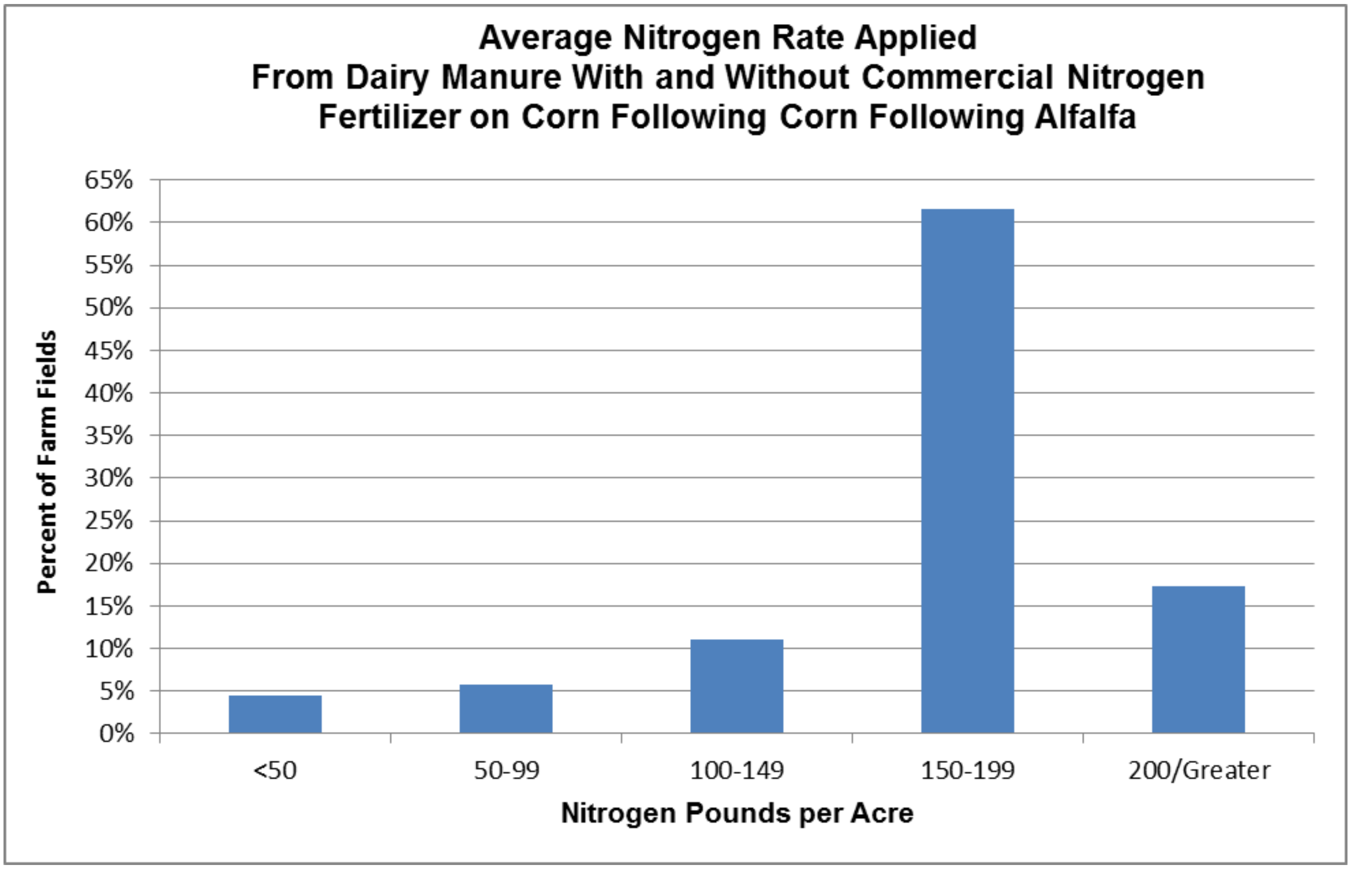

Figure 139. Average nitrogen rates applied to corn following corn following alfalfa from dairy manure or dairy manure and commercial nitrogen fertilizer in Minnesota for 2019: 450 fields

Figure 140 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure and no commercial nitrogen fertilizer to corn following corn following alfalfa (CMQ-2, CMQ-7, and CMQ-10). The average corn yield was 130 bushels per acre. The average nitrogen rate applied from dairy manure was 153 pounds per acre.

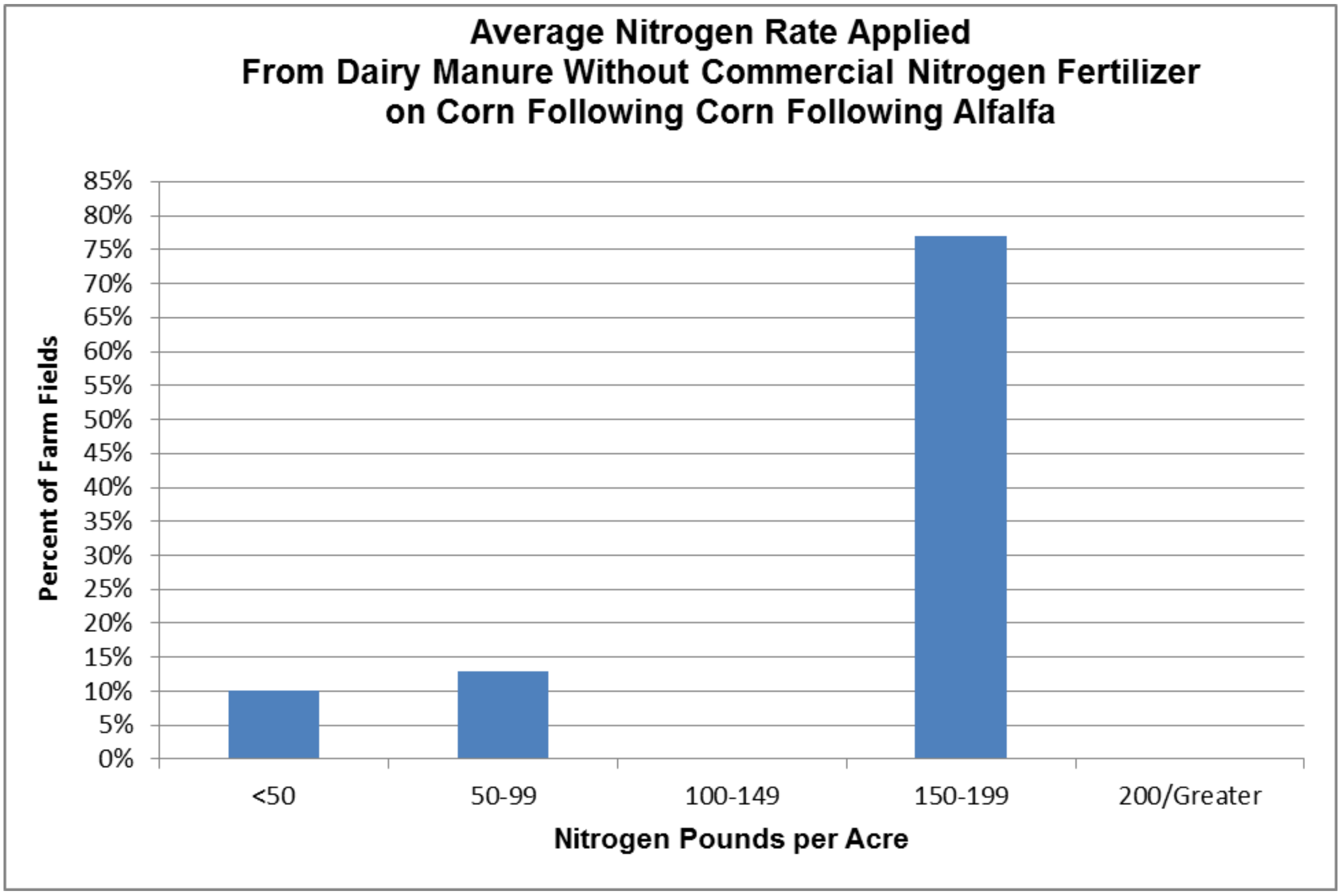

Figure 140. Average nitrogen rates applied to corn following corn following alfalfa from dairy manure and no commercial nitrogen fertilizer in Minnesota for 2019: 199 fields

Figure 141 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure and commercial nitrogen fertilizer to corn following corn following alfalfa (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 178 bushels per acre. The average nitrogen rate applied from dairy manure was 100 pounds per acre, and the average commercial nitrogen fertilizer rate was 71 pounds per acre for an average of 171 pounds of nitrogen per acre.

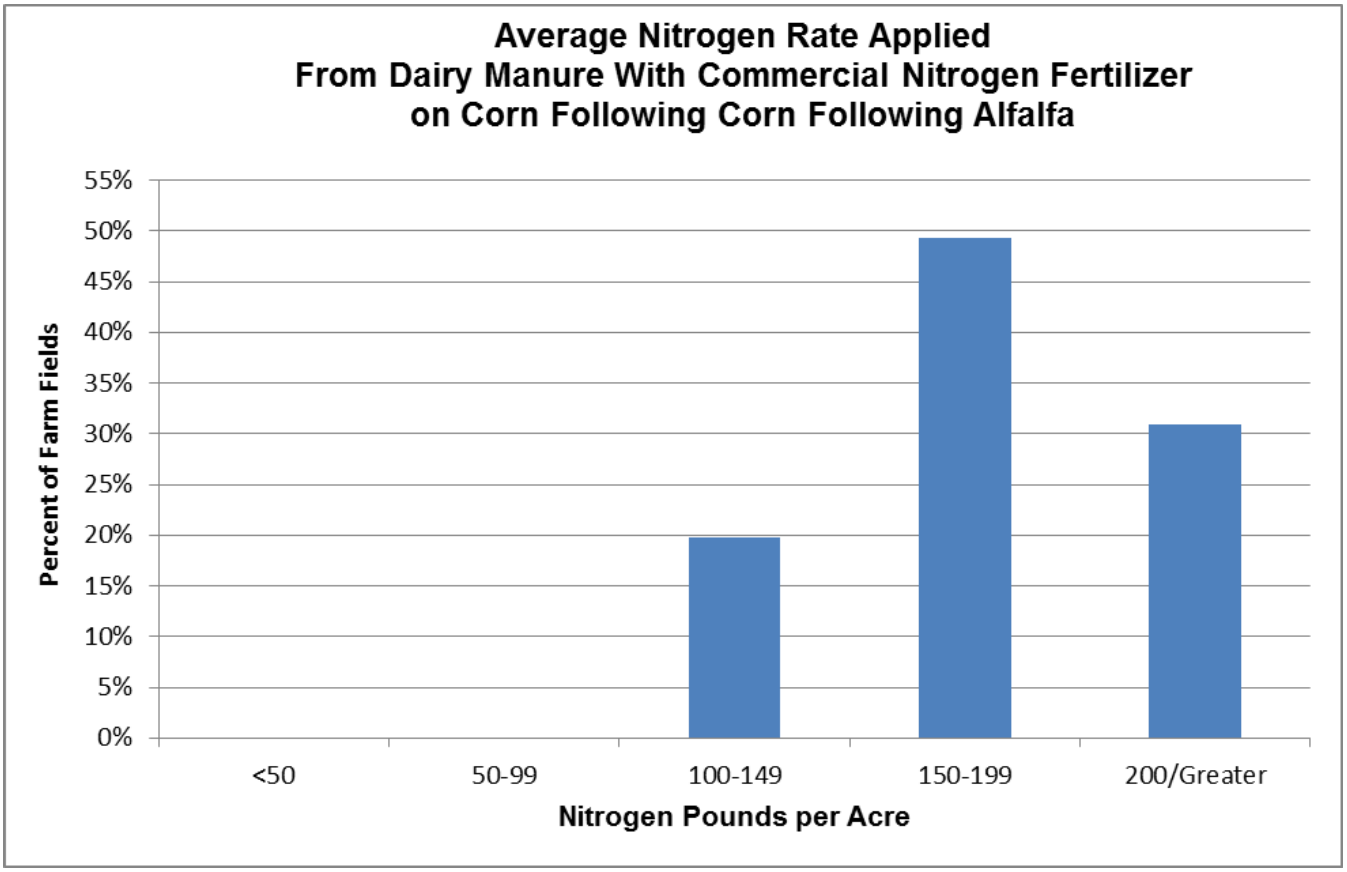

Figure 141. Average nitrogen rates applied to corn following corn following alfalfa from dairy manure and commercial nitrogen fertilizer in Minnesota for 2019: 251 fields

Figure 142 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure and commercial nitrogen fertilizer to corn following corn following alfalfa when the farmer did not know the nitrogen content of the dairy manure application (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). Therefore, dairy manure nitrogen was not included in that analysis when the quantity of nitrogen from dairy manure applied to the field is not known. The average corn yield was 175 bushels per acre. The average commercial nitrogen fertilizer rate was 69 pounds per acre.

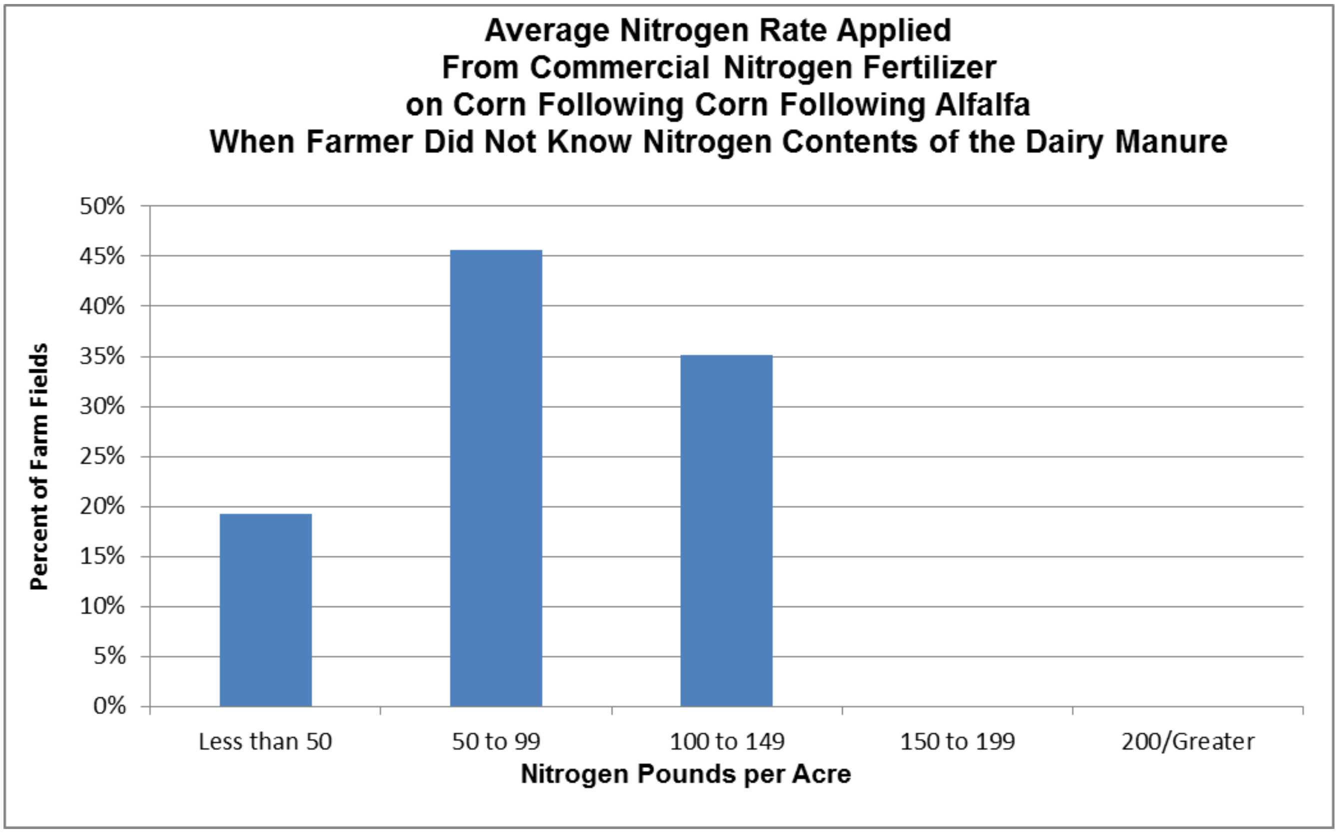

Figure 142. Average nitrogen rates applied to corn following corn following alfalfa from commercial nitrogen fertilizer in Minnesota for 2019 when the dairy manure nitrogen content is unknown: 181 fields

Less than five responses reported dairy manure nitrogen rates from corn following alfalfa:

- With and without commercial nitrogen fertilizer.
- Without commercial nitrogen fertilizer.
- With commercial nitrogen fertilizer.
- When farmer did not know nitrogen contents of the manure and applied commercial nitrogen fertilizer.

Less than five responses reported dairy manure nitrogen rates from corn following small grains:

- With and without commercial nitrogen fertilizer.
- Without commercial nitrogen fertilizer.
- With commercial nitrogen fertilizer.
- When farmer did not know nitrogen contents of the manure and applied commercial nitrogen fertilizer.

Less than five responses reported dairy manure nitrogen rates from corn following other crops:

- With and without commercial nitrogen fertilizer.
- Without commercial nitrogen fertilizer.
- With commercial nitrogen fertilizer.
- When farmer did not know nitrogen contents of the manure and applied commercial nitrogen fertilizer.

Manure Applications from Beef Manure for Corn following All Crops

Figure 143 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure or applied beef manure and commercial nitrogen fertilizer to corn following soybeans (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 175 bushels per acre. The average nitrogen rate applied from beef manure was 85 pounds per acre, and the average commercial nitrogen fertilizer rate was 104 pounds per acre for an average of 189 pounds of nitrogen per acre.

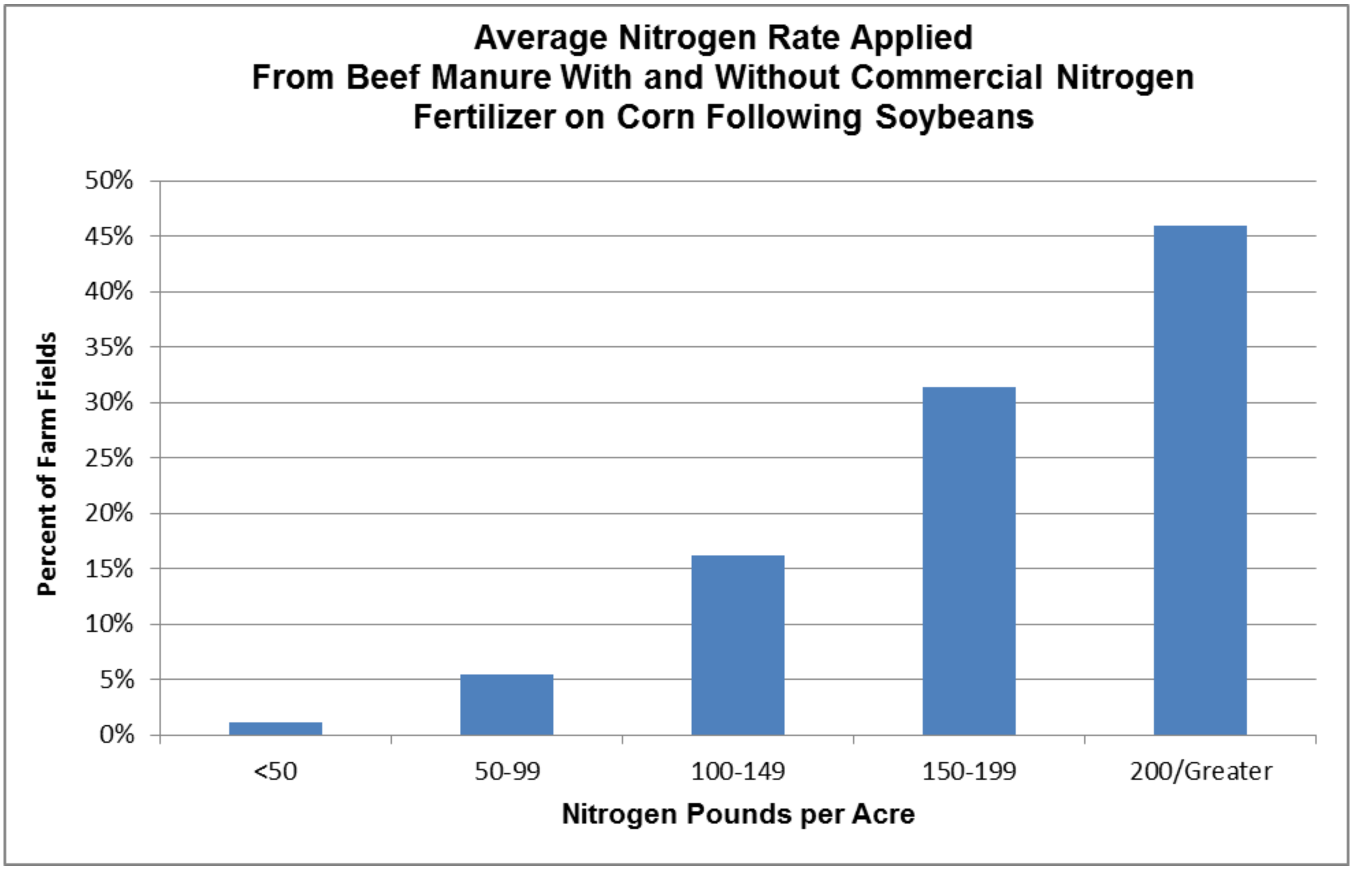

Figure 143. Average nitrogen rates applied to corn following soybeans from beef manure or beef manure and commercial nitrogen fertilizer in Minnesota for 2019: 626 fields

Less than five responses reported beef manure nitrogen rates from corn following soybeans:

- Without commercial nitrogen fertilizer.

Figure 144 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure and commercial nitrogen fertilizer to corn following soybeans (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 176 bushels per acre. The average nitrogen rate applied from beef manure was 83 pounds per acre, and the average commercial nitrogen fertilizer rate was 109 pounds per acre for an average of 192 pounds of nitrogen per acre.

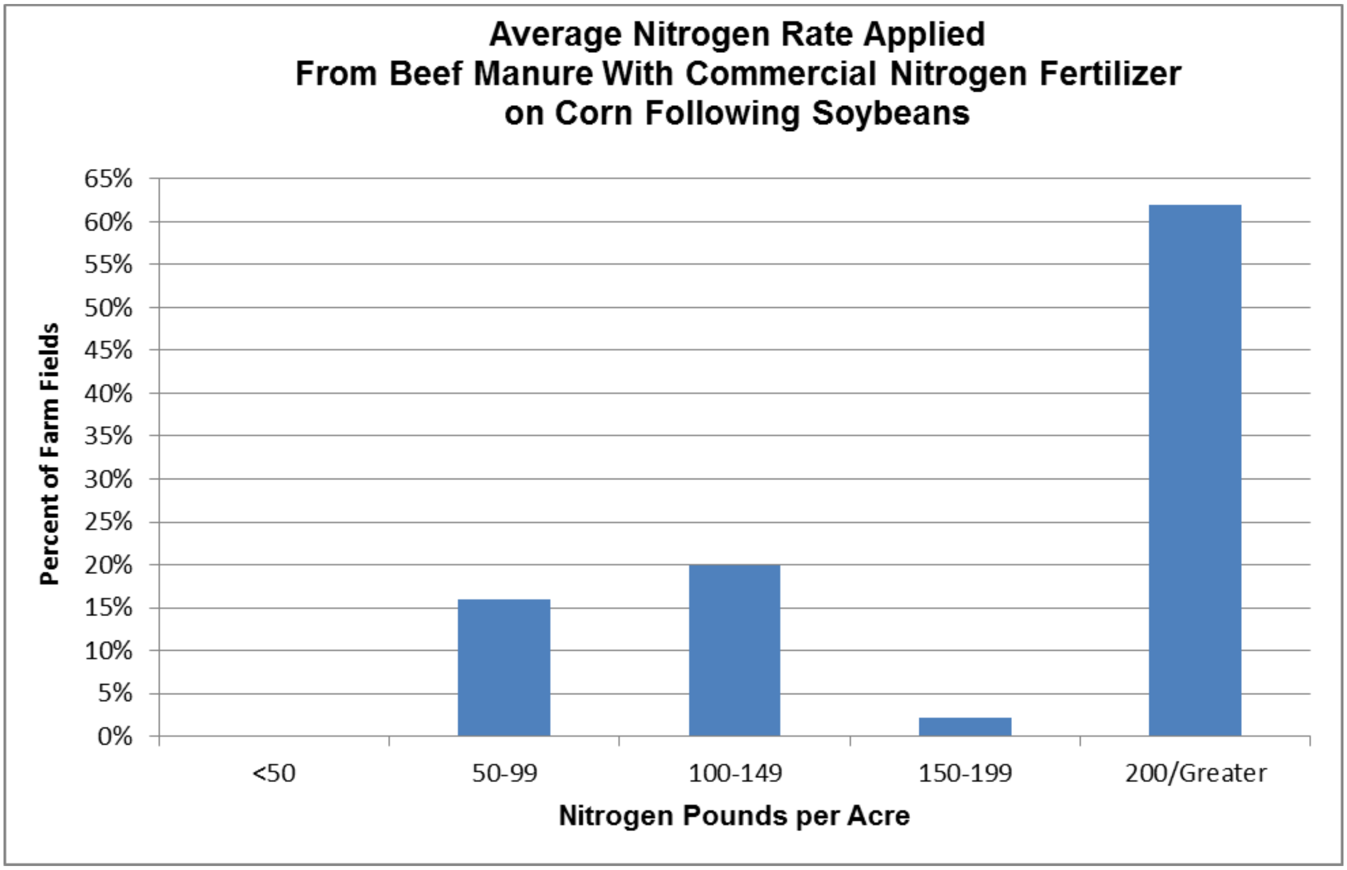

Figure 144. Average nitrogen rates applied to corn following soybeans from beef manure and commercial nitrogen fertilizer in Minnesota for 2019: 597 fields

Figure 145 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure and commercial nitrogen fertilizer to corn following soybeans when the farmer did not know the nitrogen content of the beef manure application (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). Therefore, beef manure nitrogen was not included in that analysis when the quantity of nitrogen from beef manure applied to the field is not known. The average corn yield was 182 bushels per acre. The average commercial nitrogen fertilizer rate was 117 pounds per acre.

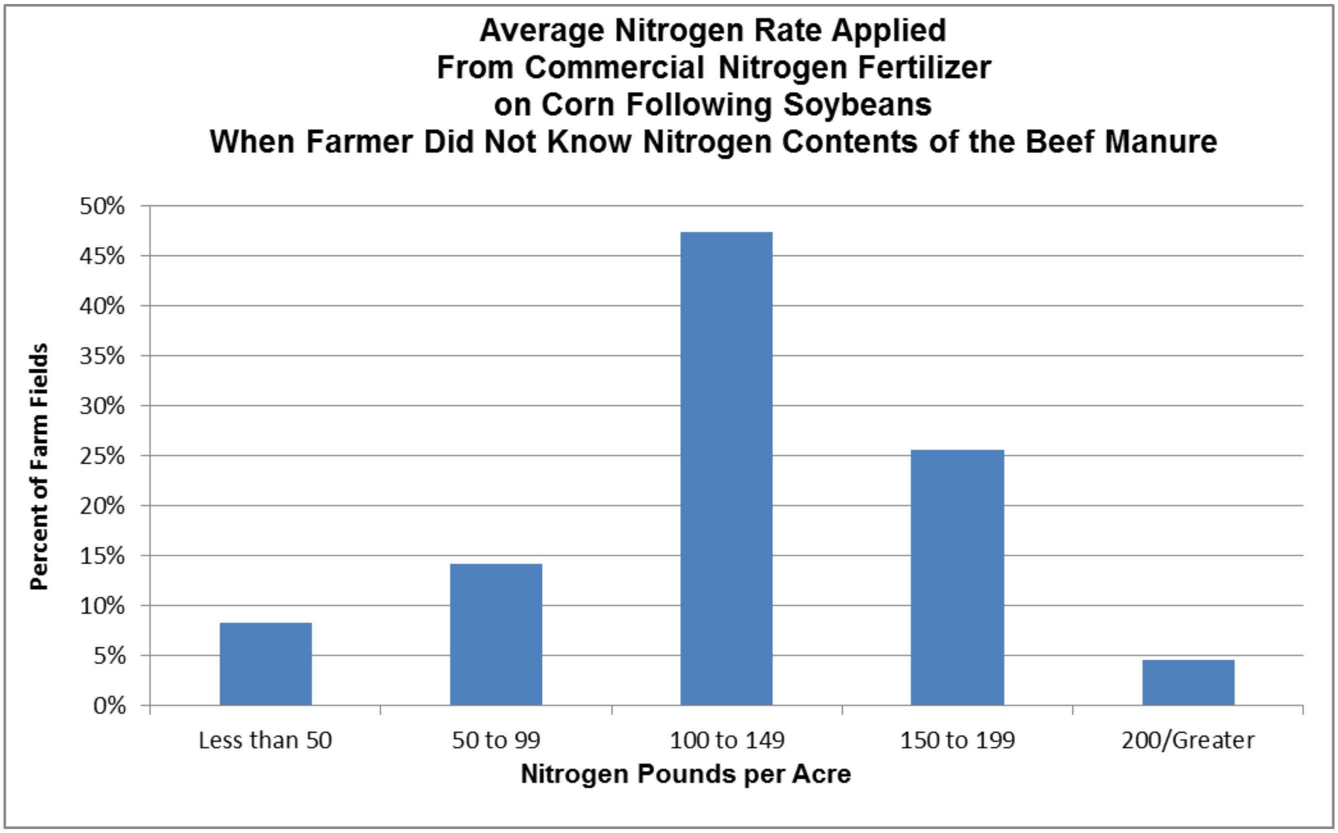

Figure 145. Average nitrogen rates applied to corn following soybeans from commercial nitrogen fertilizer in Minnesota for 2019 when the beef manure nitrogen content is unknown: 766 fields

Figure 146 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure or applied beef manure and commercial nitrogen fertilizer to corn following corn (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 164 bushels per acre. The average nitrogen rate applied from beef manure was 108 pounds per acre, and the average commercial nitrogen fertilizer rate was 78 pounds per acre for an average of 186 pounds of nitrogen per acre.

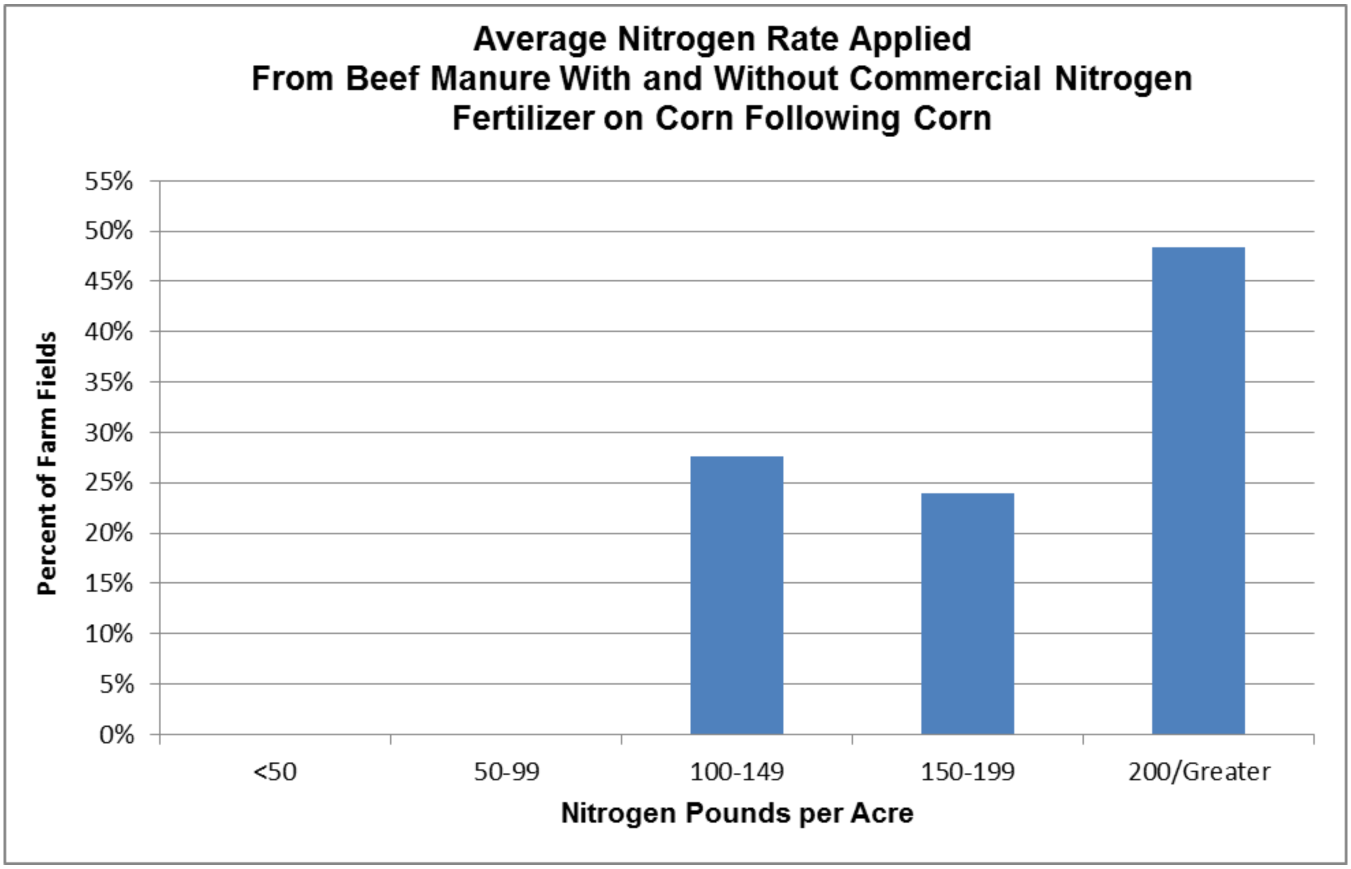

Figure 146. Average nitrogen rates applied to corn following corn from beef manure or beef manure and commercial nitrogen fertilizer in Minnesota for 2019: 472 fields

Figure 147 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure and no commercial nitrogen fertilizer to corn following corn (CMQ-2, CMQ-7, and CMQ-10). The average corn yield was 132 bushels per acre. The average nitrogen rate applied from beef manure was 151 pounds per acre.

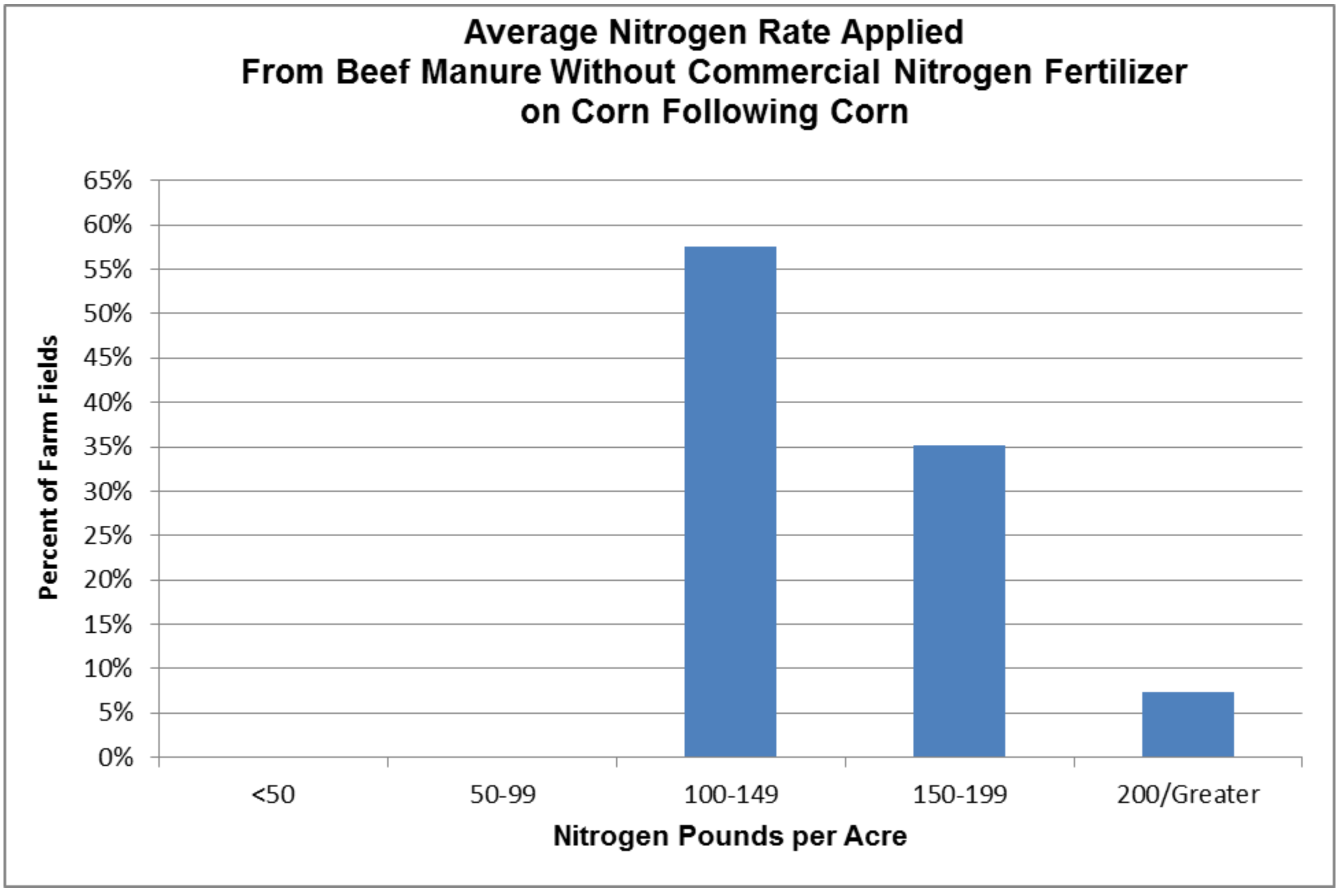

Figure 147. Average nitrogen rates applied to corn following corn from beef manure and no commercial nitrogen fertilizer in Minnesota for 2019: 117 fields

Figure 148 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure and commercial nitrogen fertilizer to corn following corn (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 174 bushels per acre. The average nitrogen rate applied from beef manure was 93 pounds per acre, and the average commercial nitrogen fertilizer rate was 104 pounds per acre for an average of 197 pounds of nitrogen per acre.

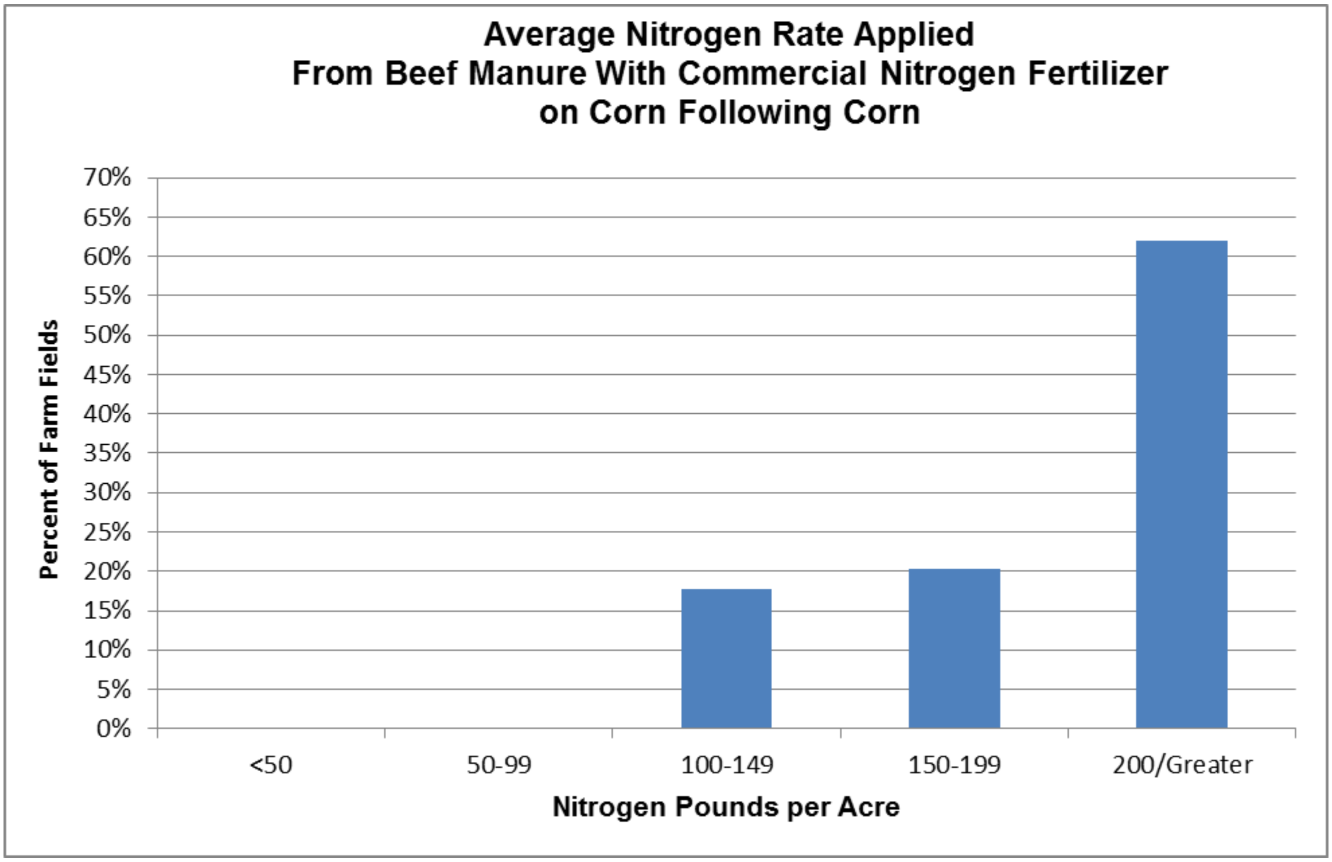

Figure 148. Average nitrogen rates applied to corn following corn from beef manure and commercial nitrogen fertilizer in Minnesota for 2019: 355 fields

Figure 149 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure and commercial nitrogen fertilizer to corn following corn when the farmer did not know the nitrogen content of the beef manure application (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). Therefore, beef manure nitrogen was not included in that analysis when the quantity of nitrogen from beef manure applied to the field is not known. The average corn yield was 182 bushels per acre. The average commercial nitrogen fertilizer rate was 117 pounds per acre.

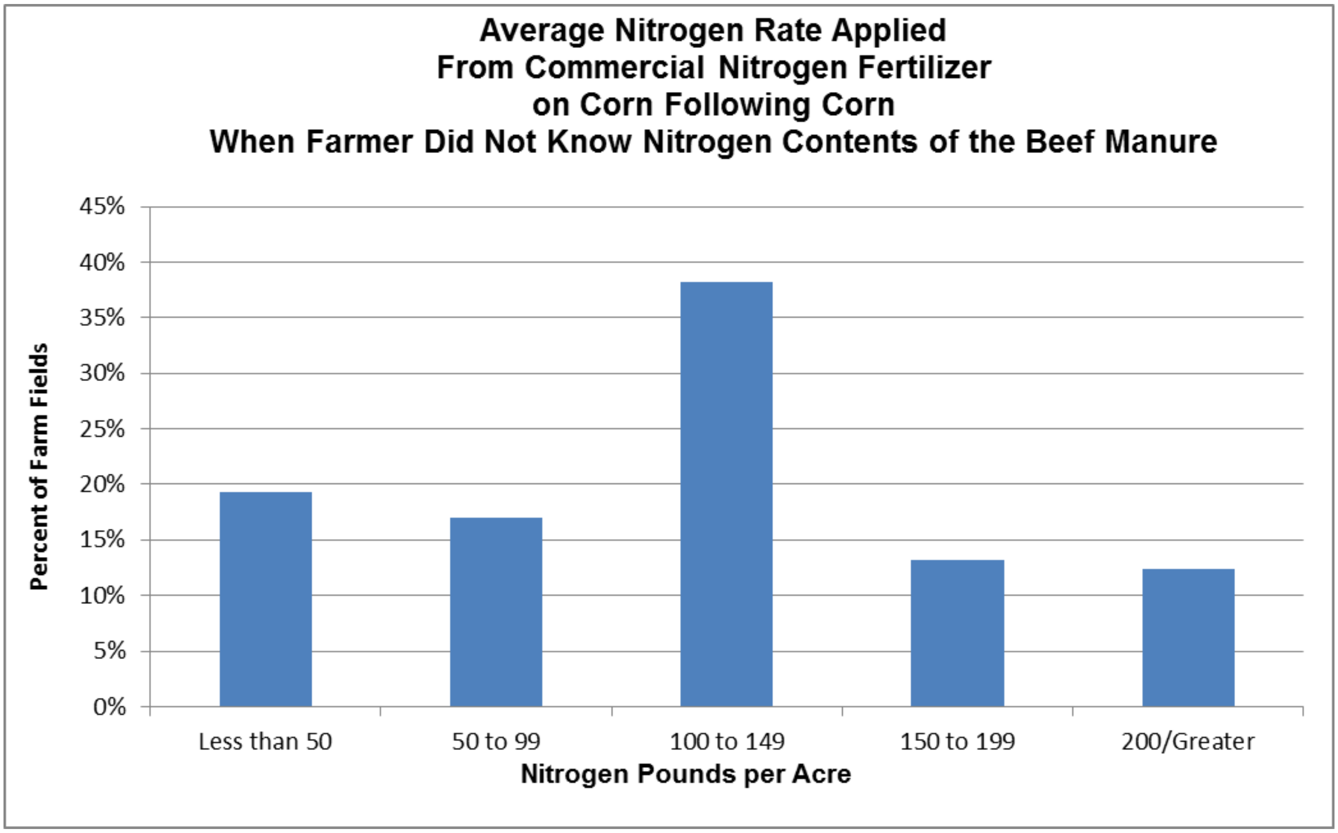

Figure 149. Average nitrogen rates applied to corn following corn from commercial nitrogen fertilizer in Minnesota for 2019 when the beef manure nitrogen content is unknown: 593 fields

Figure 150 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure or applied beef manure and commercial nitrogen fertilizer to corn following corn following alfalfa (CMQ-2, CMQ-3, CMQ-7, CMQ-10 and CMQ-14). The average corn yield was 166 bushels per acre. The average nitrogen rate applied from beef manure was 51 pounds per acre, and the average commercial nitrogen fertilizer rate was 64 pounds per acre for an average of 115 pounds of nitrogen per acre.

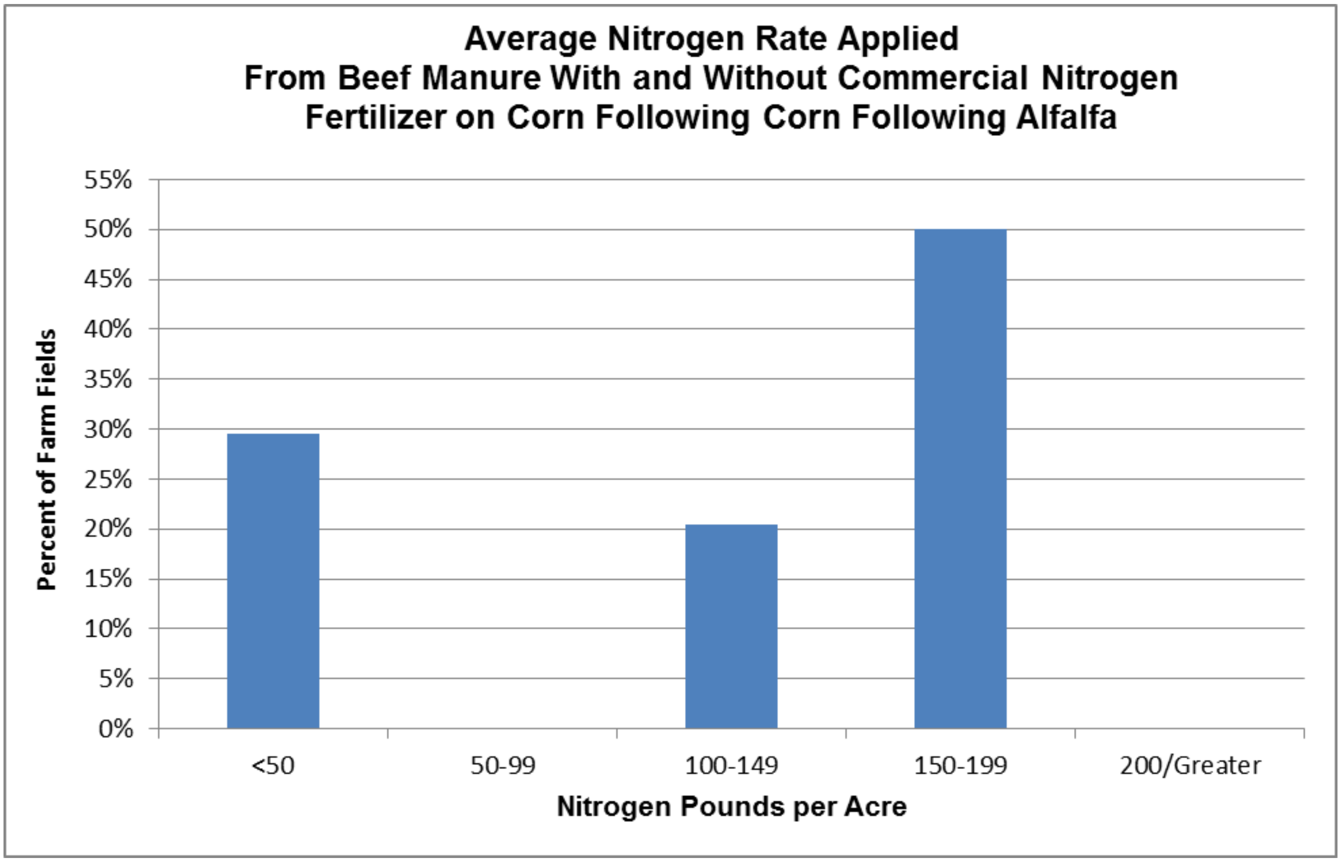

Figure 150. Average nitrogen rates applied to corn following corn following alfalfa from beef manure or beef manure and commercial nitrogen fertilizer in Minnesota for 2019: 117 fields

Less than five responses reported beef manure nitrogen rates from corn following corn following alfalfa:

- Without commercial nitrogen fertilizer.
- With commercial nitrogen fertilizer.

Figure 151 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure and commercial nitrogen fertilizer to corn following corn following alfalfa when the farmer did not know the nitrogen content of the beef manure application (CMQ-2, CMQ-3, CMQ-7, CMQ-10 and CMQ-14). Therefore, beef manure nitrogen was not included in that analysis when the quantity of nitrogen from beef manure applied to the field is not known. The average corn yield was 94 bushels per acre. The average commercial nitrogen fertilizer rate was 51 pounds per acre.

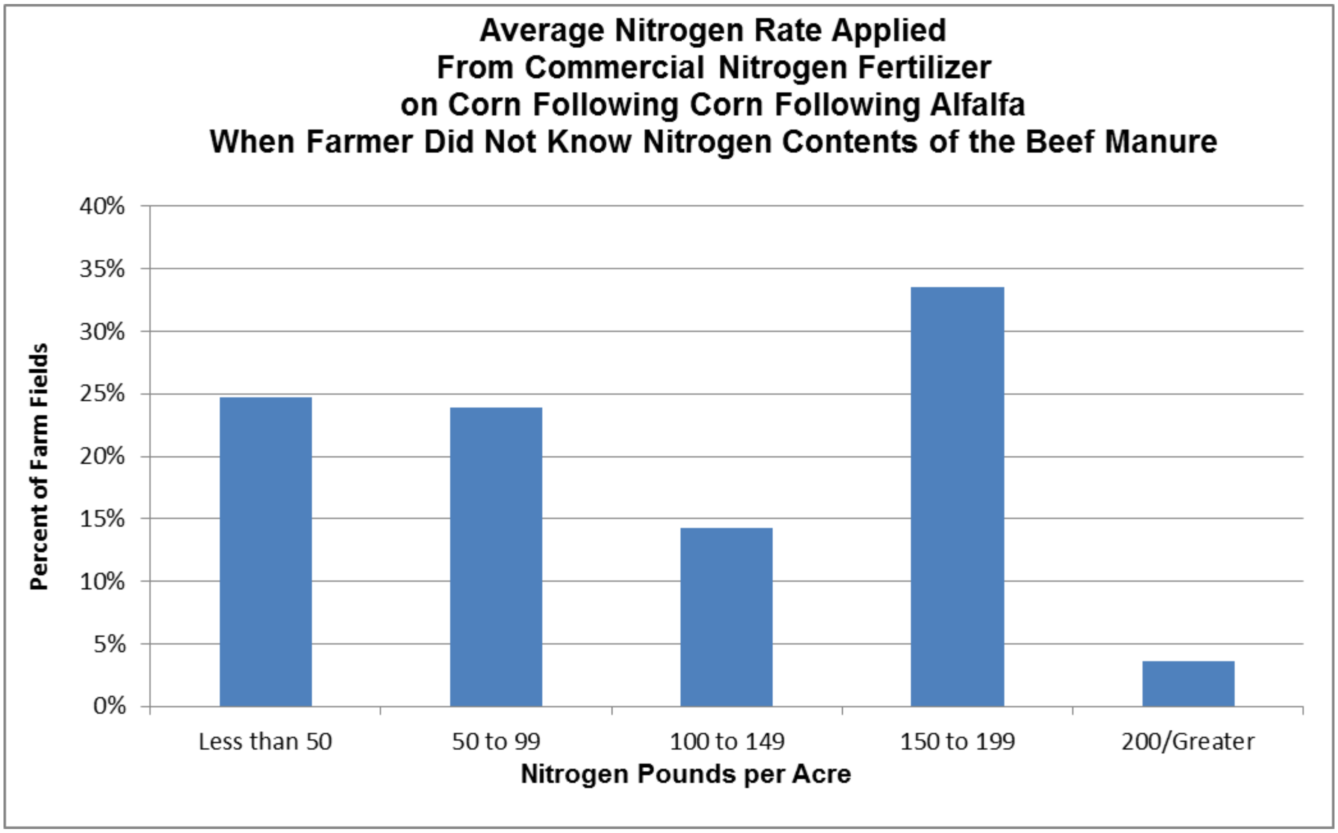

Figure 151. Average nitrogen rates applied to corn following corn following alfalfa from commercial nitrogen fertilizer in Minnesota for 2019 when the beef manure nitrogen content is unknown: 170 fields

Figure 152 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure or applied beef manure and commercial nitrogen fertilizer to corn following alfalfa (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 161 bushels per acre. The average nitrogen rate applied from beef manure was 93 pounds per acre, and the average commercial nitrogen fertilizer rate was 75 pounds per acre for an average of 168 pounds of nitrogen per acre.

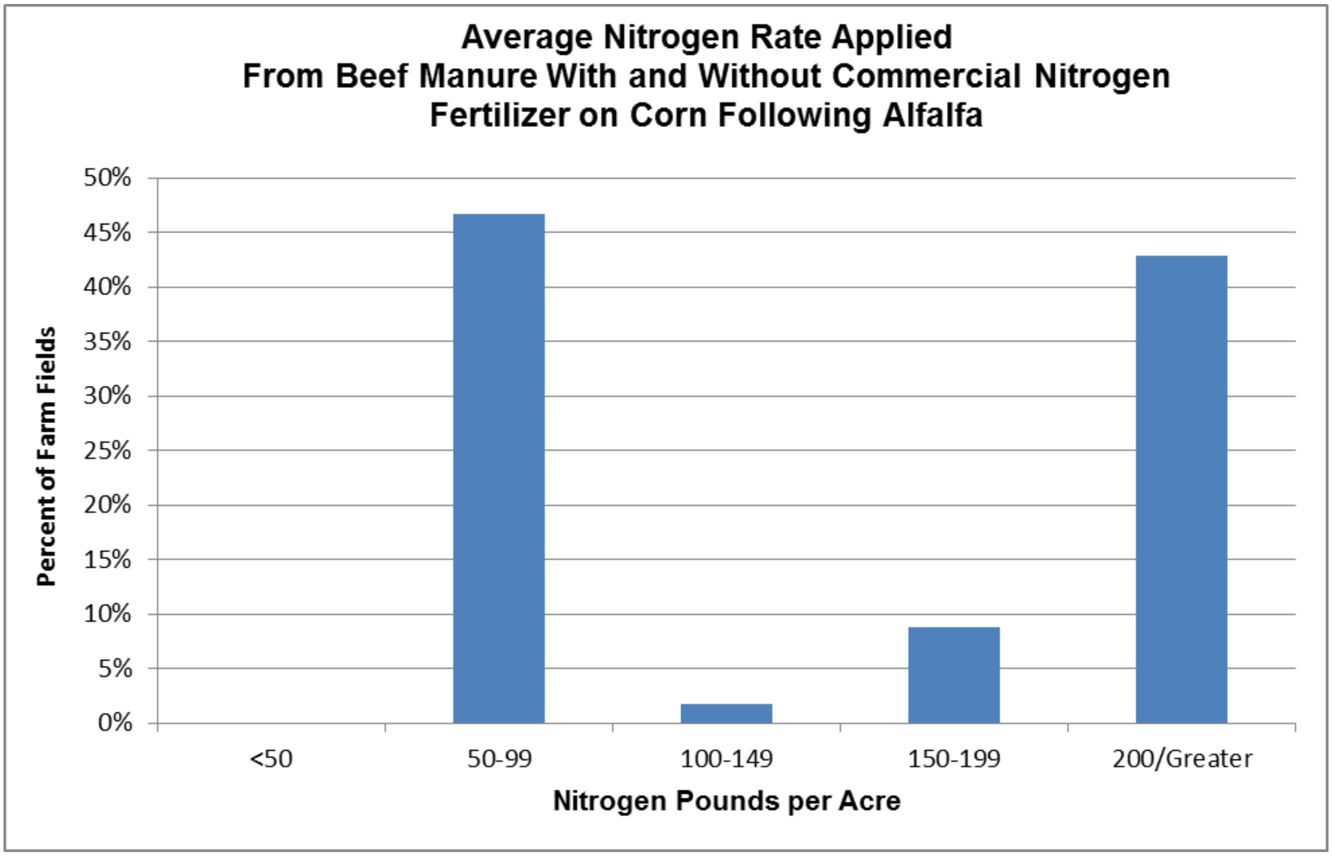

Figure 152. Average nitrogen rates applied to corn following alfalfa from beef manure or beef manure and commercial nitrogen fertilizer in Minnesota for 2019: 186 fields

Less than five responses reported beef manure nitrogen rates from corn following alfalfa:

- Without commercial nitrogen fertilizer.

Figure 153 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure and commercial nitrogen fertilizer to corn following alfalfa (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 163 bushels per acre. The average nitrogen rate applied from beef manure was 98 pounds per acre, and the average commercial nitrogen fertilizer rate was 92 pounds per acre for an average of 190 pounds of nitrogen per acre.

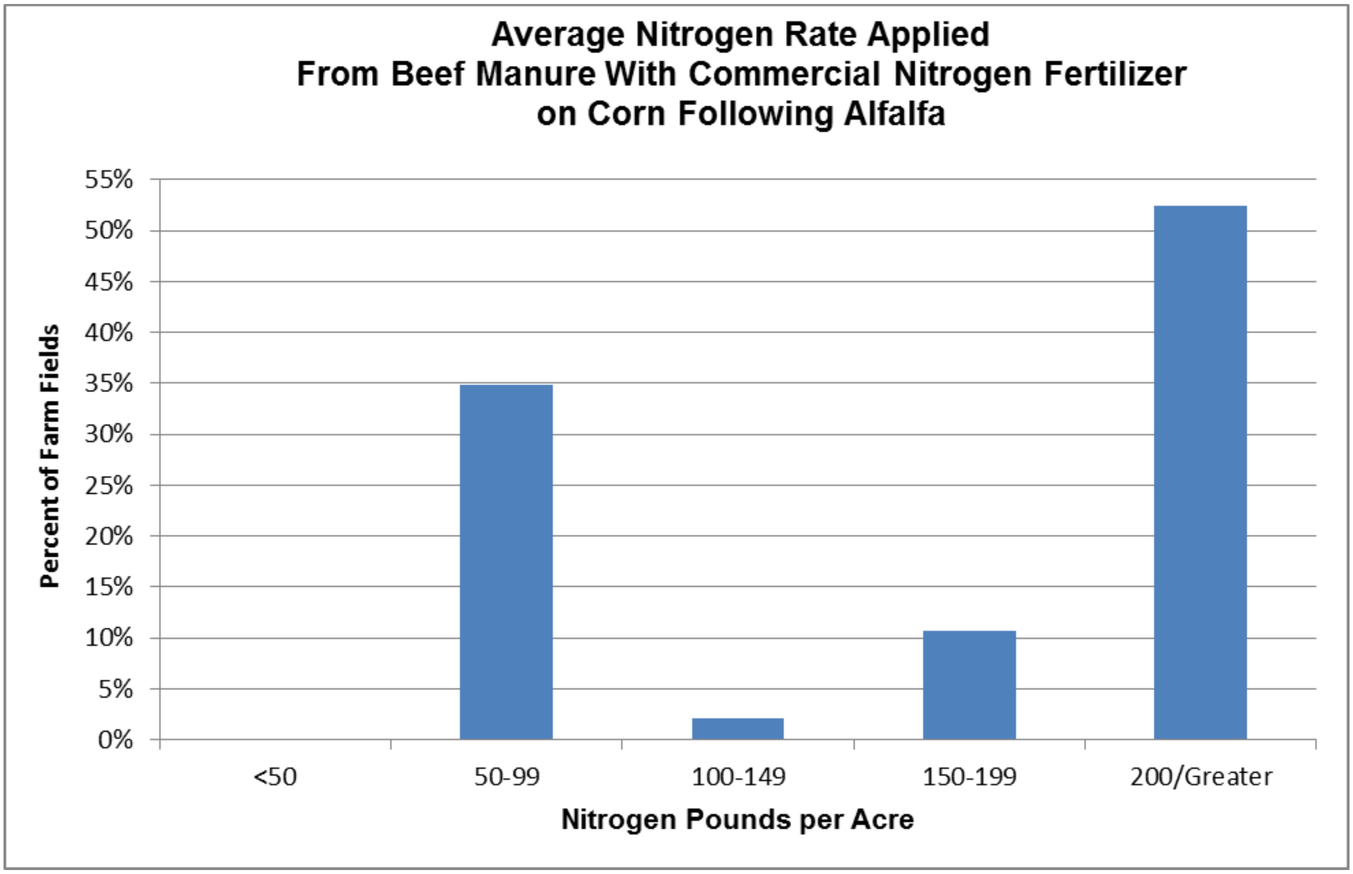

Figure 153. Average nitrogen rates applied to corn following alfalfa from beef manure and commercial nitrogen fertilizer in Minnesota for 2019: 152 fields

Figure 154 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure and commercial nitrogen fertilizer to corn following alfalfa when the farmer did not know the nitrogen content of the beef manure application (CMQ-2, CMQ-7, CMQ-10 and CMQ-14). Therefore, beef manure nitrogen was not included in that analysis when the quantity of nitrogen from beef manure applied to the field is not known. The average corn yield was 157 bushels per acre. The average commercial nitrogen fertilizer rate was 51 pounds per acre.

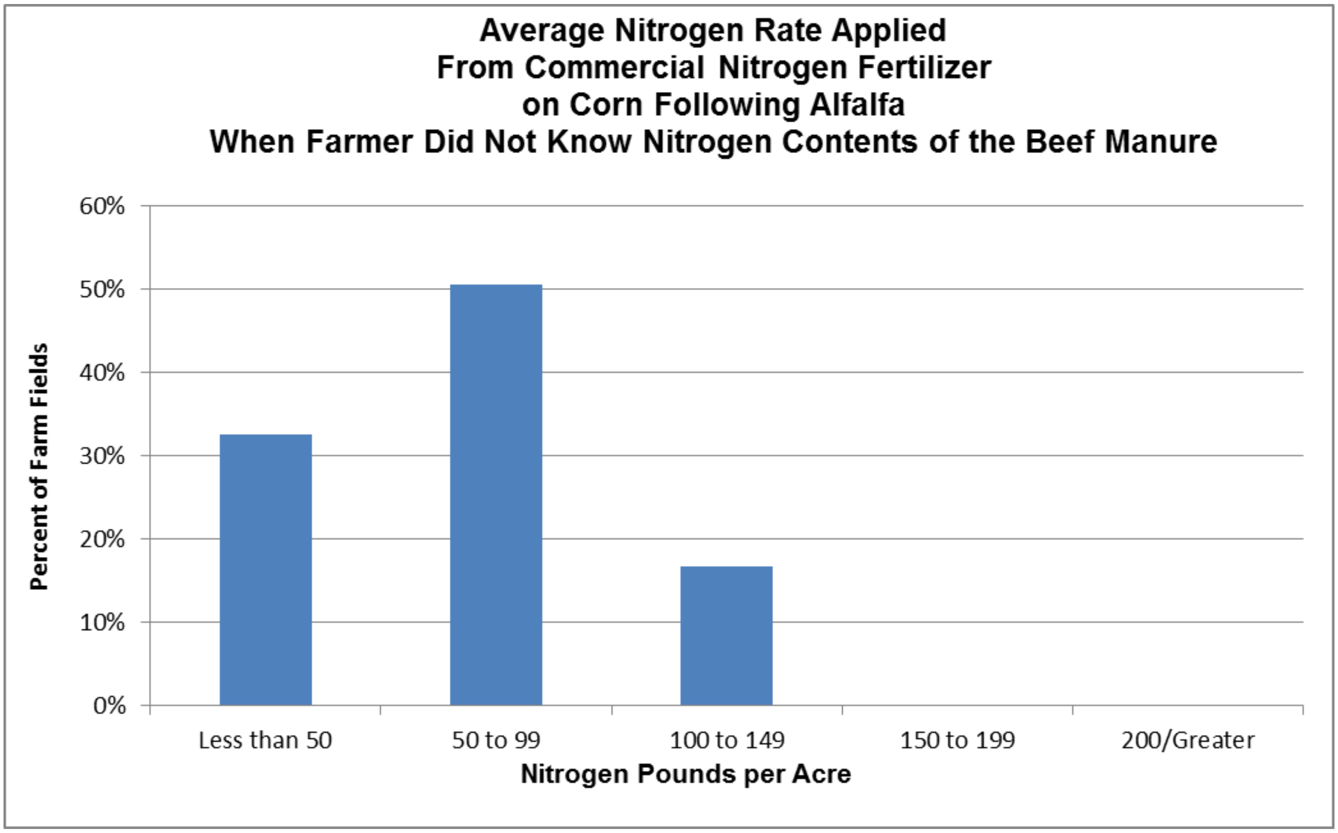

Figure 154. Average nitrogen rates applied to corn following alfalfa from commercial nitrogen fertilizer in Minnesota for 2019 when the beef manure nitrogen content is unknown: 89 fields

Figure 155 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure or applied beef manure and commercial nitrogen fertilizer to corn following small grains (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 170 bushels per acre. The average nitrogen rate applied from beef manure was 76 pounds per acre, and the average commercial nitrogen fertilizer rate was 88 pounds per acre for an average of 164 pounds of nitrogen per acre.

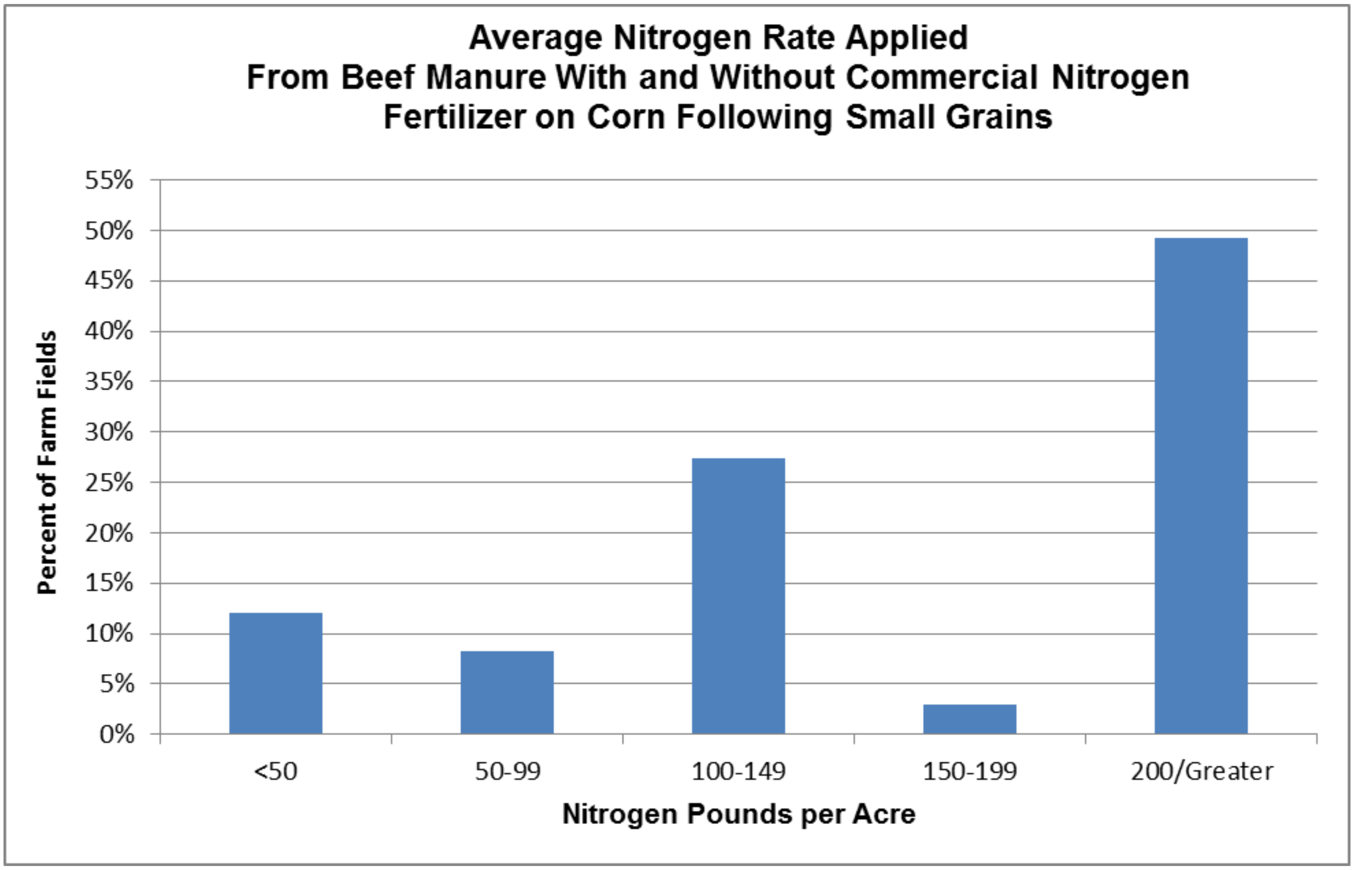

Figure 155. Average nitrogen rates applied to corn following small grains from beef manure or beef manure and commercial nitrogen fertilizer in Minnesota for 2019: 103 fields

Less than five responses reported beef manure nitrogen rates from corn following small grains:

- Without commercial nitrogen fertilizer.

Figure 156 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure and commercial nitrogen fertilizer to corn following small grains (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 182 bushels per acre. The average nitrogen rate applied from beef manure was 83 pounds per acre, and the average commercial nitrogen fertilizer rate was 100 pounds per acre for an average of 183 pounds of nitrogen per acre.

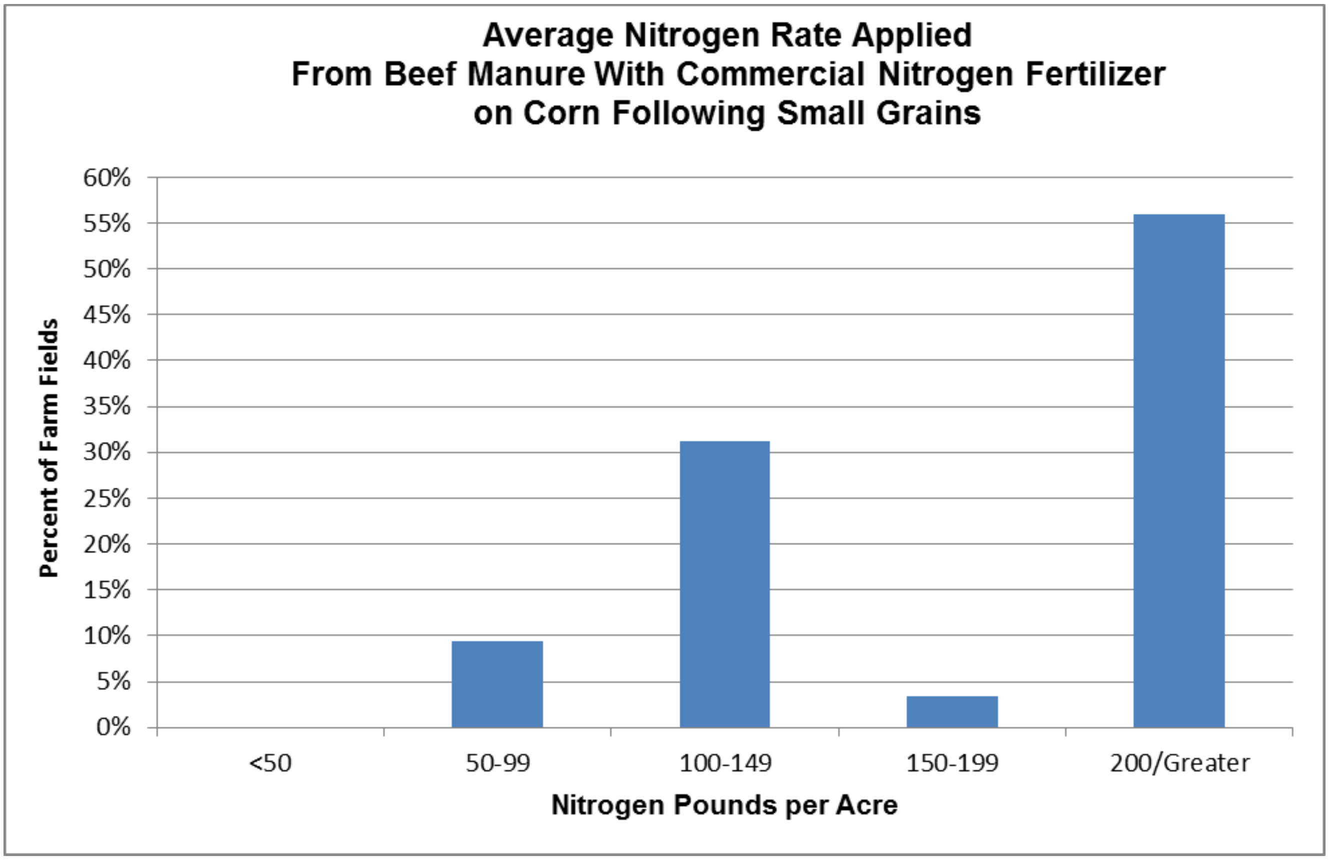

Figure 156. Average nitrogen rates applied to corn following small grains from beef manure and commercial nitrogen fertilizer in Minnesota for 2019: 91 fields

Figure 157 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure and commercial nitrogen fertilizer to corn following small grains when the farmer did not know the nitrogen content of the beef manure application (CMQ-2, CMQ-7, CMQ-10 and CMQ-14). Therefore, beef manure nitrogen was not included in that analysis when the quantity of nitrogen from beef manure applied to the field is not known. The average corn yield was 142 bushels per acre. The average commercial nitrogen fertilizer rate was 90 pounds per acre.

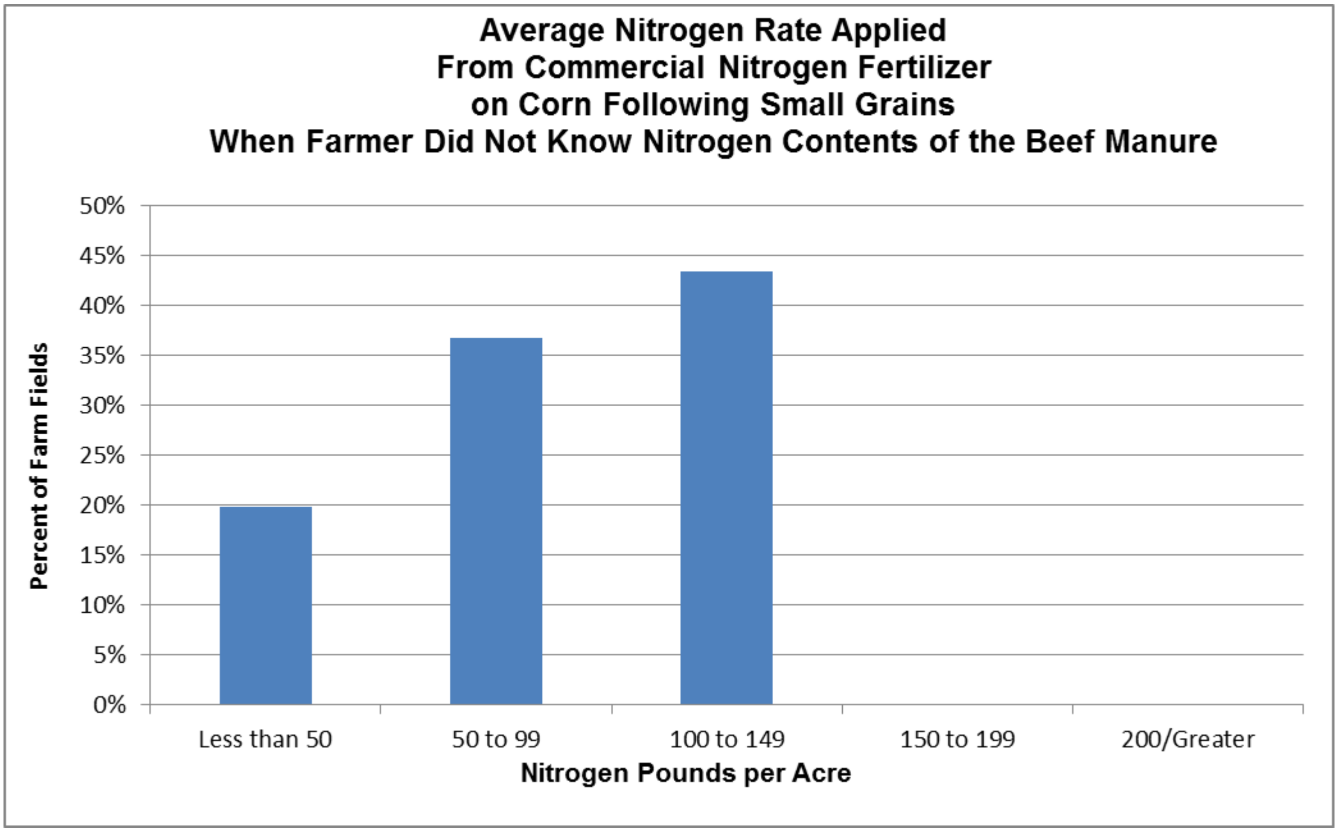

Figure 157. Average nitrogen rates applied to corn following small grains from commercial nitrogen fertilizer in Minnesota for 2019 when the beef manure nitrogen content is unknown: 150 fields

Less than five responses reported beef manure nitrogen rates from corn following other crops:

- With and without commercial nitrogen fertilizer.
- Without commercial nitrogen fertilizer.
- With commercial nitrogen fertilizer.
- When the farmer did not know the nitrogen contents of the beef manure and applied additional commercial nitrogen fertilizer.

Manure Applications from Hog Manure for Corn following All Crops

Figure 158 details the distribution of average nitrogen rates in Minnesota from farmers that applied hog manure or applied hog manure and commercial nitrogen fertilizer to corn following soybeans (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 198 bushels per acre. The average nitrogen rate applied from hog manure was 123 pounds per acre, and the average commercial nitrogen fertilizer rate was 45 pounds per acre for an average of 168 pounds of nitrogen per acre.

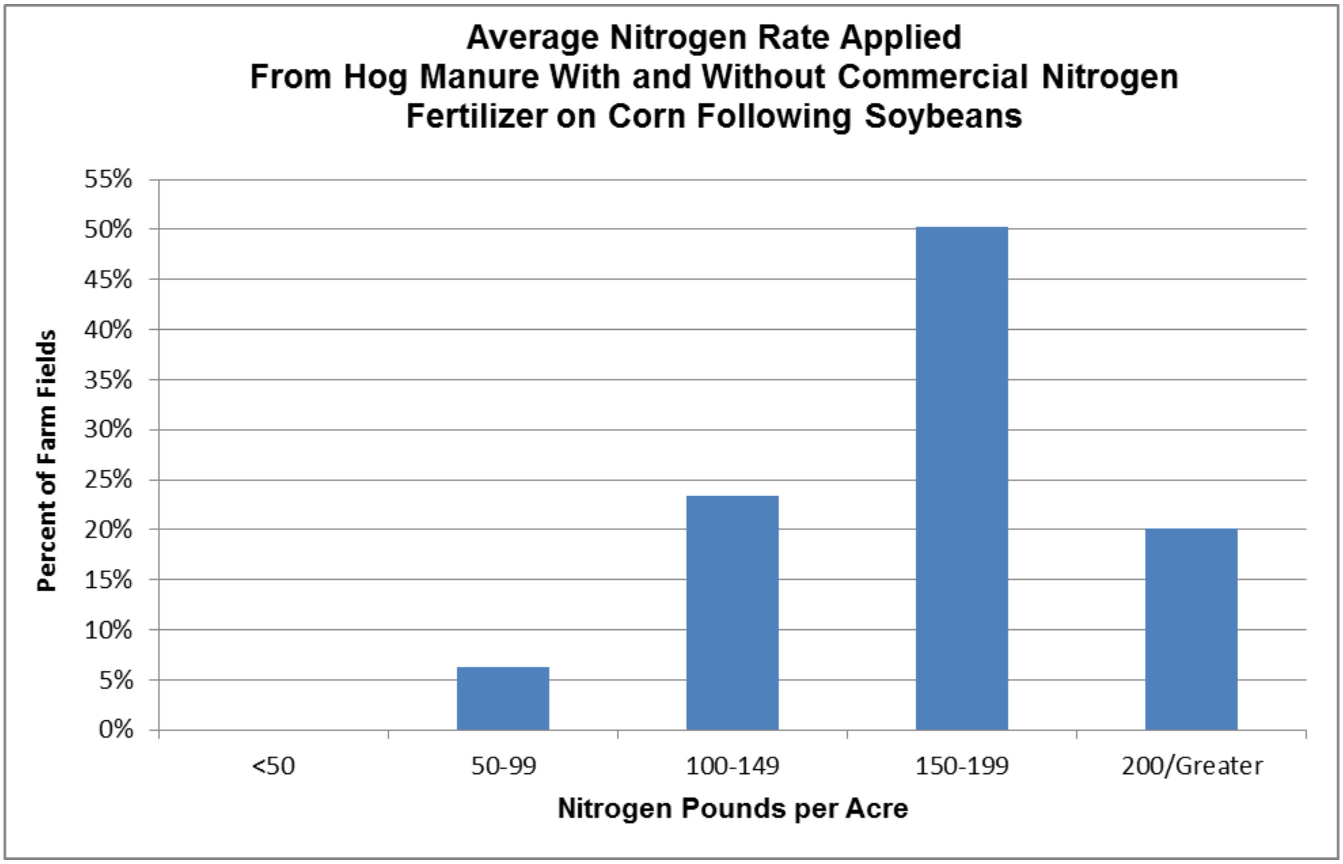

Figure 158. Average nitrogen rates applied to corn following soybeans from hog manure or hog manure and commercial nitrogen fertilizer in Minnesota for 2019: 1,450 fields

Figure 159 details the distribution of average nitrogen rates in Minnesota from farmers that applied hog manure and no commercial nitrogen fertilizer to corn following soybeans (CMQ-2, CMQ-7, and CMQ-10). The average corn yield was 194 bushels per acre. The average nitrogen rate applied from manure was 135 pounds per acre.

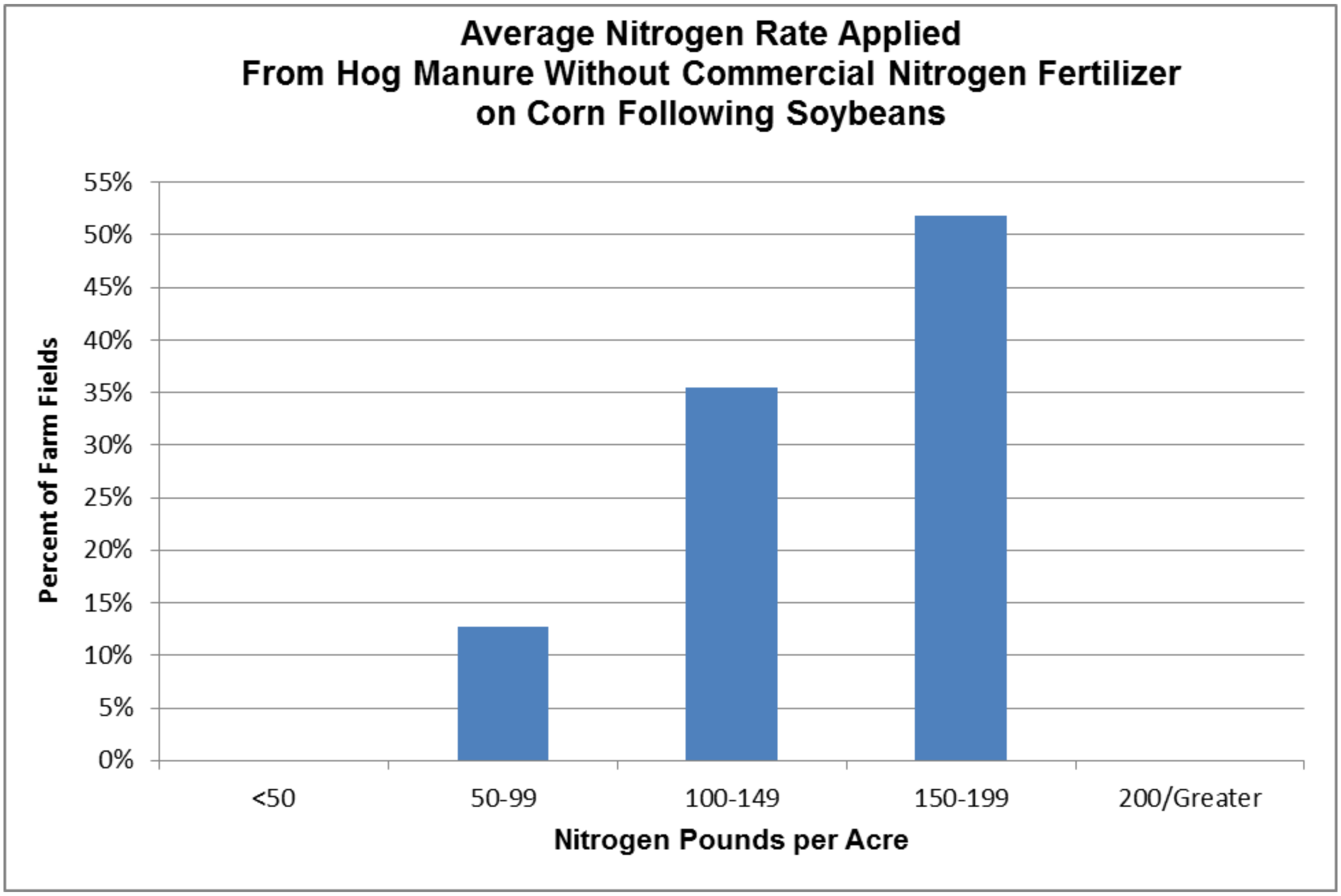

Figure 159. Average nitrogen rates applied to corn following soybeans from hog manure and no commercial nitrogen fertilizer in Minnesota for 2019: 467 fields

Figure 160 details the distribution of average nitrogen rates in Minnesota from farmers that applied hog manure and commercial nitrogen fertilizer to corn following soybeans (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 200 bushels per acre. The average nitrogen rate applied from manure was 118 pounds per acre, and the average commercial nitrogen fertilizer rate was 66 pounds per acre for an average of 184 pounds of nitrogen per acre.

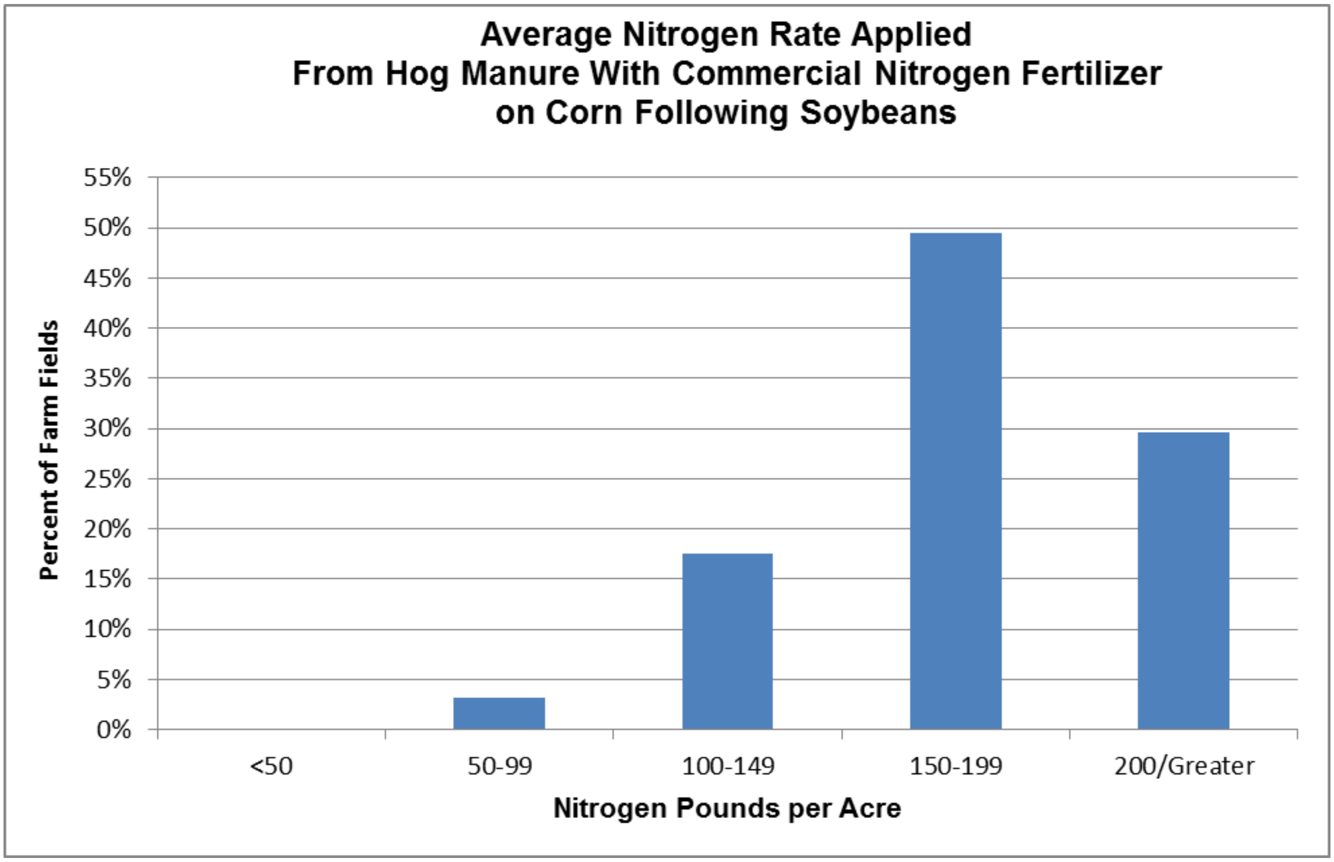

Figure 160. Average nitrogen rates applied to corn following soybeans from hog manure and commercial nitrogen fertilizer in Minnesota for 2019: 983 fields

No responses reported hog manure nitrogen rates from corn following soybeans:

- When the farmer did not know the nitrogen contents of the hog manure and applied additional commercial nitrogen fertilizer.

Figure 161 details the distribution of average nitrogen rates in Minnesota from farmers that applied hog manure or applied hog manure and commercial nitrogen fertilizer to corn following corn (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 203 bushels per acre. The average nitrogen rate applied from hog manure was 151 pounds per acre, and the average commercial nitrogen fertilizer rate was 14 pounds per acre for an average of 165 pounds of nitrogen per acre.

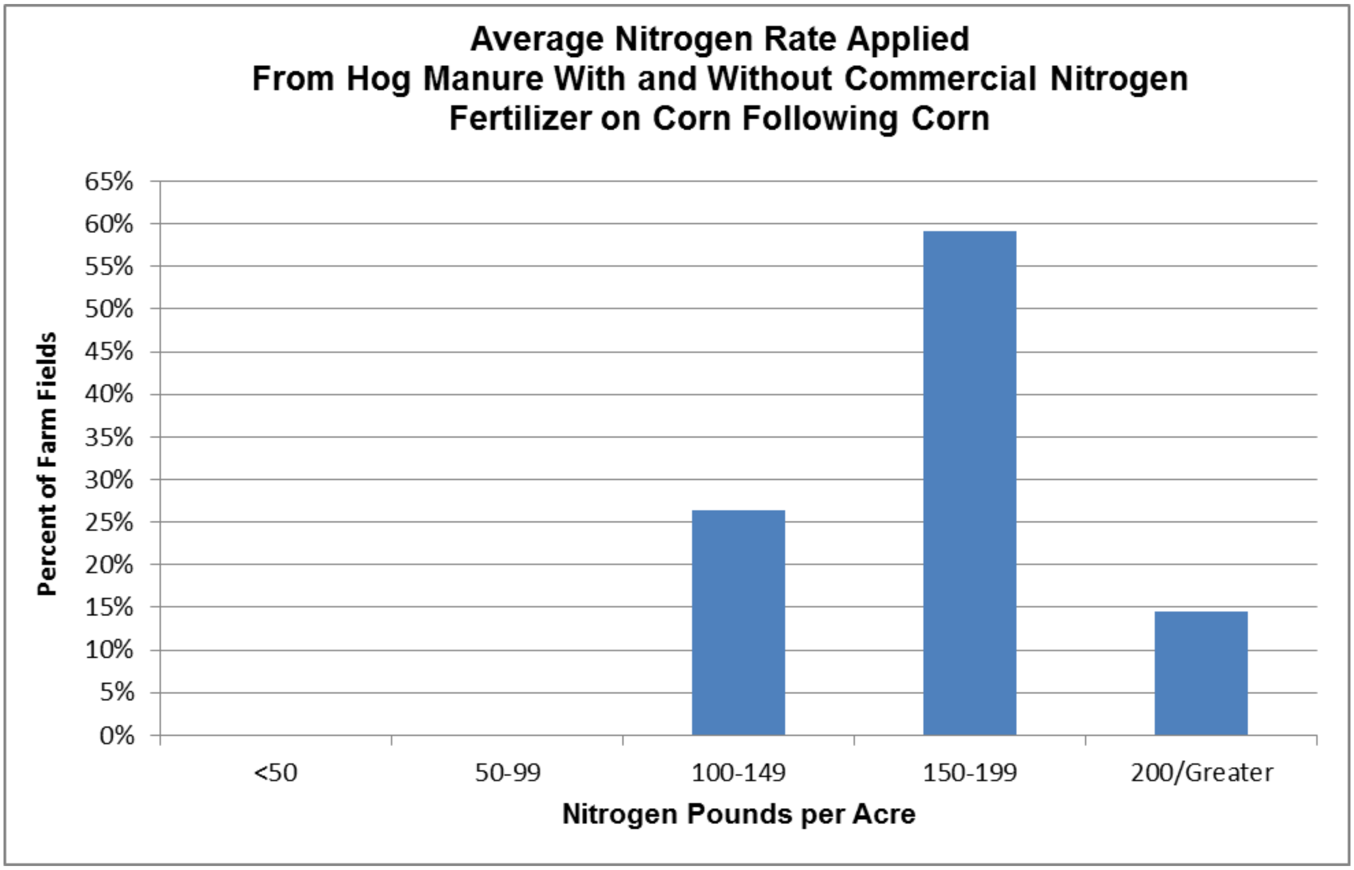

Figure 161. Average nitrogen rates applied to corn following corn from hog manure or hog manure and commercial nitrogen fertilizer in Minnesota for 2019: 257 fields

Less than five responses reported hog manure nitrogen rates from corn following corn:

- Without commercial nitrogen fertilizer.

Figure 162 details the distribution of average nitrogen rates in Minnesota from farmers that applied hog manure and commercial nitrogen fertilizer to corn following corn (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 206 bushels per acre. The average nitrogen rate applied from hog manure was 25 pounds per acre, and the average commercial nitrogen fertilizer rate was 135 pounds per acre for an average of 160 pounds of nitrogen per acre.

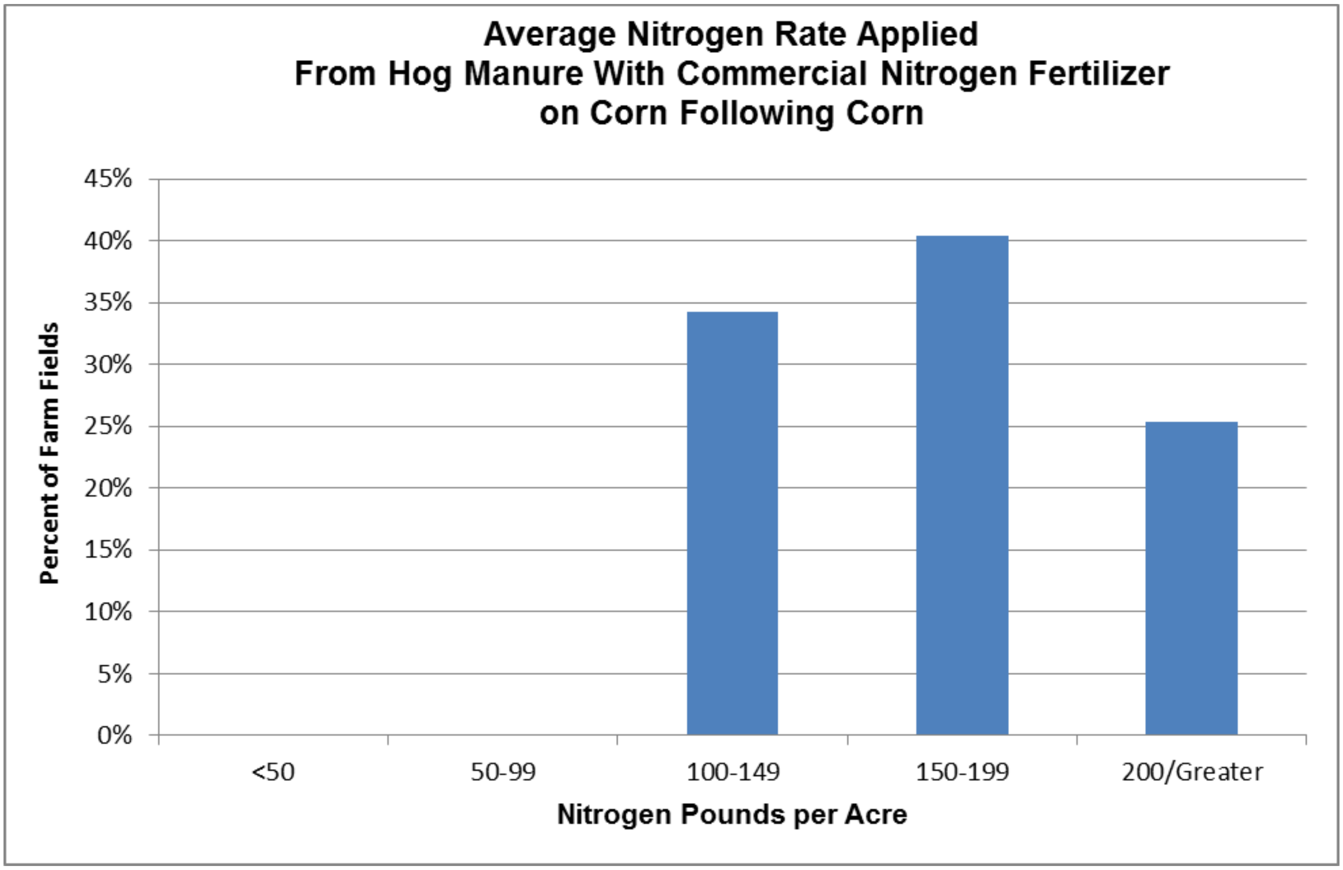

Figure 162. Average nitrogen rates applied to corn following corn from hog manure and commercial nitrogen fertilizer in Minnesota for 2019: 147 fields

Less than five responses reported hog manure nitrogen rates from corn following corn:

- When the farmer did not know the nitrogen contents of the hog manure and applied additional commercial nitrogen fertilizer.

Less than five responses reported hog manure nitrogen rates from corn following corn following alfalfa:

- With and without commercial nitrogen fertilizer.
- Without commercial nitrogen fertilizer.
- With commercial nitrogen fertilizer.

No responses reported hog manure nitrogen rates from corn following corn following alfalfa:

- When the farmer did not know the nitrogen contents of the hog manure and applied additional commercial nitrogen fertilizer.

No responses reported hog manure nitrogen rates from corn following alfalfa:

- With and without commercial nitrogen fertilizer.
- Without commercial nitrogen fertilizer.
- With commercial nitrogen fertilizer.
- When the farmer did not know the nitrogen contents of the hog manure and applied additional commercial nitrogen fertilizer.

Less than five responses reported hog manure nitrogen rates from corn following small grains:

- With and without commercial nitrogen fertilizer.
- Without commercial nitrogen fertilizer.
- With commercial nitrogen fertilizer.

No responses reported hog manure nitrogen rates from corn following small grains:

- When the farmer did not know the nitrogen contents of the hog manure and applied additional commercial nitrogen fertilizer.

No responses reported hog manure nitrogen rates from corn following other crops:

- With and without commercial nitrogen fertilizer.
- Without commercial nitrogen fertilizer.
- With commercial nitrogen fertilizer.

Less than five responses reported hog manure nitrogen rates from corn following other crops:

- When the farmer did not know the nitrogen contents of the hog manure and applied additional commercial nitrogen fertilizer.

Manure Applications from Poultry Manure for Corn following All Crops

Figure 163 details the distribution of average nitrogen rates in Minnesota from farmers that applied poultry manure or applied poultry manure and commercial nitrogen fertilizer to corn following soybeans (CMQ-2, CMQ-7, CMQ-10 and CMQ-14). The average corn yield was 190 bushels per acre. The average nitrogen rate applied from poultry manure was 102 pounds per acre, and the average commercial nitrogen fertilizer rate was 64 pounds per acre for an average of 166 pounds of nitrogen per acre.

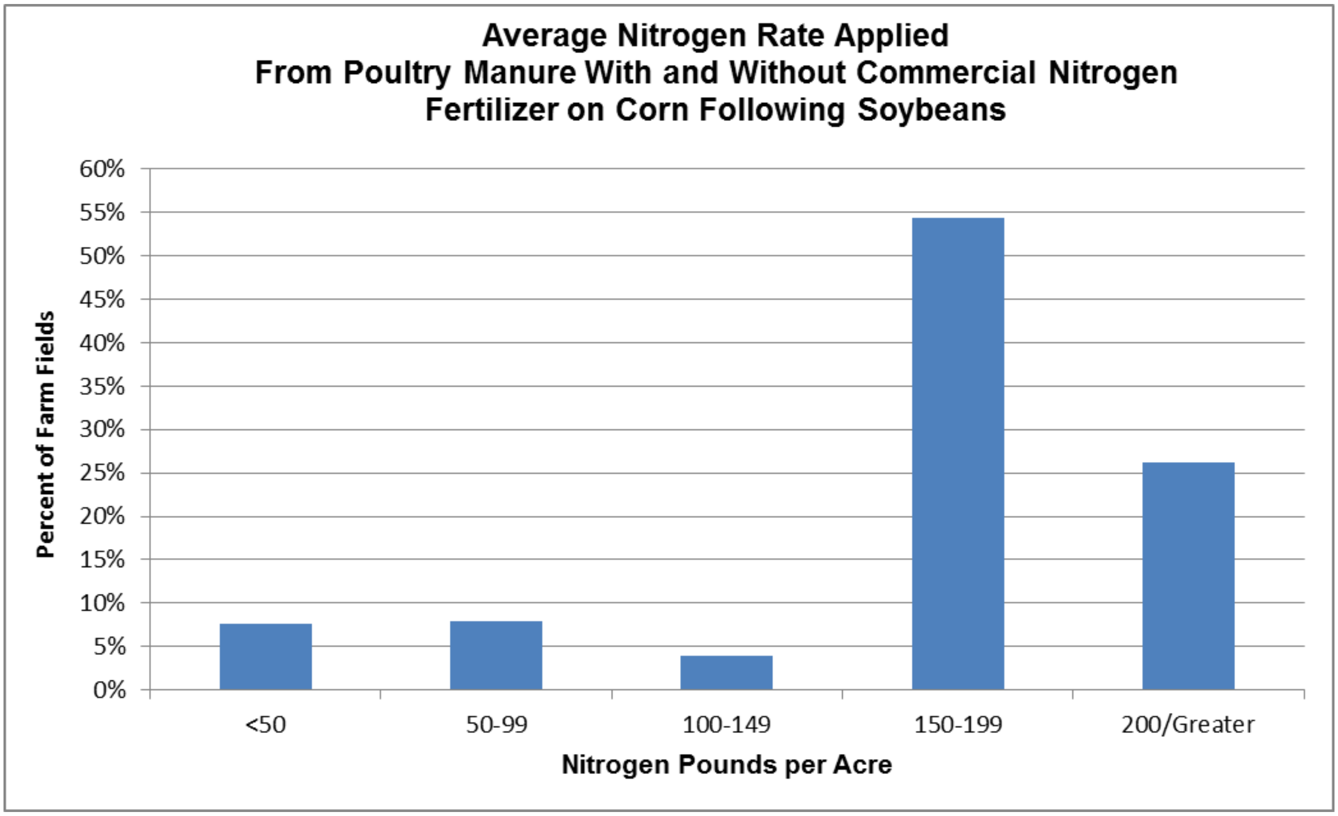

Figure 163. Average nitrogen rates applied to corn following soybeans from poultry manure or poultry manure and commercial nitrogen fertilizer in Minnesota for 2019: 360 fields

Less than five responses reported poultry manure nitrogen rates from corn following soybeans:

- Without commercial nitrogen fertilizer.

Figure 164 details the distribution of average nitrogen rates in Minnesota from farmers that applied poultry manure and commercial nitrogen fertilizer to corn following soybeans (CMQ-2, CMQ-7, CMQ-10, and CMQ-14). The average corn yield was 187 bushels per acre. The average nitrogen rate applied from poultry manure was 109 pounds per acre, and the average commercial nitrogen fertilizer rate was 69 pounds per acre for an average of 178 pounds of nitrogen per acre.

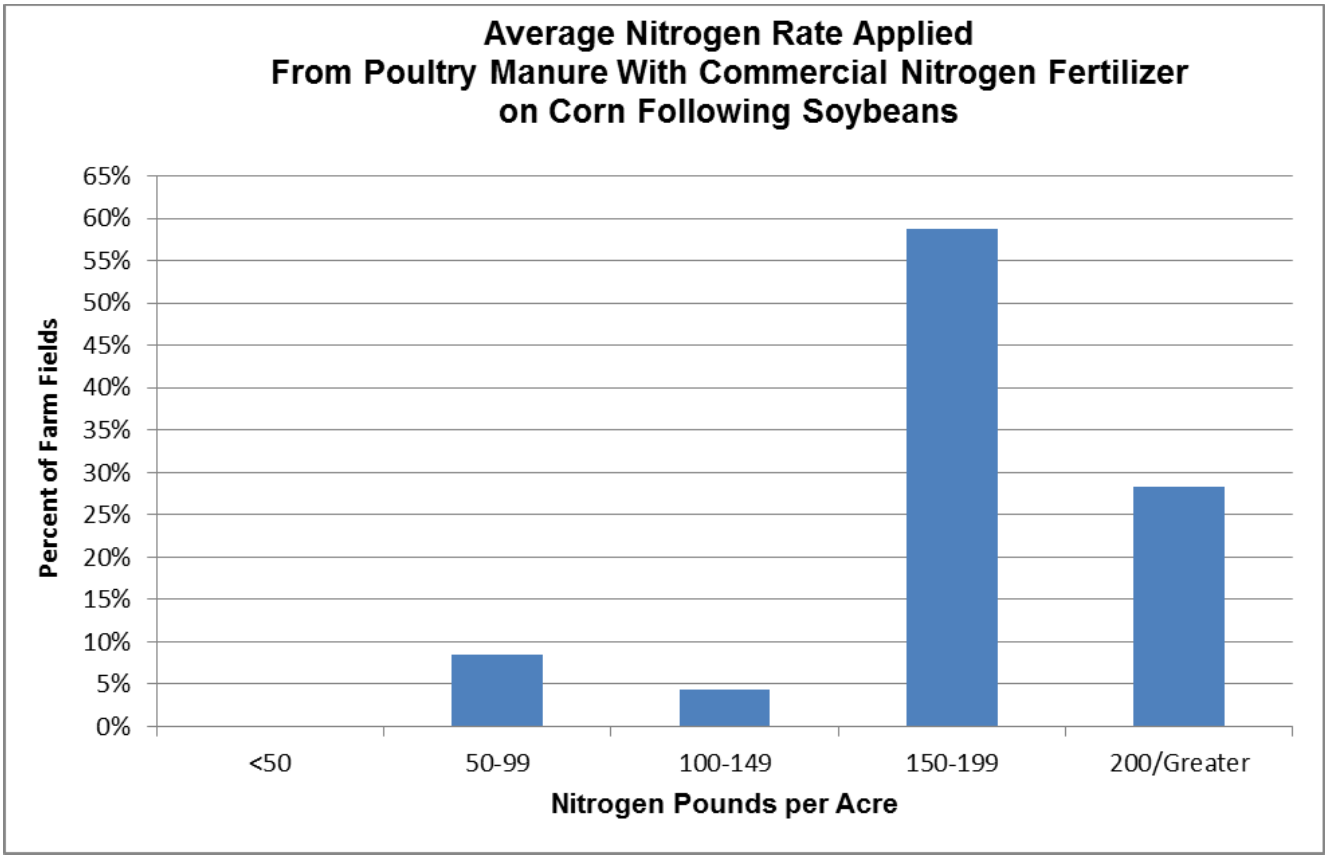

Figure 164. Average nitrogen rates applied to corn following soybeans from poultry manure and commercial nitrogen fertilizer in Minnesota for 2019: 333 fields

Less than five responses reported poultry manure nitrogen rates from corn following soybeans:

- When the farmer did not know the nitrogen contents of the poultry manure and applied additional commercial nitrogen fertilizer.

Less than five responses reported poultry manure nitrogen rates from corn following corn:

- With and without commercial nitrogen fertilizer.
- Without commercial nitrogen fertilizer.
- With commercial nitrogen fertilizer.

No responses reported poultry manure nitrogen rates from corn following corn:

- When the farmer did not know the nitrogen contents of the poultry manure and applied additional commercial nitrogen fertilizer.

No responses reported poultry manure nitrogen rates from corn following corn following alfalfa:

- With and without commercial nitrogen fertilizer.
- Without commercial nitrogen fertilizer.
- With commercial nitrogen fertilizer.
- When the farmer did not know the nitrogen contents of the poultry manure and applied additional commercial nitrogen fertilizer.

Less than five responses reported poultry manure nitrogen rates from corn following small grains:

- With and without commercial nitrogen fertilizer.
- Without commercial nitrogen fertilizer.
- With commercial nitrogen fertilizer.
- When the farmer did not know the nitrogen contents of the poultry manure and applied additional commercial nitrogen fertilizer.

Less than five responses reported poultry manure nitrogen rates from corn following other crops:

- With and without commercial nitrogen fertilizer.
- Without commercial nitrogen fertilizer.
- With commercial nitrogen fertilizer.
- When the farmer did not know the nitrogen contents of the poultry manure and applied additional commercial nitrogen fertilizer.

Manure Applications from Other Sources of Manure for Corn following All Crops

Less than five responses reported other sources of manure nitrogen rates from corn following all crops:

- With and without commercial nitrogen fertilizer.
- Without commercial nitrogen fertilizer.
- With commercial nitrogen fertilizer.
- When the farmer did not know the nitrogen contents of the poultry manure and applied additional commercial nitrogen fertilizer.

Statewide Manure Use and Practices

Table 223 details if the manure applied was from the farmer's livestock (CMQ-11).

Table 223. Origin of the manure in regards to livestock ownership source

BMP Region	Manure From the Farmer's Livestock	Percent of Respondents
Northwestern	Yes	81
Northwestern	No	19
Irrigated and Non-irrigated Sandy Soils	Yes	85
Irrigated and Non-irrigated Sandy Soils	No	15
Southwestern and West Central	Yes	74
Southwestern and West Central	No	26
South Central	Yes	68
South Central	No	32
Southeastern	Yes	93
Southeastern	No	7
Statewide	**Yes**	**79**
Statewide	**No**	**21**

Table 224 details when the manure was last tested for nutrients (CMQ-12).

Table 224. Date of last test for manure nutrient content

BMP Region	Last Nutrient Test of Manure	Percent of Respondents
Northwest	This Year	11
Northwest	Last 3 Years	3
Northwest	Over Three Years Ago	14
Northwest	Don’t Test	72
Irrigated and Non-irrigated Sandy Soils	This Year	24
Irrigated and Non-irrigated Sandy Soils	Last 3 Years	14
Irrigated and Non-irrigated Sandy Soils	Over Three Years Ago	15
Irrigated and Non-irrigated Sandy Soils	Don’t Test	47
Southwestern and West Central	This Year	54
Southwestern and West Central	Last 3 Years	17
Southwestern and West Central	Over Three Years Ago	6
Southwestern and West Central	Don’t Test	23
South Central	This Year	47
South Central	Last 3 Years	15
South Central	Over Three Years Ago	12
South Central	Don’t Test	26
Southeastern	This Year	23
Southeastern	Last 3 Years	4
Southeastern	Over Three Years Ago	19
Southeastern	Don’t Test	54
Statewide	**This Year**	**38**
Statewide	**Last 3 Years**	**13**
Statewide	**Over Three Years Ago**	**12**
Statewide	**Don’t Test**	**37**

Table 225 details the percent of respondents who applied fertilizer on manured corn fields (CMQ-13).

Table 225. Commercial fertilizer applications on manured fields by region

BMP Region	Application of Commercial Fertilizer to Manured Corn Field	Percent of Respondents
Northwest	Yes	50
Northwest	No	50
Irrigated and Non-irrigated Sandy Soils	Yes	70
Irrigated and Non-irrigated Sandy Soils	No	30
Southwestern and West Central	Yes	74
Southwestern and West Central	No	26
South Central	Yes	77
South Central	No	23
Southeastern	Yes	81
Southeastern	No	19
Statewide	**Yes**	**74**
Statewide	**No**	**26**

Table 226 details the average amount of nitrogen applied per acre to the manured corn field from commercial nitrogen fertilizer by livestock type (CMQ-7 and CMQ-14).

Table 226. Average amount of nitrogen from commercial fertilizer applied to manured corn fields by livestock type

BMP Region	Animal Type	Average Nitrogen Rate From Commercial Fertilizer Pounds per Acre
Northwest	All	44
Northwest	Dairy	**
Northwest	Beef	47
Northwest	Other	**
Irrigated and Non-irrigated Sandy Soils	All	69
Irrigated and Non-irrigated Sandy Soils	Dairy	50
Irrigated and Non-irrigated Sandy Soils	Beef	85
Irrigated and Non-irrigated Sandy Soils	Hog	**
Irrigated and Non-irrigated Sandy Soils	Poultry	42
Irrigated and Non-irrigated Sandy Soils	Other	**
Southwestern and West Central	All	71
Southwestern and West Central	Dairy	45
Southwestern and West Central	Beef	93
Southwestern and West Central	Hog	52
Southwestern and West Central	Poultry	54
Southwestern and West Central	Other	**
South Central	All	83
South Central	Dairy	85
South Central	Beef	115
South Central	Hog	61
South Central	Poultry	79
South Central	Other	**
Southeastern	All	94
Southeastern	Dairy	80
Southeastern	Beef	107
Southeastern	Hog	**
Statewide	**All**	**77**
Statewide	**Dairy**	**65**
Statewide	**Beef**	**95**
Statewide	**Hog**	**60**
Statewide	**Poultry**	**57**
Statewide	**Other**	**72**

** Less than five responses

Table 227 details the total amount of nitrogen applied per acre to the manured corn field from both manure and commercial nitrogen fertilizer by livestock type (CMQ-7, CMQ-10, and CMQ-14).

Table 227. Average amount of nitrogen from both manure and commercial fertilizer applied to manured corn fields by livestock type

BMP Region	Animal Type	Average Nitrogen Rate From Manure and Commercial Fertilizer Pounds per Acre
Northwest	All	81
Northwest	Dairy	**
Northwest	Beef	74
Northwest	Other	**
Irrigated and Non-irrigated Sandy Soils	All	120
Irrigated and Non-irrigated Sandy Soils	Dairy	137
Irrigated and Non-irrigated Sandy Soils	Beef	108
Irrigated and Non-irrigated Sandy Soils	Hog	**
Irrigated and Non-irrigated Sandy Soils	Poultry	113
Irrigated and Non-irrigated Sandy Soils	Other	**
Southwestern and West Central	All	155
Southwestern and West Central	Dairy	145
Southwestern and West Central	Beef	149
Southwestern and West Central	Hog	164
Southwestern and West Central	Poultry	190
Southwestern and West Central	Other	**
South Central	All	157
South Central	Dairy	160
South Central	Beef	140
South Central	Hog	170
South Central	Poultry	144
South Central	Other	**
Southeastern	All	138
Southeastern	Dairy	148
Southeastern	Beef	126
Southeastern	Hog	**
Statewide	**All**	**142**
Statewide	**Dairy**	**146**
Statewide	**Beef**	**127**
Statewide	**Hog**	**169**
Statewide	**Poultry**	**147**
Statewide	**Other**	**136**

** Less than five responses

Statewide Manure Application and Management on Soybeans

Information on manure management was gathered on the operator's largest soybean field for the 2019 growing season. Information about management practices on all soybean acres were not collected in this section of the survey. Manure applications on crops other than soybeans were not collected in this section of the survey. Typically, in Minnesota, a small proportion of manure is applied to the soybean crop. Manure is generally applied in the fall or spring. Manure information was collected at the same time as pesticide and commercial nitrogen fertilizer information during the survey, thus limiting the amount of information that could be gathered due to time constraints for the respondent. If manure was not used, then the survey was concluded.

Participants who grew soybeans were asked if they had a soybean field that was applied with manure. If yes, they were then asked the acreage of their largest soybean field applied with manure, the average yield of the soybean field during the past three crops, and if the whole field was applied with manure.

Table 228 details the BMP regions where the total number represented soybeans acres were harvested for the 2019 soybean crop by farmers who applied manure to their fields (SMQ- 1 and SMQ-4). All fields that had soybeans harvested in 2019 without manure are excluded from the following analysis.

Table 228. Summary of respondents and corresponding soybean acres applied with manure by BMP region for the 2019 crop year

BMP Region	Number of Respondents	Number of Soybean Acres Applied with at Least Some Manure[97]
Northwestern	96	14,216
Irrigated and Non-irrigated Sandy Soils	584	39,899
Southwestern and West Central	321	48,021
South Central	291	33,131
Southeastern	165	18,663
Statewide	**1,457**	**153,930**

[97] The survey questions asked about the farmer's manure applications on their largest field. Manure applications may have been applied to multiple fields, but the survey did not ask about the total number of manured acres. Therefor actual total acres applied with manure will be larger than 153,930.

Table 229 details the number of represented operations that had at least one soybean field with manure applied for the 2019 soybean crop (SMQ-1).

Table 229. Percent of respondents that applied manure on their soybean acres

BMP Region	Soybean Field Applied with Manure	Percent of Respondents
Northwestern	Yes	4
Northwestern	No	96
Irrigated and Non-irrigated Sandy Soils	Yes	14
Irrigated and Non-irrigated Sandy Soils	No	86
Southwestern and West Central	Yes	4
Southwestern and West Central	No	96
South Central	Yes	4
South Central	No	96
Southeastern	Yes	7
Southeastern	No	93
Statewide	**Yes**	**6**
Statewide	**No**	**94**

Table 230 details the previous crop planted before the 2019 soybean crop by BMP region (SMQ-2 and SMQ-4).

Table 230. Percent of soybean acres by previous crop in manured fields

BMP Region	Previous Crop	Percent of Manured Fields	Average Soybean Yield Bushels per Acre
Northwestern	Corn	**	**
Northwestern	Alfalfa	**	**
Northwestern	Small Grains	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	**	**
Irrigated and Non-irrigated Sandy Soils	Corn	82	45
Irrigated and Non-irrigated Sandy Soils	Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	**	**
Southwestern and West Central	Soybeans	**	**
Southwestern and West Central	Corn	77	51
South Central	Soybeans	**	**
South Central	Corn	73	49
South Central	Alfalfa	**	**
South Central	Small Grains	**	**
Southeastern	Corn	100	51
Statewide	**Soybeans**	**10**	**46**
Statewide	**Corn**	**77**	**48**
Statewide	**Alfalfa**	**	**
Statewide	**Small Grains**	**8**	**46**

** Less than five responses

Table 231 details average soybean field size where manure is applied and the manure coverage of the manured soybean fields. Fields without manure were excluded from this analysis (SMQ-3, SMQ-4, and SMQ-5).

Table 231. Acres of the average soybean field by BMP region and percent of soybean fields with 100 percent manure coverage

BMP Region	Average Size of Soybean Field in Acres	Average Soybean Yield Bushels per Acre	Percent of Fields with Complete Manure Coverage
Northwestern	100	32	9
Irrigated and Non-irrigated Sandy Soils	23	45	68
Southwestern and West Central	43	52	38
South Central	30	50	38
Southeastern	10	51	38
Statewide	**27**	**47**	**48**

Table 232 details all soybean fields with manure or with manure and commercial nitrogen fertilizer and average yield for the last three soybean crops regardless of the percent of manure coverage on the soybean field for the 2019 soybean crop. (SMQ-4).

Table 232. Average soybean yield over the last three soybean crops on soybean fields applied with manure or manure and commercial nitrogen fertilizer

BMP Region	Average Soybean Yield Bushels per Acre
Northwest	34
Irrigated and Non-irrigated Sandy Soils	44
Southwestern and West Central	51
South Central	51
Southeastern	51
Statewide	**47**

Table 233 details the main source of manure applied on the soybean field for the 2019 soybean crop (SMQ-6).

Table 233. The main source of manure applied to the soybean field by livestock type

BMP Region	Main Source of Manure	Percent of Respondents
Northwestern	Beef	85
Northwestern	Other	**
Irrigated and Non-irrigated Sandy Soils	Dairy	27
Irrigated and Non-irrigated Sandy Soils	Beef	56
Irrigated and Non-irrigated Sandy Soils	Hog	**
Irrigated and Non-irrigated Sandy Soils	Poultry	**
Irrigated and Non-irrigated Sandy Soils	Other	**
Southwestern and West Central	Dairy	**
Southwestern and West Central	Beef	58
Southwestern and West Central	Poultry	**
Southwestern and West Central	Other	**
South Central	Dairy	47
South Central	Beef	35
South Central	Hog	**
South Central	Poultry	**
Southeastern	Dairy	**
Southeastern	Beef	**
Southeastern	Poultry	**
Statewide	**Dairy**	**31**
Statewide	**Beef**	**51**
Statewide	**Hog**	**
Statewide	**Poultry**	**6**
Statewide	**Other**	**8**

** Less than five responses

Table 234 details the main consistency of manure applied on the soybean field was liquid or solid for the 2019 soybean crop (SMQ-7).

Table 234. The main consistency of manure applied to the soybean field was liquid or solid

BMP Region	Main Consistency of Manure	Percent of Respondents
Northwestern	Solid	100
Northwestern	Liquid	0
Irrigated and Non-irrigated Sandy Soils	Solid	78
Irrigated and Non-irrigated Sandy Soils	Liquid	22
Southwestern and West Central	Solid	100
Southwestern and West Central	Liquid	0
South Central	Solid	82
South Central	Liquid	18
Southeastern	Solid	85
Southeastern	Liquid	15
Statewide	**Solid**	**86**
Statewide	**Liquid**	**14**

Table 235 details the application rate for liquid manure, if known by the farmer (SMQ-7A). No respondents reported liquid manure application rates in the Northwestern and Southwestern and West Central BMP regions.

Table 235. Rates for liquid manure applications by region

BMP Region	Average Manure Application Rate Gallons per Acre
Irrigated and Non-irrigated Sandy Soils	2,804
South Central	**
Southeastern	**
Statewide	**2,598**

** Less than five responses

Table 236 details the application rate for solid manure, if known by the farmer (SMQ-7B).

Table 236. Rates for solid manure application by region

BMP Region	Average Manure Application Rate Tons per Acre
Northwestern	**
Irrigated and Non-irrigated Sandy Soils	3.85
Southwestern and West Central	6.64
South Central	7.24
Southeastern	3.66
Statewide	**5.35**

** Less than five responses

Table 237 details the percent of respondents that applied manure on a specific date as to when the manure was applied in regards to the general season (SMQ-8).

Table 237. Seasonal timing for soybean fields applied with manure on a specific date

BMP Region	Approximate Date of the Manure Application	Percent of Respondents
Northwestern	Summer 2018	42
Northwestern	Fall 2018	16
Northwestern	Winter 2018	14
Northwestern	Spring 2019	28
Irrigated and Non-irrigated Sandy Soils	Summer 2018	10
Irrigated and Non-irrigated Sandy Soils	Fall 2018	44
Irrigated and Non-irrigated Sandy Soils	Winter 2018	14
Irrigated and Non-irrigated Sandy Soils	Spring 2019	32
Southwestern and West Central	Fall 2018	50
Southwestern and West Central	Winter 2018	23
Southwestern and West Central	Spring 2019	27
South Central	Summer 2018	9
South Central	Fall 2018	51
South Central	Winter 2018	15
South Central	Spring 2019	25
Southeastern	Fall 2018	15
Southeastern	Winter 2018	19
Southeastern	Spring 2019	66
Statewide	**Summer 2018**	**8**
Statewide	**Fall 2018**	**42**
Statewide	**Winter 2018**	**17**
Statewide	**Spring 2019**	**33**

Table 238 details the average amount of nitrogen applied per acre by type of livestock manure when the farmer knew the amount of nitrogen in the manure (SMQ-6 and SMQ-9).

Table 238. Average amount of nitrogen applied per acre from manure by livestock type when the farmer knew the amount of nitrogen in the manure source

BMP Region	Animal Type	Average Nitrogen Rate Applied from Manure in Pounds per Acre
Northwestern	All	**
Northwestern	Beef	**
Irrigated and Non-irrigated Sandy Soils	All	73
Irrigated and Non-irrigated Sandy Soils	Dairy	**
Irrigated and Non-irrigated Sandy Soils	Beef	**
Irrigated and Non-irrigated Sandy Soils	Hog	**
Irrigated and Non-irrigated Sandy Soils	Poultry	**
Southwestern and West Central	All	109
Southwestern and West Central	Dairy	**
Southwestern and West Central	Beef	**
Southwestern and West Central	Poultry	**
South Central	All	94
South Central	Dairy	**
South Central	Beef	**
South Central	Poultry	**
Southeastern	All	51
Southeastern	Dairy	**
Southeastern	Beef	**
Southeastern	Poultry	**
Statewide	**All**	**81**
Statewide	**Dairy**	**47**
Statewide	**Beef**	**93**
Statewide	**Hog**	**
Statewide	**Poultry**	**113**
Statewide	**Other**	**

** Less than five responses

Average Nitrogen Rate from Manure Applications

Figure 165 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure[98] and does not include nitrogen from additional commercial nitrogen fertilizer applied to the 2019 soybean crop (SMQ-6 and SMQ-9).

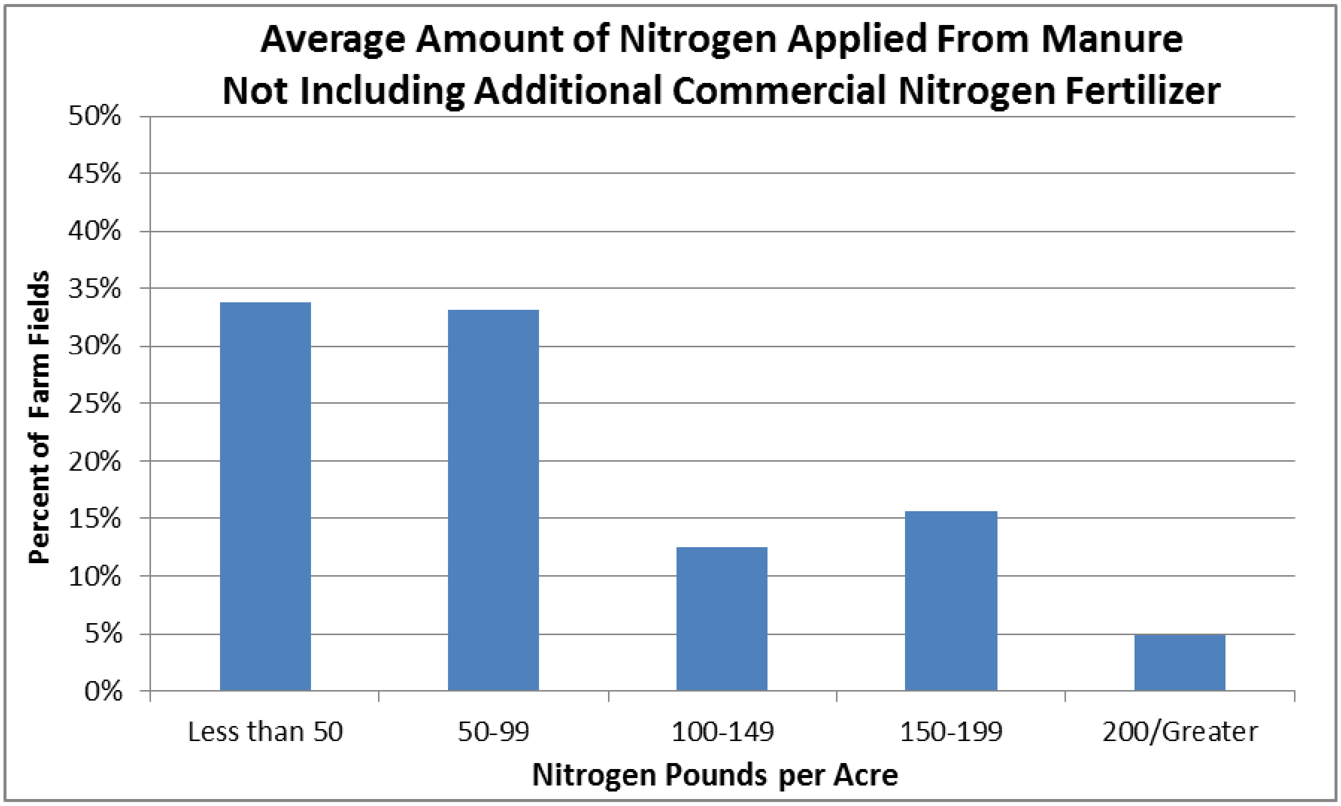

Figure 165. Average nitrogen rates applied to soybean fields from manure and does not include additional commercial nitrogen fertilizer in Minnesota for 2019: 475 fields

[98] Manure is from all manure sources

Figure 166 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure and does not include nitrogen from additional commercial nitrogen fertilizer applied to the 2019 soybean crop (SMQ-6 and SMQ-9).

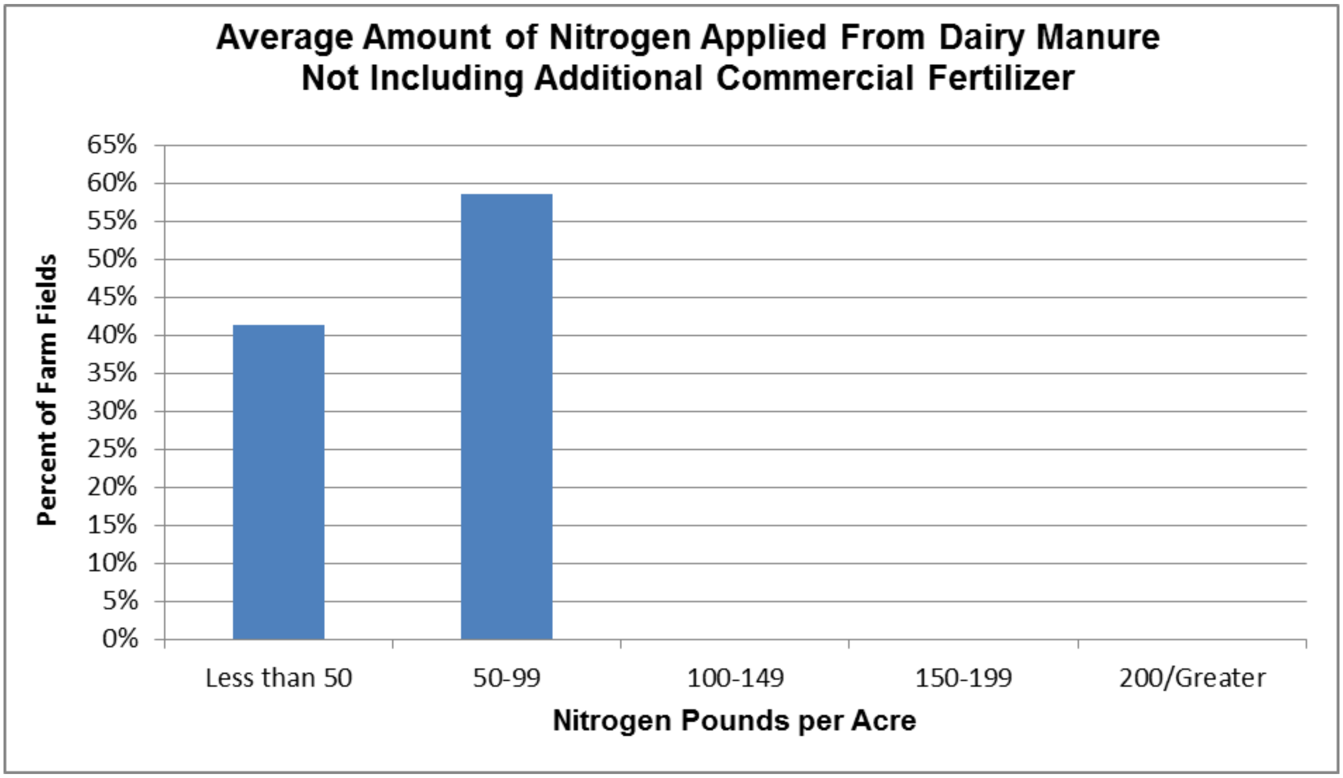

Figure 166. Average nitrogen rates applied to soybean fields from dairy manure and does not include additional commercial nitrogen fertilizer in Minnesota for 2019: 203 fields

Figure 167 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure and does not include nitrogen from additional commercial nitrogen fertilizer applied to the 2019 soybean crop (SMQ-6 and SMQ-9).

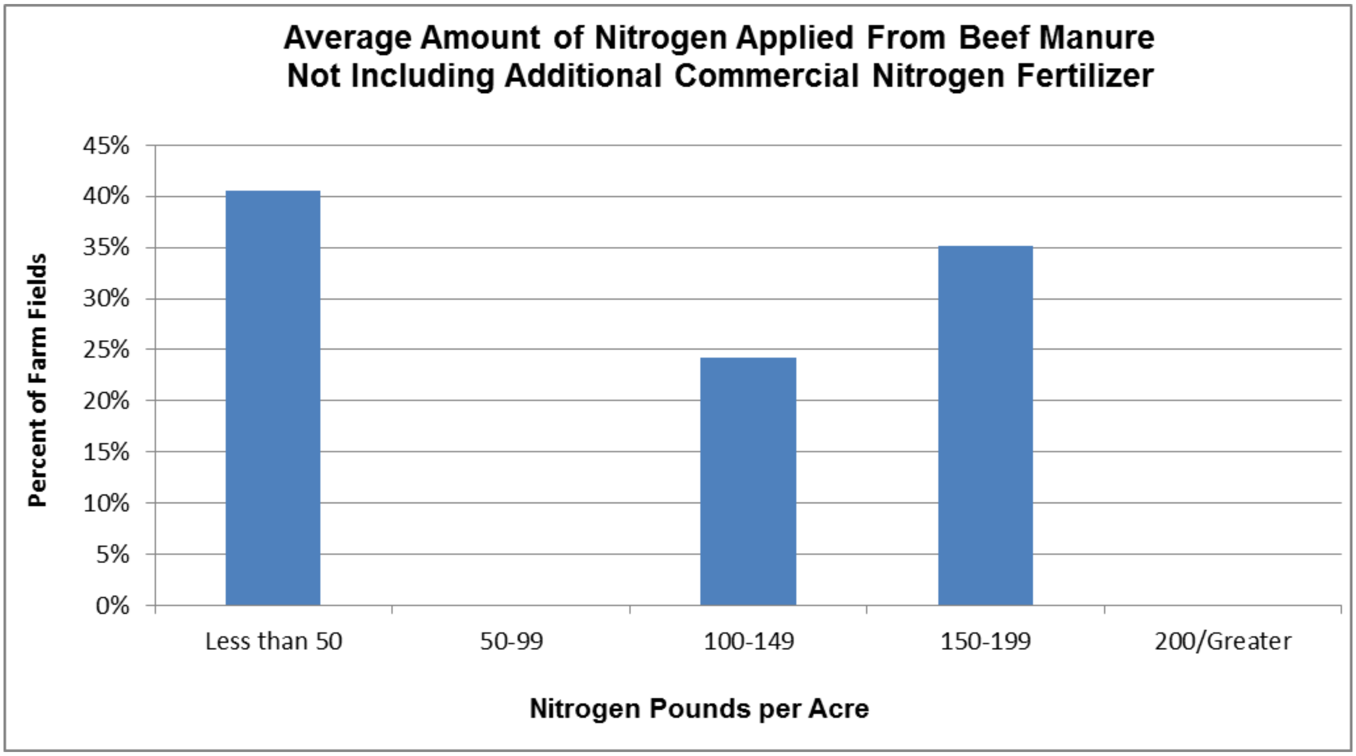

Figure 167. Average nitrogen rates applied to soybean fields from beef manure and does not include additional commercial nitrogen fertilizer in Minnesota for 2019: 138 fields

Less than five responses were reported for the average nitrogen rate regardless if additional commercial nitrogen fertilizer was applied to the 2019 soybean crop from:

- Hog manure.

Figure 168 details the distribution of average nitrogen rates in Minnesota from farmers that applied poultry manure and does not include nitrogen from additional commercial nitrogen fertilizer applied to the 2019 soybean crop (SMQ-6 and SMQ-9).

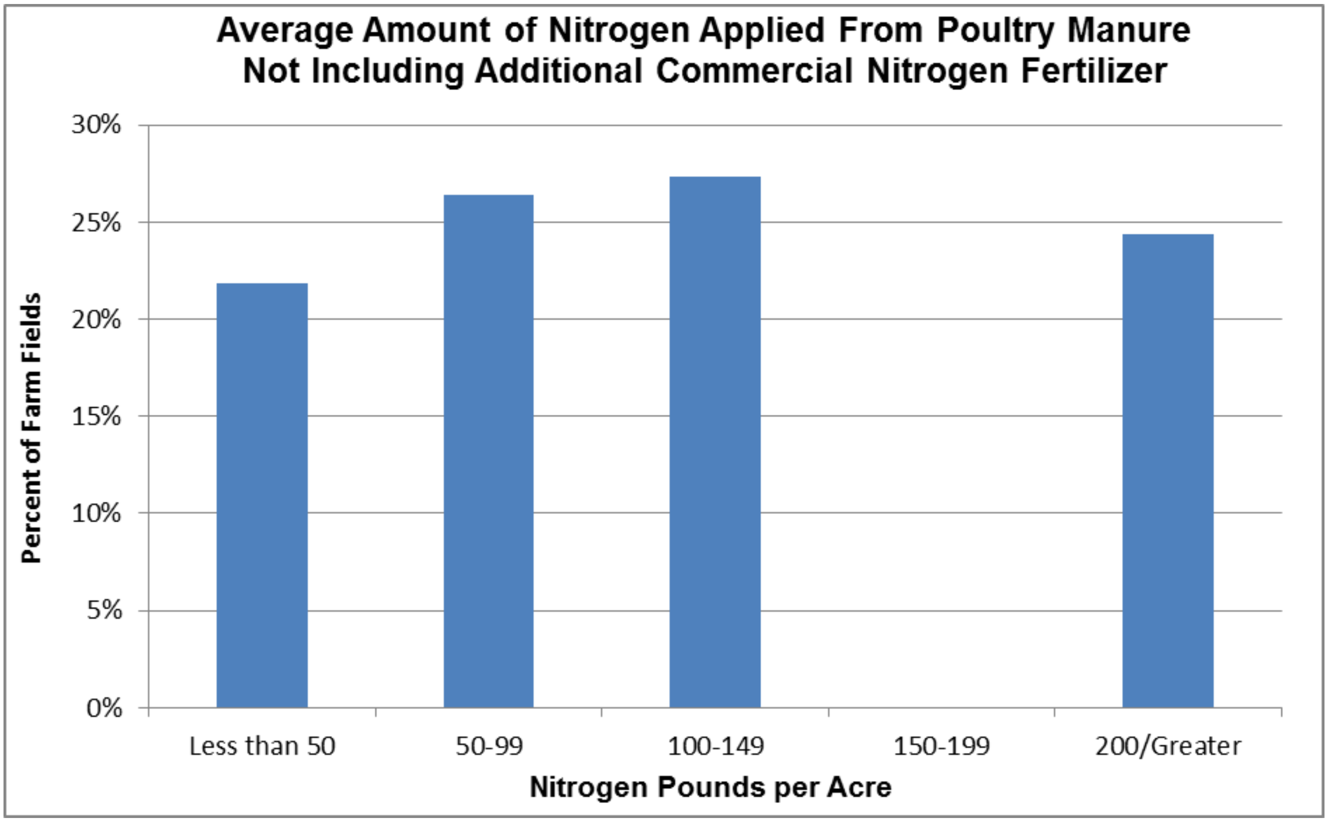

Figure 168. Average nitrogen rates applied to soybean fields from poultry manure and does not include additional commercial nitrogen fertilizer in Minnesota for 2019: 94 fields

Less than five responses were reported for the average nitrogen rate regardless if additional commercial nitrogen fertilizer was applied to the 2019 soybean crop from:

- From other sources of manure.

Nitrogen Rate from Manure and Commercial Nitrogen Fertilizer Applications

Less than five responses reported the average nitrogen rate from manure and commercial nitrogen fertilizer sources to the 2019 soybean crop.

Nitrogen Rates and Average Soybean Yields on Manured Fields

Table 239 details the nitrogen rates and soybean yields by BMP region on soybean following various crops (SMQ-2, SMQ-6, SMQ-9, and SMQ-13). These are soybean fields applied with manure[99] or manure and commercial nitrogen fertilizer.

Table 239. Average amount of nitrogen applied from manure or manure and commercial nitrogen fertilizer and corresponding soybean yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Manure Only or Manure and Commercial Fertilizer Pounds per Acre	Average Soybean Yield Bushels per Acre
Northwest	Small Grains	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	**	**
Irrigated and Non-irrigated Sandy Soils	Corn	24	45
Irrigated and Non-irrigated Sandy Soils	Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	**	**
Southwestern and West Central	Soybeans	**	**
Southwestern and West Central	Corn	109	53
South Central	Corn	90	52
South Central	Alfalfa	**	**
Southeastern	Corn	53	51
Statewide	**Soybeans**	**	**
Statewide	**Corn**	**33**	**48**
Statewide	**Alfalfa**	**	**
Statewide	**Small Grains**	**	**

** Less than five responses

[99] Manure is from all manure sources

Table 240 details the nitrogen rates and soybean yields by BMP region on soybean following various crops (SMQ-2, SMQ-6, and SMQ-9). These are soybean fields applied with manure and no commercial fertilizer.

Table 240. Average amount of nitrogen applied from manure and no commercial nitrogen fertilizer and corresponding soybean yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Manure Only Pounds per Acre	Average Soybean Yield Bushels per Acre
Northwest	Small Grains	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	**	**
Irrigated and Non-irrigated Sandy Soils	Corn	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	**	**
Southwestern and West Central	Corn	109	53
South Central	Corn	**	**
South Central	Alfalfa	**	**
Southeastern	Corn	**	**
Statewide	**Soybeans**	**	**
Statewide	**Corn**	**82**	**50**
Statewide	**Alfalfa**	**	**
Statewide	**Small Grains**	**	**

** Less than five responses

Table 241 details the nitrogen rates and soybean yields by BMP region on soybean following various crops (SMQ-2, SMQ-6, SMQ-9, and SMQ-13). These are soybean fields applied with manure and commercial nitrogen fertilizer.

Table 241. Average amount of nitrogen applied from manure and commercial nitrogen fertilizer and corresponding soybean yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Manure and Commercial Fertilizer Pounds per Acre	Average Soybean Yield Bushels per Acre
Irrigated and Non-irrigated Sandy Soils	Corn	18	45
Irrigated and Non-irrigated Sandy Soils	Alfalfa	**	**
Southwestern and West Central	Soybeans	**	**
South Central	Corn	**	**
Southeastern	Corn	**	**
Statewide	**Soybeans**	**	**
Statewide	**Corn**	**28**	**48**
Statewide	**Alfalfa**	**	**

** Less than five responses

Table 242 details the nitrogen rates and soybean yields by BMP region on soybean following various crops (SMQ-2, SMQ-6, SMQ-9, and SMQ-13). These are soybean fields applied with dairy manure or dairy manure and commercial nitrogen fertilizer.

Table 242. Average amount of nitrogen applied from dairy manure or dairy manure and commercial nitrogen fertilizer and corresponding soybean yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Dairy Manure Only or Dairy Manure and Commercial Fertilizer Pounds per Acre	Average Soybean Yield Bushels per Acre
Irrigated and Non-irrigated Sandy Soils	Corn	**	**
Southwestern and West Central	Corn	**	**
South Central	Corn	**	**
South Central	Alfalfa	**	**
Southeastern	Corn	**	**
Statewide	**Corn**	**47**	**51**
Statewide	**Alfalfa**	**	**

** Less than five responses

Table 243 details the nitrogen rates and soybean yields by BMP region on soybean following various crops (SMQ-2, SMQ-6, SMQ-9, and SMQ-13). These are soybean fields applied with dairy manure and no commercial fertilizer.

Table 243. Average amount of nitrogen applied from dairy manure and no commercial nitrogen fertilizer and corresponding soybean yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Dairy Manure Only Pounds per Acre	Average Soybean Yield Bushels per Acre
Irrigated and Non-irrigated Sandy Soils	Corn	**	**
Southwestern and West Central	Corn	**	**
South Central	Corn	**	**
South Central	Alfalfa	**	**
Southeastern	Corn	**	**
Statewide	**Corn**	**47**	**51**
Statewide	**Alfalfa**	**	**

** Less than five responses

Less than five responses reported applying dairy manure and commercial nitrogen fertilizer to the 2019 soybean crop.

Table 244 details the nitrogen rates and soybean yields by BMP region on soybean following various crops (SMQ-2, SMQ-6, SMQ-9, and SMQ-13). These are soybean fields applied with beef manure or beef manure and commercial nitrogen fertilizer.

Table 244. Average amount of nitrogen applied from beef manure or beef manure and commercial nitrogen fertilizer and corresponding soybean yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied from Beef Manure Only or Beef Manure and Commercial Fertilizer Pounds per Acre	Average Soybean Yield Bushels per Acre
Irrigated and Non-irrigated Sandy Soils	Corn	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	**	**
Southwestern and West Central	Corn	**	**
South Central	Corn	**	**
Statewide	**Corn**	**102**	**55**
Statewide	**Small Grains**	**	**

** Less than five responses

Table 245 details the nitrogen rates and soybean yields by BMP region on soybean following various crops (SMQ-2, SMQ-6, and SMQ-9). These are soybean fields applied with beef manure and no commercial fertilizer.

Table 245. Average amount of nitrogen applied from beef manure and no commercial nitrogen fertilizer and corresponding soybean yields to previous crops by BMP region

BMP Region	Previous Crop	Average Nitrogen Rate Applied From Beef Manure Only Pounds per Acre	Average Soybean Yield Bushels per Acre
Irrigated and Non-irrigated Sandy Soils	Corn	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	**	**
Southwestern and West Central	Corn	**	**
South Central	Corn	**	**
Southeastern	Corn	**	**
Statewide	**Corn**	**106**	**53**
Statewide	**Small Grains**	**	**

** Less than five responses

Less than five responses reported the nitrogen rates and soybean yields following various crops for:

- Hog manure applied with fertilizer and no additional fertilizer.
- Poultry manure applied with fertilizer and no additional fertilizer.
- Other sources of manure applied with fertilizer and no additional fertilizer.

Manure Application from All Manure Sources for Soybeans following All Crops

Less than five responses reported manure nitrogen rates from soybeans following soybeans:

- When the farmer knew the amount of nitrogen in manure applied.
- When the farmer did not know the amount of nitrogen in manure applied.

Figure 169 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure[100] or applied manure and commercial nitrogen fertilizer to soybeans following corn (SMQ-2, SMQ-6, SMQ-9, and SMQ-13). The average soybean yield was 51 bushels per acre. The average nitrogen rate applied from manure was 81 pounds per acre, and the average commercial nitrogen fertilizer rate was 1 pound per acre for an average of 82 pounds of nitrogen per acre.

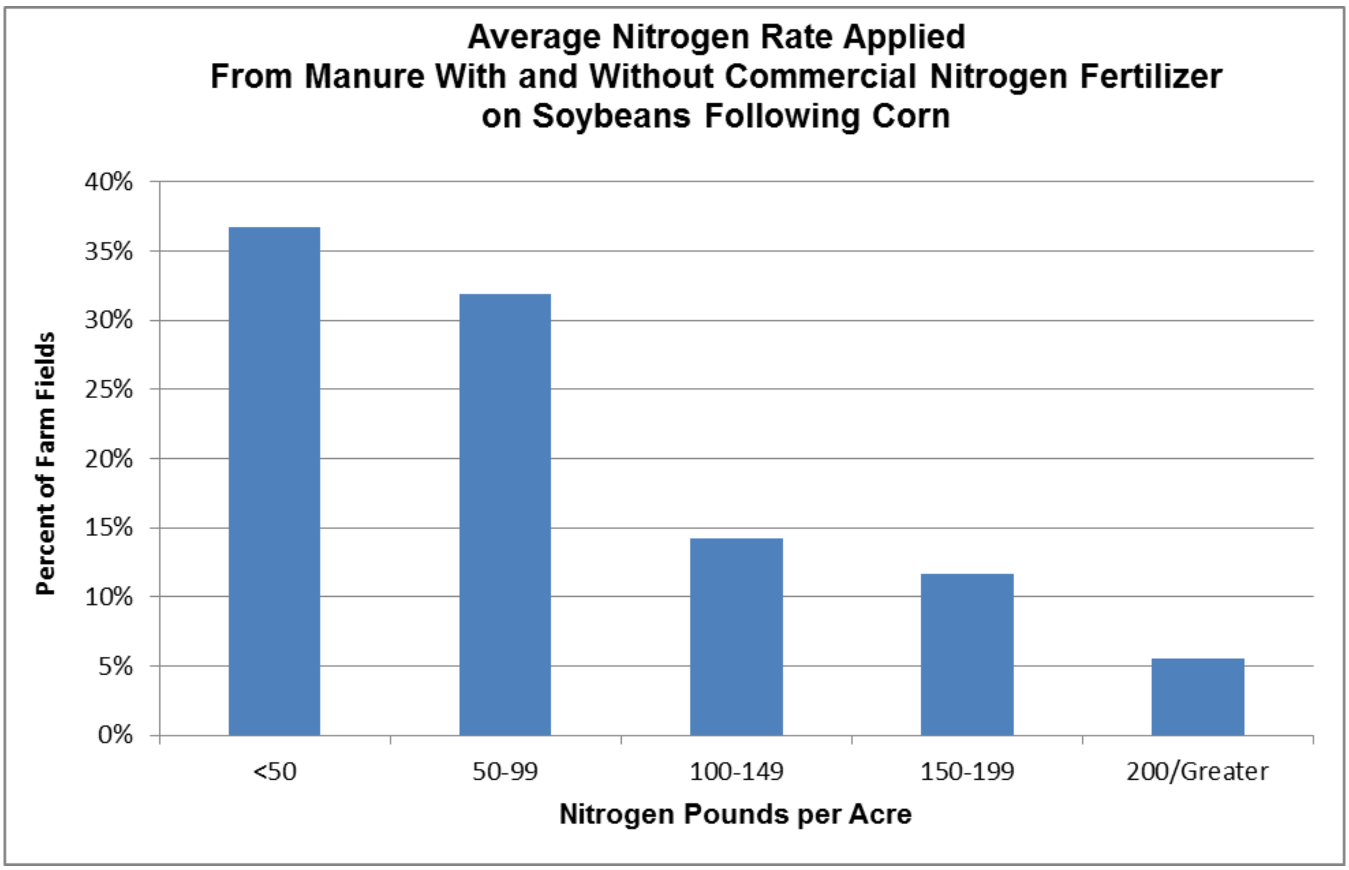

Figure 169. Average nitrogen rates applied to soybeans following corn from manure or manure and commercial nitrogen fertilizer in Minnesota for 2019: 418 fields

[100] Manure is from all manure sources

Figure 170 details the distribution of average nitrogen rates in Minnesota from farmers that applied manure and no commercial nitrogen fertilizer to soybeans following corn (SMQ-2, SMQ-6, and SMQ-9). The average soybean yield was 50 bushels per acre. The average nitrogen rate applied from manure was 82 pounds per acre.

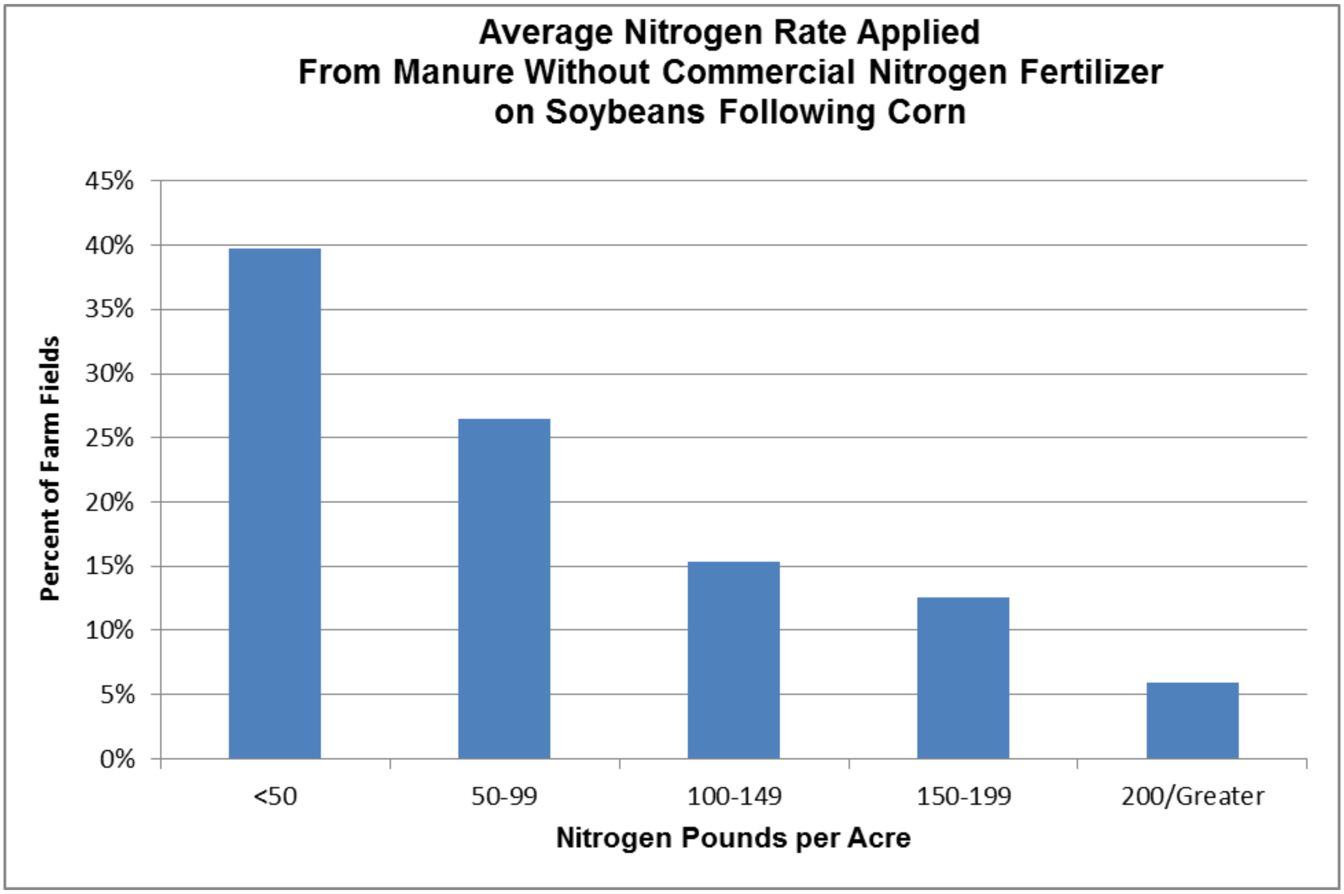

Figure 170. Average nitrogen rates applied to soybeans following corn from manure and no commercial nitrogen fertilizer in Minnesota for 2019: 387 fields

Less than five responses reported manure nitrogen rates from soybeans following alfalfa

- When the farmer knew the amount of nitrogen in manure applied.

No responses reported manure nitrogen rates from soybeans following alfalfa

- When the farmer did not know the amount of nitrogen in manure applied.

Less than five responses reported manure nitrogen rates from soybeans following small grains

- When the farmer knew the amount of nitrogen in manure applied.

No responses reported manure nitrogen rates from soybeans following small grains.

- When the farmer did not know the amount of nitrogen in manure applied.

No responses reported manure nitrogen rates from soybeans following other crops

- When the farmer knew the amount of nitrogen in manure applied.
- When the farmer did not know the amount of nitrogen in manure applied.

No responses reported dairy manure nitrogen rates from soybeans following soybeans

- When the farmer knew the amount of nitrogen in manure applied.
- When the farmer did not know the amount of nitrogen in manure applied.

Figure 171 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure or applied dairy manure and commercial nitrogen fertilizer to soybeans following corn (SMQ-2, SMQ-6, SMQ-9, and SMQ-13). The average soybean yield was 51 bushels per acre. The average nitrogen rate applied from dairy manure was 47 pounds per acre, and the average commercial nitrogen fertilizer rate was 0 pounds per acre for an average of 47 pounds of nitrogen per acre.

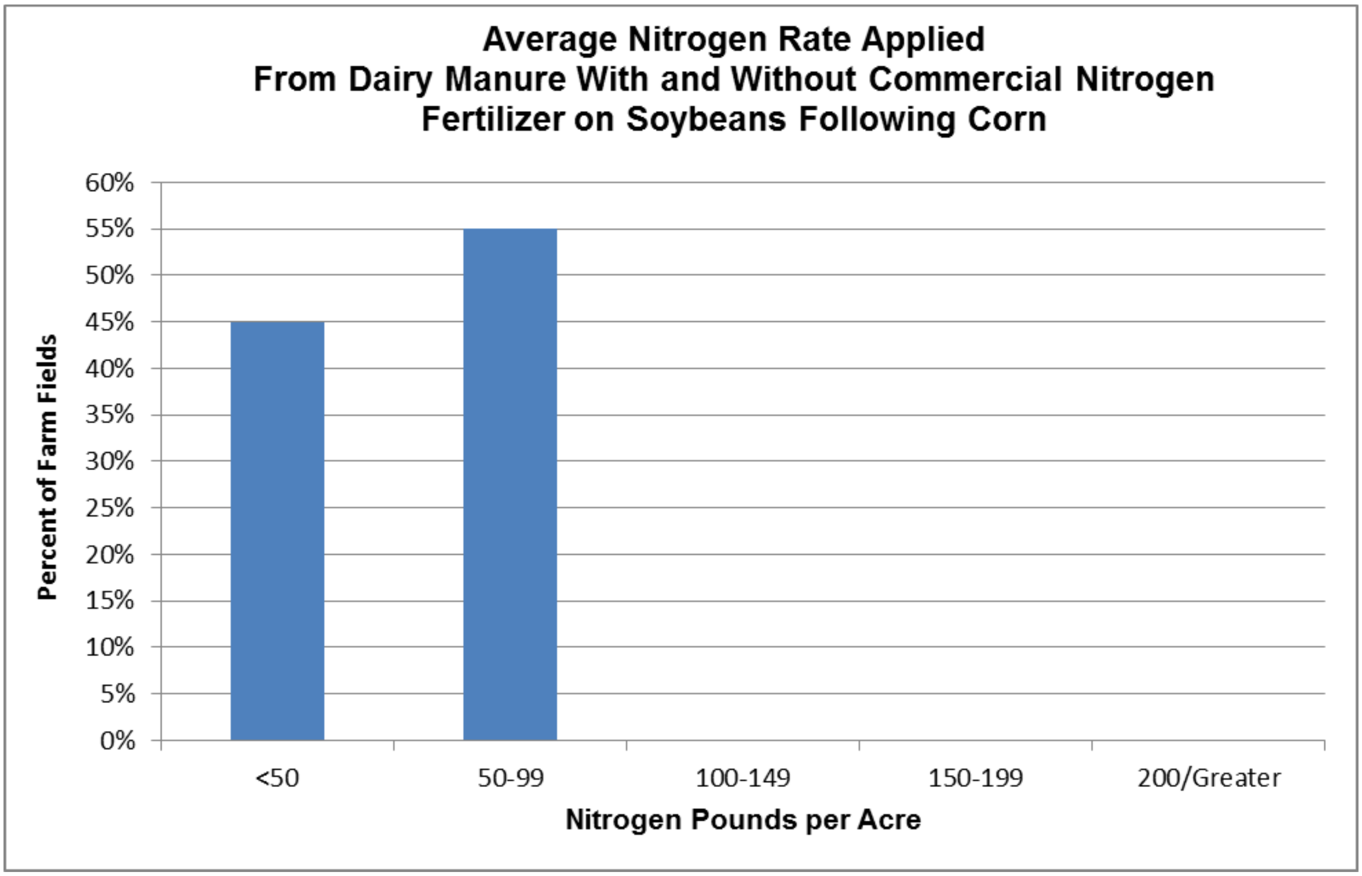

Figure 171. Average nitrogen rates applied to soybeans following corn from dairy manure or dairy manure and commercial nitrogen fertilizer in Minnesota for 2019: 186 fields

Figure 172 details the distribution of average nitrogen rates in Minnesota from farmers that applied dairy manure and no commercial nitrogen fertilizer to soybeans following corn (SMQ-2, SMQ-6, and SMQ-9). The average soybean yield was 51 bushels per acre. The average nitrogen rate applied from dairy manure was 47 pounds per acre.

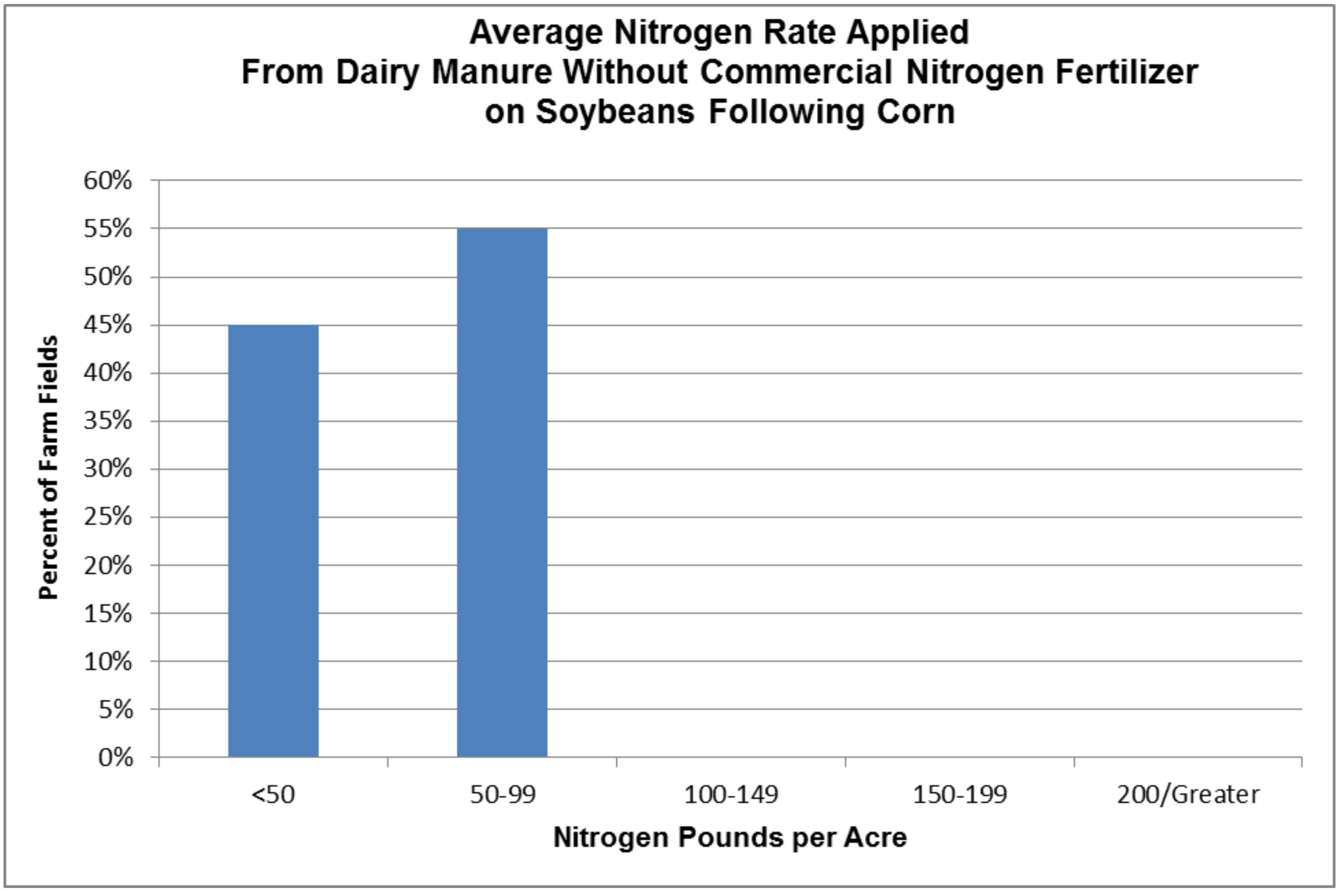

Figure 172. Average nitrogen rates applied to soybeans following corn from dairy manure and no commercial nitrogen fertilizer in Minnesota for 2019: 186 fields

No responses reported dairy manure nitrogen rates from:

- Soybeans following corn with additional commercial nitrogen fertilizer.

No responses reported dairy manure nitrogen rates from soybeans following corn

- When the farmer did not know the amount of nitrogen in manure applied.

Less than five responses reported nitrogen rates from dairy manure and commercial nitrogen fertilizer to soybeans following alfalfa:

- When the farmer knew the amount of nitrogen in the manure with commercial nitrogen fertilizer.

No responses reported nitrogen rates from dairy manure and commercial nitrogen fertilizer to soybeans following alfalfa:

- When the farmer knew the amount of nitrogen in the manure with no commercial nitrogen fertilizer.

No responses reported nitrogen rates from dairy manure and commercial nitrogen fertilizer to soybeans following small grains:

- When the farmer knew the amount of nitrogen in the manure with commercial nitrogen fertilizer.
- When the farmer knew the amount of nitrogen in the manure with no commercial nitrogen fertilizer.

No responses reported nitrogen rates from dairy manure and commercial nitrogen fertilizer to soybeans following other crops:

- When the farmer knew the amount of nitrogen in the manure with commercial nitrogen fertilizer.
- When the farmer knew the amount of nitrogen in the manure with no commercial nitrogen fertilizer.

Figure 173 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure or applied beef manure and commercial nitrogen fertilizer to soybeans following corn (SMQ-2, SMQ-6, SMQ-9, and SMQ-13). The average soybean yield was 55 bushels per acre. The average nitrogen rate applied from beef manure was 101 pounds per acre, and the average commercial nitrogen fertilizer rate was 2 pounds per acre for an average of 103 pounds of nitrogen per acre.

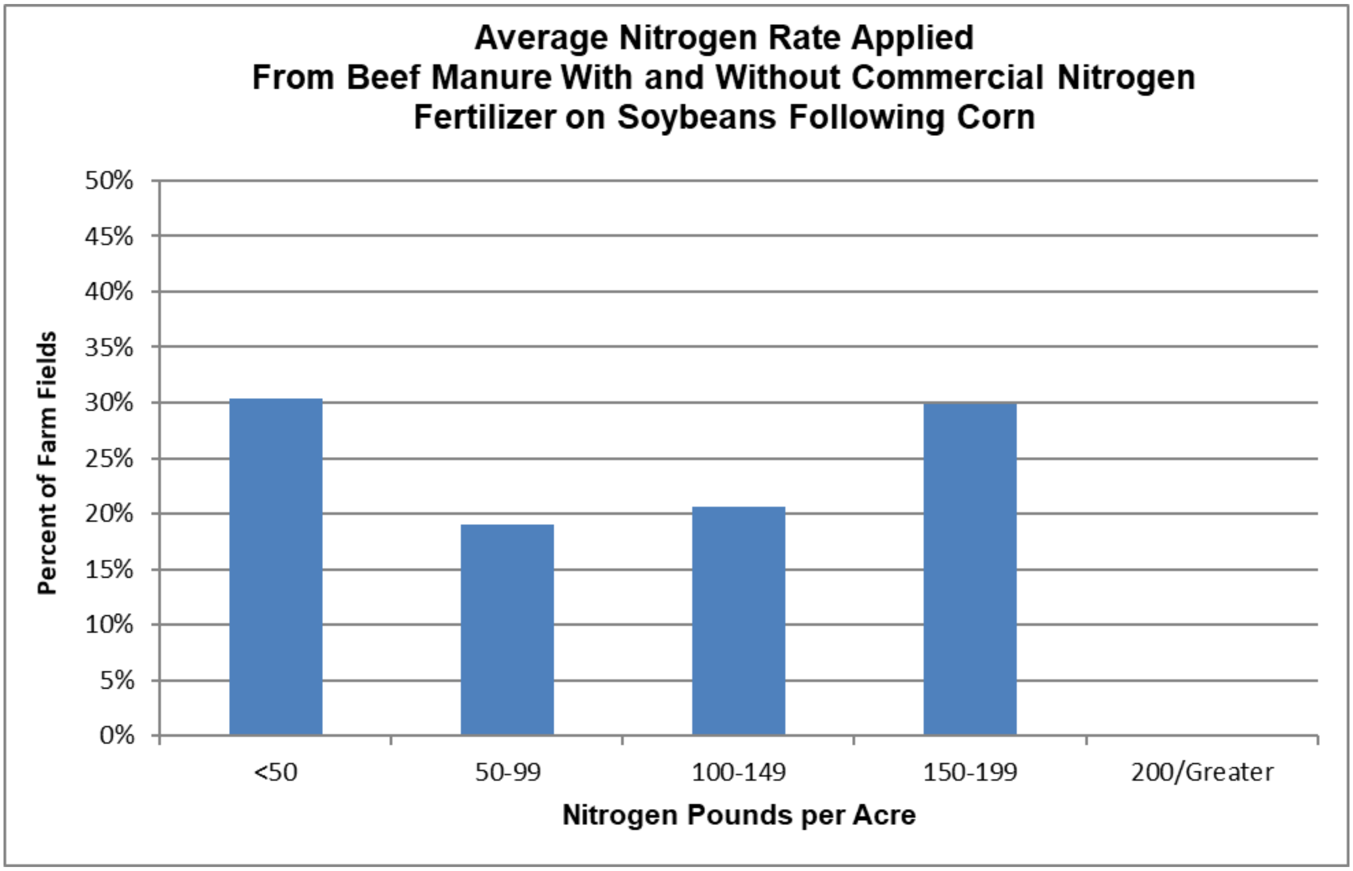

Figure 173. Average nitrogen rates applied to soybeans following corn from beef manure or beef manure and commercial nitrogen fertilizer in Minnesota for 2019: 163 fields

Figure 172 details the distribution of average nitrogen rates in Minnesota from farmers that applied beef manure and no commercial nitrogen fertilizer to soybeans following corn (SMQ-2, SMQ-6, and SMQ-9). The average soybean yield was 51 bushels per acre. The average nitrogen rate applied from beef manure was 47 pounds per acre.

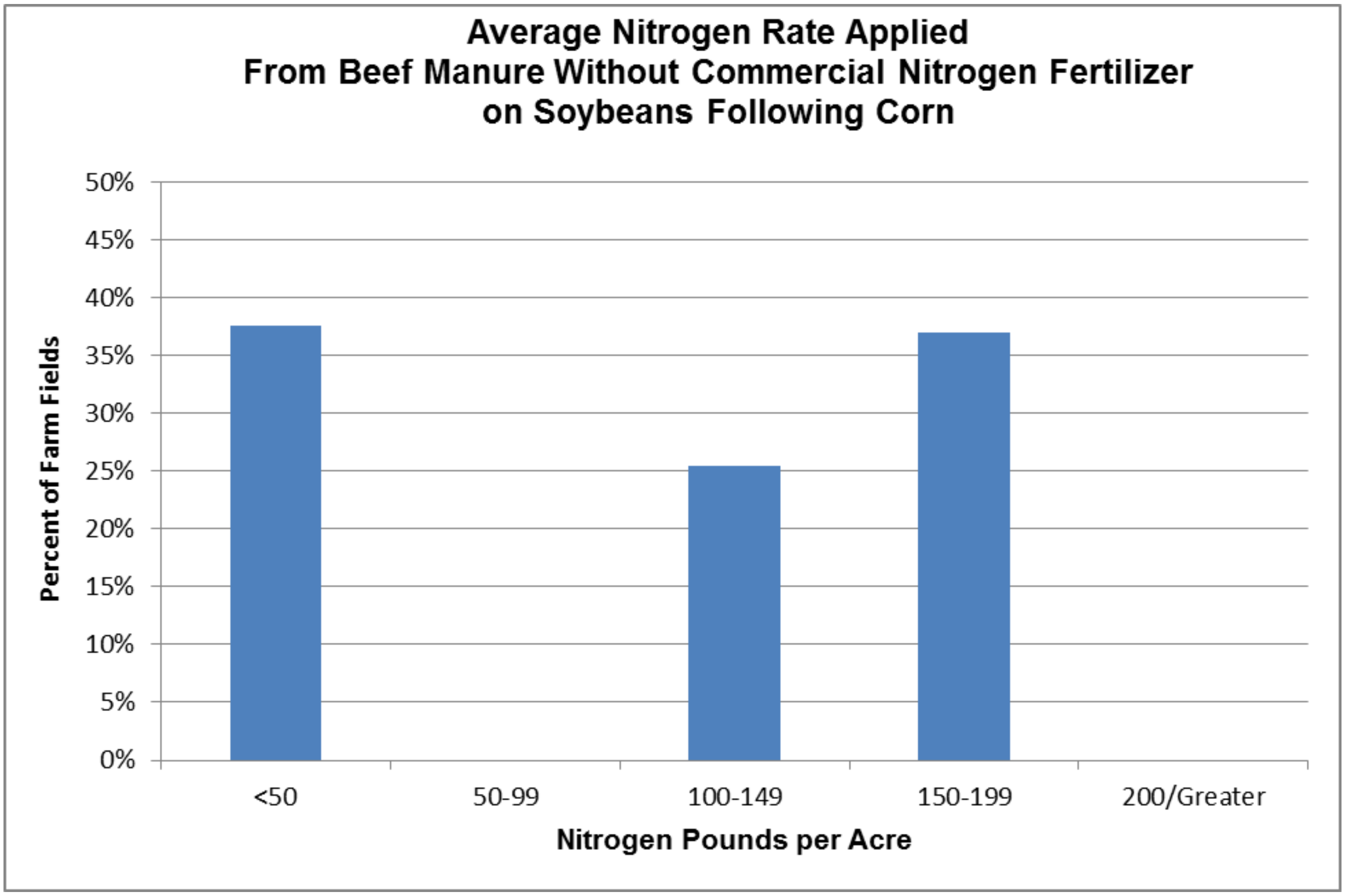

Figure 174. Average nitrogen rates applied to soybeans following corn from beef manure and no commercial nitrogen fertilizer in Minnesota for 2019: 132 fields

Less than five responses reported beef manure nitrogen rates from:

- Soybeans following corn with additional commercial nitrogen fertilizer.

No responses reported beef manure nitrogen rates from soybeans following corn

- When the farmer did not know the amount of nitrogen in manure applied.

No responses reported nitrogen rates from beef manure and commercial nitrogen fertilizer to soybeans following alfalfa:

- When the farmer knew the amount of nitrogen in the manure with commercial nitrogen fertilizer.
- When the farmer knew the amount of nitrogen in the manure with no commercial nitrogen fertilizer.

Less than five responses reported nitrogen rates from beef manure and commercial nitrogen fertilizer to soybeans following small grains:

- When the farmer knew the amount of nitrogen in the manure with commercial nitrogen fertilizer.

No responses reported nitrogen rates from beef manure and commercial nitrogen fertilizer to soybeans following small grains:

- When the farmer knew the amount of nitrogen in the manure with no commercial nitrogen fertilizer.

No responses reported nitrogen rates from beef manure and commercial nitrogen fertilizer to soybeans following other crops:

- When the farmer knew the amount of nitrogen in the manure with commercial nitrogen fertilizer.
- When the farmer knew the amount of nitrogen in the manure with no commercial nitrogen fertilizer.

Less than five responses reported nitrogen rates from hog manure and commercial nitrogen fertilizer to soybeans following all crops:

- When the farmer knew the amount of nitrogen in the manure with commercial nitrogen fertilizer.
- When the farmer knew the amount of nitrogen in the manure with no commercial nitrogen fertilizer.

Less than five responses reported nitrogen rates from poultry manure and commercial nitrogen fertilizer to soybeans following all crops:

- When the farmer knew the amount of nitrogen in the manure with commercial nitrogen fertilizer.
- When the farmer knew the amount of nitrogen in the manure with no commercial nitrogen fertilizer.

Less than five responses reported nitrogen rates from other manure sources and commercial nitrogen fertilizer to soybeans following all crops:

- When the farmer knew the amount of nitrogen in the manure with commercial nitrogen fertilizer.
- When the farmer knew the amount of nitrogen in the manure with no commercial nitrogen fertilizer.

Appendix 1. MASS Data Sheet

Survey questions for fertilizer and manure start after the farmer is questioned about pesticide use.

Fertilizer Use Questions Field 1 2019 Crop Season

FIELDS MP102 Part 1 (Corn Field 1)

Corn All Question 1 Total Crop Acres How many acres of corn did you plant?

Corn Fertilizer Question 1 Corn Acre Did all your corn fields receive manure for the 2019 crop year? Yes No

Setup Statement Verify Acres First on a corn fields with no manure or compost applied in the fall of 2018 and no manure or compost applied during the 2019 crop year.

Corn Fertilizer Question 2 Corn Irrigated Was this field irrigated? Yes No

Corn Fertilizer Question 3 Corn Prev Crop What was the crop grown on this field in 2018 before the 2019 corn crop? (Not including cover crop)?

Prev Crop =

Soybeans (1) "Soybeans",

Corn (2) "Corn",

Alfalfa (3) "Alfalfa",

Small Grains (4) "Small Grains",

Other (99) "Other"

Corn Fertilizer Question 4 If Corn Planted What was the crop harvested from this field in the 2017 season, before the last two crops? Yes, no, DK, RF

Corn Fertilizer Question 5 No Manure How many acres were in your largest corn field in 2018?

Corn Fertilizer Question 6 Ave Yield What was the average yield of this field over the last 3 corn crops? Bushels per Acre, DK, RF

Corn Fertilizer Question 7 Fert Applied Was any commercial nitrogen fertilizer applied to this corn field in 2018? Please include fall applications in 2017 for the 2018 crop year. Yes No

Corn Fertilizer Question 8 Var Rate Was any commercial nitrogen fertilizer applied on this field at more than one rate or a variable rate? If yes, use a field average. Yes, No, DK, RF

Setup Statement Var Rate Please use a field average for all fertilizer rate questions

Corn Fertilizer Question 9 Total N What was the total amount of nitrogen applied PER ACRE on this field? Pounds per Acre, DK, RF

Corn Fertilizer Question 9b Fert Type What type of fertilizer was used to supply the majority of the nitrogen applied to this field?

Corn Fertilizer Question 10 N Inhibitor Did you use a nitrogen inhibitor or stabilizer on this field?

LeadIn3 I will now ask you for all your commercial fertilizer applications made on this field for the 2019 crop year, again including any 2018 fall applications of commercial fertilizer. This will include all fall applications in 2018 and all 2019 applications including preplant applications, starter/planter applications and post plant applications. **Explanation of the table below.** Farmers were questioned about the fertilizer applications through a table questionnaire listed below.

Questions for each application included:

What type of fertilizer or nutrient was used for the application?

What was the quantity applied in the application?

What was the unit of the application?

When was the application made?

How was the product applied?

Or, if the farmer new the actual amount of nutrients applied

How many pounds of nitrogen was in the application?

How many pounds of phosphorus was in the application?

How many pounds of potash was in the application?

How many pounds of sulfur was in the application?

Corn Fertilizer Question Table Fert Rate

Line		Type of Fertilizer or Nutrient [Enter Code]	What Quantity was applied per acre? [Quantity]	Enter Unit [Unit Code]	When was this applied? [Enter Code]		Report Actual Nutrients Applied for Other Dry Mix [19] or Other Types [13]: N Nitrogen (Pounds)	P2O5 Phosphate (Pounds)	K2O Potash (Pounds)	S Sulfur (Pounds)
01	Fall of 2015 Application 1					or				
02	Fall of 2015 Application 2					or				
03	Spring/Summer 2016 Application 1					or				
04	Spring/Summer 2016 Application 2					or				
05	Spring/Summer 2016 Application 3					or				
06	Spring/Summer 2016 Application 4					or				
07	Spring/Summer 2016 Application 5					or				
		10 Anhyfrous Ammonia		1 Pounds	1 Spring Preplant					
		11 Urea		12 Gallons	2 Starter					
		12 Liquid N		19 Pounds	3 Post Plant					
		14 Map								
		15 Dap								
		16 Lime								
		17 Potash								
		18 Ammonium Sulfate								
		19 Other dry mix								
		13 Other type or Unknown								

FIELDS MP102 Part 1 (Soybean Field 1)

Soybean All Question 1 Total Crop Acres How many acres of soybeans did you plant?

Soybean Fertilizer Question 1 Soybean Acre Did all your soybean fields receive manure for the 2019 crop year? Yes No

Setup Statement Verify Acres Think about your largest soybean field that you planted in 2019 without any manure.

Soybean Fertilizer Question 2 Soybean Irrigated Was this field irrigated? Yes No

Soybean Fertilizer Question 3 Soybean Prev Crop What was the crop grown on this field in 2018 before the 2019 soybean crop? (Not including cover crop)?

Prev Crop =

Soybeans (1) "Soybeans",

Corn (2) "Corn",

Alfalfa (3) "Alfalfa",

Small Grains (4) "Small Grains",

Other (99) "Other"

Soybean Fertilizer Question 4 No Manure How many acres were in your largest soybean field in 2019?

Soybean Fertilizer Question 5 Ave Yield What was the average yield of this field over the last 3 soybean crops? Bushels per Acre, DK, RF

Soybean Fertilizer Question 6 Fert Applied Was any commercial nitrogen fertilizer applied to this soybean field in 2019? Please include fall applications in 2018 for the 2019 crop year. Yes No

Soybean Fertilizer Question 7 Var Rate Was any commercial nitrogen fertilizer applied on this field at more than one rate or a variable rate? If yes, use a field average. Yes, No, DK, RF

Setup Statement Var Rate Please use a field average for all fertilizer rate questions

Soybean Fertilizer Question 8 Total N What was the total amount of nitrogen applied PER ACRE on this field? Pounds per Acre, DK, RF

Soybean Fertilizer Question 8b Fert Type What type of fertilizer was used to supply the majority of the nitrogen applied to this field?

Soybean Fertilizer Question 9 N Inhibitor Did you use a nitrogen inhibitor or stabilizer on this field?

LeadIn3 I will now ask you for all your commercial fertilizer applications made on this field for the 2019 crop year, again including any 2018 fall applications of commercial fertilizer. This will include all fall applications in 2018 and all 2019 applications including preplant applications, starter/planter applications and post plant applications.

Explanation of the table below. Farmers were questioned about the fertilizer applications through a table questionnaire listed below.

Questions for each application included:

What type of fertilizer or nutrient was used for the application?

What was the quantity applied in the application?

What was the unit of the application?

When was the application made?

How was the product applied?

Or, if the farmer new the actual amount of nutrients applied

How many pounds of nitrogen was in the application?

How many pounds of phosphorus was in the application?

How many pounds of potash was in the application?

How many pounds of sulfur was in the application?

Soybean Fertilizer Question Table Fert Rate

Line		Type of Fertilizer or Nutrient [Enter Code]	What Quantity was applied per acre? [Quantity]	Enter Unit [Unit Code]	When was this applied? [Enter Code]		Report Actual Nutrients Applied for Other Dry Mix [19] or Other Types [13] N Nitrogen (Pounds)	P2O5 Phosphate (Pounds)	K2O Potash (Pounds)	S Sulfur (Pounds)
01	Fall of 2015 Application 1					or				
02	Fall of 2015 Application 2					or				
03	Spring/Summer 2016 Application 1					or				
04	Spring/Summer 2016 Application 2					or				
05	Spring/Summer 2016 Application 3					or				
06	Spring/Summer 2016 Application 4					or				
07	Spring/Summer 2016 Application 5					or				
		10 Anhyfrous Ammonia		1 Pounds	1 Spring Preplant					
		11 Urea		12 Gallons	2 Starter					
		12 Liquid N		19 Pounds	3 Post Plant					
		14 Map								
		15 Dap								
		16 Lime								
		17 Potash								
		18 Ammonium Sulfate								
		19 Other dry mix								
		13 Other type or Unknown								

Manure Use Questions Field 1 2019 Crop Season

FIELDS MP102 Part 1 (Corn Field 1)

LeadIn1, I will now ask you about a corn field that was applied with manure for the 2019 growing season.

Corn Manure Question 1 Corn Manure Do you have a corn field that was applied with manure for the 2019 crop, including manure applied in the fall of 2018?

Corn Manure Question 2 Corn Manure What was the crop grown on this field in 2018?

Prev Crop =

Soybeans (1) "Soybeans",

Corn (2) "Corn",

Alfalfa (3) "Alfalfa",

Small Grains (4) "Small Grains",

Other (99) "Other"

Corn Manure Question 3 Corn Manure Was alfalfa the previous crop grown in 2017 (before the 2018 corn crop you previously mentioned)?

Corn Manure LeadIn1 Think about your largest corn field you planted in 2019 with manure applied for the 2019 growing season. I will now ask you questions about that specific field. All following questions will be in relation to that specific field.

Corn Manure Question 4 Corn Manure How many acres were in your largest corn field?

Corn Manure Question 5 Corn Manure What was the average corn yield of this field over the past three corn crops?

Corn Manure Question 6 Corn Manure Did the whole corn field receive manure?

Corn Manure Question 7 Corn Manure What is the main source of manure used on the field?

Beef (1) “Dairy”,
Beef (2) “Beef”,
Hog (3) “Hog”,
Poultry (4) “Poultry”,
Other (5) “Other”,
Do Not Know (99) “Don’t Know

Corn Manure Question 8 Corn Manure Was the manure applied solid or liquid?
(1) Solid: Solid
(2) Liquid: Liquid

Corn Manure Question 8a Corn Manure [If liquid] What was the rate applied in gallons per acre?

Corn Manure Question 8b Corn Manure [If solid] What was the rate applied in tons per acre?

Corn Manure Question 9a Corn Manure What was the approximate date the manure was applied?

Corn Manure Question 10 Corn Manure What is the total amount of 1st year available nitrogen applied from the manure as units (pounds per acre)?

Corn Manure Question 11 Corn Manure Was this manure from your own farm operation?

Corn Manure Question 12 Corn Manure When was the last time your manure was tested for nutrient content?

Corn Manure Question 13 Corn Manure Did you also apply commercial fertilizers to this field for the 2019 crop year?

Corn Manure Question 14 Corn Manure What were the total units of nitrogen applied per acre to this field from commercial fertilizers for the 2019 crop year? Don't forget the starter may include nitrogen as well as phosphorus or sulfur sources.

Corn Manure Question 15 Corn Manure When was the last time your manure was tested for nutrient content?
(1) This_Year: This year (include a previous year application for the current crop year)
(2) Last_3_Years: Last 3 years
(3) Over_3_Years: Over 3 years ago
(7) Dont_Test: Don't Test

FIELDS MP102 Part 1 (Soybean Field 1)

LeadIn1, I will now ask you about a soybean field that was applied with manure for the 2019 growing season.

Soybean Manure Question 1 Soybean Manure Do you have a soybean field that was applied with manure for the 2019 crop, including manure applied in the fall of 2018?

Soybean Manure Question 2 Soybean Manure What was the crop grown on this field in 2018?

Prev Crop =

Soybeans (1) "Soybeans",

Corn (2) "Corn",

Alfalfa (3) "Alfalfa",

Small Grains (4) "Small Grains",

Other (99) "Other"

Soybean Manure LeadIn1 Think about your largest corn field you planted in 2019 with manure applied for the 2019 growing season. I will now ask you questions about that specific field. All following questions will be in relation to that specific field.

Soybean Manure Question 3 Soybean Manure How many acres were in your largest soybean field?

Soybean Manure Question 4 Soybean Manure What was the average soybean yield of this field over the past three corn crops?

Soybean Manure Question 5 Soybean Manure Did the whole soybean field receive manure?

Soybean Manure Question 6 Soybean Manure What is the main source of manure used on the field?

Dairy (1) “Dairy”,
Beef (2) “Beef”,
Hog (3) “Hog”,
Poultry (4) “Poultry”,
Other (5) “Other”,
Do Not Know (99) “Don’t Know

Soybean Manure Question 7 Soybean Manure Was the manure applied solid or liquid?
(1) Solid: Solid
(2) Liquid: Liquid

Soybean Manure Question 7a Soybean Manure [If liquid] What was the rate applied in gallons per acre?

Soybean Manure Question 7b Soybean Manure [If solid] What was the rate applied in tons per acre?

Soybean Manure Question 8a Soybean Manure What was the approximate date the manure was applied?

Soybean Manure Question 9 Soybean Manure What is the total amount of 1st year available nitrogen applied from the manure as units (pounds per acre)?

Soybean Manure Question 10 Soybean Manure Was this manure from your own farm operation?

Soybean Manure Question 11 Soybean Manure When was the last time your manure was tested for nutrient content?

Soybean Manure Question 12 Soybean Manure Did you also apply commercial fertilizers to this field for the 2019 crop year?

Soybean Manure Question 13 Soybean Manure What were the total units of nitrogen applied per acre to this field from commercial fertilizers for the 2019 crop year? Don't forget the starter may include nitrogen as well as phosphorus or sulfur sources.

Soybean Manure Question 14 Soybean Manure When was the last time your manure was tested for nutrient content?
(1) This_Year: This year (include a previous year application for the current crop year)
(2) Last_3_Years: Last 3 years
(3) Over_3_Years: Over 3 years ago
(7) Dont_Test: Don't Test

ALL CROPS SOIL SAMPLING

Soil Sampling Question 1 All Fields What type of soil sampling did you use on this field? (Include all types used in the last 3 years).
(1) Traditional: Traditional
(2) Grid: Grid
(3) Zone: Zone
(4) Nitrate: In-season Nitrate test
(4) None: No soil sampling done
(5) Other

Soil Sampling Question 2 All Fields Did you tissue test on Corn or soybeans? Yes/No

Soil Sampling Question 3 All Fields How many of your corn or soybeans acres were planted with a cover crop?

Appendix 2. History of Data Collection & Process

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[101] *was conducted in 2001 by expanding the existing Agricultural Resource Management Study (ARMS) developed by NASS. The normal number of participating Minnesota corn 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, primary sources of pesticide management, scouting, timing, and other pesticide management related information was obtained.*

In neighboring North Dakota, the USDA, NASS, the 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. With the goal of expanding to a statewide scale while reducing costs, a second pilot[102]*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 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 (AI) can be expressed in pounds, ounces, pints or quarts), complications can quickly develop. Another major complicating factor may result due to 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.*

The second pilot survey was conducted in 2003 to test two methods of collecting pesticide rate information. "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 information that was provided. "Method Two" was used in neighboring Grant County, where another 150 farm operators were contacted, and when farm records were incomplete, follow-up calls were made to the pesticide dealer to complete the survey. The number of surveys with complete data sets significantly increased with the additional assistance from the dealerships. Eighty-three percent of the surveys were complete in Grant County, where dealer follow-up calls were made, compared to forty-six percent in Douglas County. Equally impressive was the overall support by the local dealerships.

[101] "Expanded Minnesota Agricultural Statistics Pesticide Use Data", 2003, by NASS and MDA.
[102] Unpublished data. From the September 20, 2003 EPA Report.