

Commercial Fertilizer Usage and Management Practices Associated with Minnesota's 2016 Soybean and Wheat Crops

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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 soybean and wheat acres through the use of commercial nitrogen.

In Minnesota, nitrate is detected frequently in groundwater and surface water resources. Nitrate may exceed the safe drinking water standard¹ in groundwater in some areas and sometimes exceeds the draft threshold in surface water². 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. This is the first year that the MDA is collecting nitrogen, phosphorus, potash³, and sulfur applied to the crops surveyed. In past years, only nitrogen information was collected. NASS developed the survey sample of 7,600 farms. This was done by selecting approximately 106 farms from each of 72 agricultural counties surveyed in this report. All farmers from each county who grew one or both of the target crops (soybean and wheat) were eligible to be selected. This number provided a large pool to reach the desired goal of obtaining approximately 34 farms per county with complete records. Counties not included in the survey are Lake of the Woods, Koochiching, Itasca, Clearwater, St. Louis, Carlton, Lake, Cook, Cass, Crow Wing, Hubbard, Wadena, Aikin, Anoka, and Ramsey Counties.

NASS phone enumerators attempted to contact 7,600 producers in early 2017. From this pool, approximately 2,200 farmers who raised wheat or soybeans during the 2016 growing season were interviewed.

The general purpose of this survey was to ask farmers about commercial fertilizer applications on wheat and soybeans. This included rates, applications, incorporation, types of fertilizer and other management decisions

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 \(EPA 822-F-18-001\)](#). 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 contaminants, 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 toxicity.

- 3.1 mg/l nitrate-N for class 2A waters
- 4.9 mg/l nitrate-N for class 2B waters

The draft standards can be found at: [Water quality standards | Minnesota Pollution Control Agency \(state.mn.us\)](#)

³ Potash and potassium are used interchangeably in this report.

based on fertilizer use on soybean and wheat acres. Fertilizer inputs refer to soil enriching plant nutrients, primarily nitrogen (N), phosphorus (P₂O₅), potassium (K₂O), and sulfur (SO₄-S).

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

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. 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 was not repeated. Readers are encouraged to visit the four 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", and the "Commercial Nitrogen and Manure Fertilizer Selection and Management Practices Associated with Minnesota's 2014 Corn Crop" 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 2016, the ARMS was conducted for hay and corn crops and the MDA conducted a survey for wheat 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 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.

2016 Commercial Fertilizer Use Practices Summary and Highlights

This report summarizes survey results for a number of important practices associated with commercial fertilizer applications on Minnesota's 2016 wheat and soybeans. Over 2,200 wheat or soybean producers participated in the telephone survey and information was collected for 114,000 wheat acres and 557,000 soybean acres. This survey represents approximately nine percent of Minnesota's 1,260,000 wheat acres, and seven percent of Minnesota's 7,490,000 soybean acres harvested in 2016. Survey questions focused on the 90 percent of the respondents that fertilized wheat acres with commercial fertilizer, and the 36 percent of respondents that fertilized soybean acres with commercial fertilizer. This is the sixth fertilizer survey performed by the MDA and NASS to collect information on commercial fertilizer use and management practices on Minnesota crop acres.

The average yield for soybeans reported by farmers in the survey was 48 bushels per acre and the average yield for wheat was 55 bushels per acre. Both yields were slightly less than the USDA reported yield of 52 bushels per acre for soybeans and 59 bushels per acre for wheat for the 2016 crop year.

Ninety percent of the wheat fields were fertilized, and those fertilized fields received an average rate of 101 pounds of nitrogen, 23 pounds of phosphorus, 19 pounds of potash, and 1 pound of sulfur.

Thirty-six percent of the soybean fields were fertilized, and those fertilized fields received an average rate of 11 pounds of nitrogen, 27 pounds of phosphorus, 46 pounds of potash, and 2 pounds of sulfur.

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 wheat and soybean growers in Minnesota. Approximately 2,200 farmers that raised wheat or soybeans participated in the survey. The definition of “wheat” for purposes of this report includes spring wheat and excludes durum or winter wheat. In Minnesota over 99% of the wheat harvested was spring wheat in 2016. Soybeans included all types of soybeans.

Process

Farmers were interviewed over the phone in April 2017. 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 wheat 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. Many surveys conducted by NASS employ advanced sampling strategies which are designed to statistically represent a non-homogenous population, thus “weighting” the data to account for sample size, county size, and crop acreage, etc. Such strategies can be very expensive and are not without their own limitations.⁴ This survey did not employ such strategies; rather, wheat and soybean farmers were randomly selected in Minnesota. Therefore, weighting in areas or counties was not performed. The MDA can be contacted to further discuss interpretation of the survey data.

If there were less than 5 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.

⁴ For an explanation of survey methods and data quality associated with annual county-level data, visit the NASS “Quick Stats” Understanding Agricultural Statistics website at:
https://www.nass.usda.gov/Education_and_Outreach/Understanding_Statistics/index.php

Wheat Section

Wheat is not a major crop in the Southeast BMP region, and less than five farmers reported growing wheat in the Southeast BMP region. Therefore, Southeast BMP region farmers were included with the farmers from the South Central region in the following wheat section.

Farmers in the survey were first asked “How many acres of wheat did you plant?” Table 1 details the number of farmers⁵ and corresponding wheat acres planted by BMP region for the 2016 crop year (WAQ-1⁶).

Table 1. Summary of respondents and corresponding wheat acres planted by BMP region for the 2016 crop year.

BMP Region	Number of Respondents	Number of Wheat Acres
Northwestern	198	97,994
Irrigated and Non-irrigated Sandy Soils	68	5,875
South Western and West Central	106	9,036
South Central ⁷	33	1,231
Statewide	405	114,136

Farmers in the survey were then asked, “Do you have a wheat field without manure?” Table 2 details the percent of farmers who had a wheat field without manure applied by BMP region (WFQ-1). Farmers that answered no to this question applied manure on all their wheat fields for the 2016 growing year.

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

BMP Region	Wheat Field Without Manure Applied	Percent of Respondents
Northwestern	Yes	90
Northwestern	No	10
Irrigated and Non-irrigated Sandy Soils	Yes	76
Irrigated and Non-irrigated Sandy Soils	No	24
South Western and West Central	Yes	83
South Western and West Central	No	17
South Central	Yes	76
South Central	No	24
Statewide	Yes	85
Statewide	No	15

⁵ Farmers and respondents are used interchangeably in this document. The farmer interviewed is the respondent.

⁶ WAQ1 is Wheat All Question 1 and can be found at the end of the report in the appendix. All question references will be in this format. WFQ stands for Wheat Fertilizer Question and is in the same appendix.

⁷ Due to the low number of wheat farmers in the SE BMP region, the SC and SE BMP regions are combined for all wheat survey results and published as South Central.

Table 3 details the number of respondents and all wheat acres who reported having a field without manure applied to the 2016 wheat 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 fertilizer with wheat. Excluded are respondents and acres from Table 2 who applied manure on all of their wheat fields. Farmers with only manured acres will be excluded from fertilizer analysis from this point forward.

Table 3. Summary of respondents and corresponding wheat acres by BMP region for farmers who reported a field without manure applied in the fall of 2015 or anytime in the 2016 crop year.

BMP Region	Number of Respondents	Number of Wheat Acres
Northwestern	179	88,164
Irrigated and Non-irrigated Sandy Soils	52	4,362
South Western and West Central	88	8,602
South Central	25	879
Statewide	344	102,007

All wheat fields without manure applied are included in the analysis for the following tables. There were 344 wheat fields in the commercial fertilizer analysis.

Farmers were then told by the phone enumerator⁸ “I will now ask you about your fertilizer inputs on your wheat acres. First on a wheat field with no manure. Think about your largest wheat field that you planted in 2016 without any manure.” 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 wheat field on their farm.

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

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

BMP Region	Largest Wheat Field was Irrigated	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	0
Irrigated and Non-irrigated Sandy Soils	No	100
South Western and West Central	Yes	2
South Western and West Central	No	98
South Central	Yes	0
South Central	No	100
Statewide	Yes	1
Statewide	No	99

⁸ 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 2015 before the 2016 wheat crop?” Table 5 details the previous crop planted before the current wheat crop by BMP region and corresponding yield (WFQ-3, WFQ-3b and WFQ-5). The table includes the next question to the farmers “What was the average wheat yield of this field over the past three wheat crops?” The average wheat yield was 58 bushels per acre in the Northwestern BMP region, 46 bushels per acre in the Irrigated and Non-irrigated Sandy Soils BMP region, 56 bushels per acre in the South Western and West Central BMP region, and 52 bushels per acre in the South Central BMP region. The average wheat yield across all wheat fields in Minnesota was 55 bushels per acre.

Table 5. Percent of fields by previous crop and the corresponding wheat yield in 2016.

BMP Region	Previous Crop	Percent of Fields	Average Wheat Yield Bushels per Acre
Northwestern	Soybeans	88	59
Northwestern	Corn	**	**
Northwestern	Small Grains	5	49
Northwestern	Other	5	60
Irrigated and Non-irrigated Sandy Soils	Soybeans	79	48
Irrigated and Non-irrigated Sandy Soils	Corn	**	**
Irrigated and Non-irrigated Sandy Soils	Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	13	37
Irrigated and Non-irrigated Sandy Soils	Other	**	**
South Western and West Central	Soybeans	81	56
South Western and West Central	Corn	14	58
South Western and West Central	Small Grains	**	**
South Central	Soybeans	60	55
South Central	Corn	24	53
South Central	Alfalfa	**	**
South Central	Small Grains	**	**
Statewide	Soybeans	83	57
Statewide	Corn	7	55
Statewide	Alfalfa	**	**
Statewide	Small Grains	7	45
Statewide	Other	3	53

** Less than five responses

Commercial Fertilizer Applications on Wheat

Farmers were then asked, “Was any commercial fertilizer applied to this wheat field for the 2016 wheat crop?” Table 6 details the percent of non-manured wheat fields applied with commercial fertilizer (WFQ-6).

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

BMP Region	Fertilizer Applied	Percent of Respondents
Northwestern	Yes	96
Northwestern	No	4
Irrigated and Non-irrigated Sandy Soils	Yes	83
Irrigated and Non-irrigated Sandy Soils	No	17
South Western and West Central	Yes	84
South Western and West Central	No	16
South Central	Yes	88
South Central	No	12
Statewide	Yes	90
Statewide	No	10

There were 344 wheat fields in the commercial fertilizer analysis and farmers provided complete information for 310 fields. Thirty-four farmers were unable to report actual fertilizer applications. Of the 310 farmers that reported complete data, 277 farmers reported applying fertilizer that included the nutrient rate and timing on their wheat fields. The following wheat fertilizer tables are based on those 277 fields.

Farmers were asked “Was any commercial fertilizer applied to this wheat 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 wheat field (WFQ-7).

Table 7. Variable rate commercial fertilizer application by BMP region on the farmers largest wheat field.

BMP Region	Variable Rate Fertilizer Application	Percent of Respondents
Northwestern	Variable Rate	13
Northwestern	One Rate	87
Irrigated and Non-irrigated Sandy Soils	Variable Rate	14
Irrigated and Non-irrigated Sandy Soils	One Rate	86
South Western and West Central	Variable Rate	24
South Western and West Central	One Rate	76
South Central	Variable Rate	14
South Central	One Rate	86
Statewide	Variable Rate	16
Statewide	One Rate	84

Table 8⁹ details the percent of all surveyed wheat fields applied with fertilizer and the percent of fertilized fields treated with nitrogen, phosphorus, potassium, and sulfur by BMP region (WFQ-6 and WFQ-FERT TABLE).

Table 8. The percent of wheat 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 Surveyed 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	95	100	59	47	8
Irrigated and Non-irrigated Sandy Soils	81	100	56	56	15
South Western and West Central	83	100	59	56	24
South Central	88	100	71	71	33
Statewide	89	100	60	52	15

Table 9 details the percent of all surveyed wheat 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 wheat fields by BMP region (WFQ-6 and WFQ-FERT TABLE). All fertilized wheat fields received nitrogen. These are nitrogen rates on all wheat acres treated with commercial fertilizer, regardless of previous crop. Nitrogen rates are for commercial fertilizer only.

Table 9. The percent of all surveyed wheat 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 Wheat Fields Pounds per Acre
Northwestern	100	108	108
Irrigated and Non-irrigated Sandy Soils	100	93	93
South Western and West Central	100	91	91
South Central	100	95	95
Statewide	100	101	101

⁹ Not all farmers who reported fertilizer applied were able to provide complete fertilizer data. Therefore, percent of fields fertilized have slight differences in Table 8 when compared to Table 6.

Table 10 details the percent of all surveyed wheat 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 wheat fields by BMP region (WFQ-6 and WFQ-FERT TABLE). Statewide, 60% of fertilized wheat fields received phosphorus. These are phosphorus rates on all wheat acres treated with commercial fertilizer, regardless of previous crop. Phosphorus rates are for commercial fertilizer only.

Table 10. The percent of all surveyed wheat 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 Wheat Fields Pounds per Acre
Northwestern	59	39	23
Irrigated and Non-irrigated Sandy Soils	56	43	24
South Western and West Central	59	39	23
South Central	71	41	29
Statewide	60	39	23

Table 11 details the percent of all surveyed wheat 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 wheat fields by BMP region (WFQ-6 and WFQ-FERT TABLE). Statewide, 52% of fertilized wheat fields received potassium. These are potassium rates on all wheat acres treated with commercial fertilizer, regardless of previous crop. Potassium rates are for commercial fertilizer only.

Table 11. The percent of all surveyed wheat 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 Wheat Fields Pounds per Acre
Northwestern	47	36	17
Irrigated and Non-irrigated Sandy Soils	56	46	26
South Western and West Central	56	30	17
South Central	71	40	29
Statewide	52	36	19

Table 12 details the percent of all surveyed wheat 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 wheat fields by BMP region (WFQ-6 and WFQ-FERT TABLE). Statewide, 15% of fertilized wheat fields received sulfur. These are sulfur rates on all wheat acres treated with commercial fertilizer, regardless of previous crop. Sulfur rates are for commercial fertilizer only.

Table 12. The percent of all surveyed wheat 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 Wheat Fields Pounds per Acre
Northwestern	8	9	1
Irrigated and Non-irrigated Sandy Soils	15	7	1
South Western and West Central	24	8	2
South Central	33	8	3
Statewide	15	8	1

Table 13 details the nitrogen fertilizer rate and wheat yield by BMP region on wheat following various crops (WFQ-3, WFQ-5 and WFQ-FERT TABLE). These are wheat fields applied with commercial nitrogen fertilizer and no manure applications.

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

BMP Region	Previous Crop	Average Nitrogen Rate Pounds per Acre	Average Wheat Yield Bushels per Acre
Northwestern	Soybeans	109	59
Northwestern	Corn	**	**
Northwestern	Small Grains	95	51
Northwestern	Other	99	66
Irrigated and Non-irrigated Sandy Soils	Soybeans	94	49
Irrigated and Non-irrigated Sandy Soils	Corn	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	91	42
Irrigated and Non-irrigated Sandy Soils	Other	**	**
South Western and West Central	Soybeans	92	59
South Western and West Central	Corn	86	60
South Western and West Central	Small Grains	**	**
South Central	Soybeans	93	54
South Central	Corn	101	54
South Central	Small Grains	**	**
Statewide	Soybeans	102	57
Statewide	Corn	97	57
Statewide	Small Grains	92	47
Statewide	Other	93	61

** Less than five responses

Table 14 details the phosphorus fertilizer rate and wheat yield by BMP region on wheat following various crops (WFQ-3, WFQ-5 and WFQ-FERT TABLE). These are wheat fields applied with commercial phosphorus fertilizer and no manure applications.

Table 14. Average amount of phosphorus applied and corresponding wheat yield by BMP region and previous crop.

BMP Region	Previous Crop	Average Phosphorus Rate Pounds per Acre	Average Wheat Yield Bushels per Acre
Northwestern	Soybeans	39	60
Northwestern	Corn	**	**
Northwestern	Small Grains	31	46
Northwestern	Other	33	63
Irrigated and Non-irrigated Sandy Soils	Soybeans	41	50
Irrigated and Non-irrigated Sandy Soils	Corn	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	**	**
South Western and West Central	Soybeans	39	60
South Western and West Central	Corn	**	**
South Western and West Central	Small Grains	**	**
South Central	Soybeans	39	53
South Central	Corn	**	**
South Central	Small Grains	**	**
Statewide	Soybeans	39	58
Statewide	Corn	44	55
Statewide	Small Grains	40	46
Statewide	Other	33	63

** Less than five responses

Table 15 details the potassium fertilizer rate and wheat yield by BMP region on wheat following various crops (WFQ-3, WFQ-5 and WFQ-FERT TABLE). These are wheat fields applied with commercial potassium fertilizer and no manure applications.

Table 15. Average amount of potassium applied and corresponding wheat yield by BMP region and previous crop.

BMP Region	Previous Crop	Average Potassium Rate Pounds per Acre	Average Wheat Yield Bushels per Acre
Northwestern	Soybeans	37	60
Northwestern	Corn	**	**
Northwestern	Small Grains	**	**
Northwestern	Other	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	46	50
Irrigated and Non-irrigated Sandy Soils	Corn	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	**	**
South Western and West Central	Soybeans	30	59
South Western and West Central	Corn	**	**
South Western and West Central	Small Grains	**	**
South Central	Soybeans	41	53
South Central	Corn	**	**
South Central	Small Grains	**	**
Statewide	Soybeans	37	58
Statewide	Corn	41	55
Statewide	Small Grains	33	43
Statewide	Other	**	**

** Less than five responses

Table 16 details the sulfur fertilizer rate and wheat yield by BMP region on wheat following various crops (WFQ-3, WFQ-5 and WFQ-FERT TABLE). These are wheat fields applied with commercial sulfur fertilizer and no manure applications.

Table 16. Average amount of sulfur applied and corresponding wheat yield by BMP region and previous crop.

BMP Region	Previous Crop	Average Sulfur Rate Pounds per Acre	Average Wheat Yield Bushels per Acre
Northwestern	Soybeans	10	61
Northwestern	Small Grains	**	**
Northwestern	Other	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	7	51
South Western and West Central	Soybeans	8	55
South Western and West Central	Corn	**	**
South Western and West Central	Small Grains	**	**
South Central	Soybeans	9	51
South Central	Corn	**	**
Statewide	Soybeans	8	55
Statewide	Corn	**	**
Statewide	Small Grains	**	**
Statewide	Other	**	**

** Less than five responses

Fertilizer Sources and Timing

Table 17 details the respondents and corresponding wheat acres by BMP region for all farmers in this study who fall applied nitrogen on the largest wheat field (WFQ-FERT TABLE). This table includes all sources of fall applied nitrogen from commercial fertilizer.

Table 17. Average amount of fall applied nitrogen and corresponding wheat yield by BMP region.

BMP Region	Percent of Respondents: Fall Applied Nitrogen	Average Fall Nitrogen Rate Pounds per Acre	Average Wheat Yield Bushels per Acre
Northwestern	15	96	62
Irrigated and Non-irrigated Sandy Soils	**	**	**
South Western and West Central	23	81	60
South Central	14	54	50
Statewide	13	90	61

** Less than five responses

Table 18 details the respondents and corresponding wheat acres by BMP region for all farmers in this study who fall applied phosphorus on the largest wheat field (WFQ-FERT TABLE). This table includes all sources of fall applied phosphorus from commercial fertilizer.

Table 18. Average amount of fall applied phosphorus and corresponding wheat yield by BMP region.

BMP Region	Percent of Respondents: Fall Applied Phosphorus	Average Fall Phosphorus Rate Pounds per Acre	Average Wheat Yield Bushels per Acre
Northwestern	6	44	55
Irrigated and Non-irrigated Sandy Soils	**	**	**
South Western and West Central	14	43	60
South Central	10	30	55
Statewide	8	43	57

** Less than five responses

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

Table 19. Average amount of fall applied potassium and corresponding wheat yield by BMP region.

BMP Region	Percent of Respondents: Fall Applied Potassium	Average Fall Potassium Rate Pounds per Acre	Average Wheat Yield Bushels per Acre
Northwestern	7	96	62
Irrigated and Non-irrigated Sandy Soils	**	**	**
South Western and West Central	14	81	60
South Central	10	54	50
Statewide	8	37	60

** Less than five responses

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

Table 20. Average amount of fall applied sulfur and corresponding wheat yield by BMP region.

BMP Region	Percent of Respondents: Fall Applied Sulfur	Average Fall Sulfur Rate Pounds per Acre	Average Wheat Yield Bushels per Acre
Northwestern	1	24	78
Irrigated and Non-irrigated Sandy Soils	**	**	**
South Western and West Central	4	8	52
South Central	5	10	50
Statewide	2	12	57

** Less than five responses

Table 21 details the major form of nitrogen fertilizer applied in each BMP region and statewide along with the percent of respondents for those forms (WFQ-9). ‘Other’ forms of fertilizer containing nitrogen would include sources of phosphorus, such as MAP or DAP, and sulfur, such as AMS, on surveyed wheat fields.

Table 21. The major form of nitrogen applied to the field.

BMP Region	Major Form of Nitrogen Applied	Percent of Respondents
Northwestern	Anhydrous	12
Northwestern	Urea	79
Northwestern	Liquid Nitrogen	1
Northwestern	Other	7
Northwestern	Unknown	1
Irrigated and Non-irrigated Sandy Soils	Anhydrous	0
Irrigated and Non-irrigated Sandy Soils	Urea	82
Irrigated and Non-irrigated Sandy Soils	Liquid Nitrogen	5
Irrigated and Non-irrigated Sandy Soils	Other	13
Irrigated and Non-irrigated Sandy Soils	Unknown	0
South Western and West Central	Anhydrous	10
South Western and West Central	Urea	81
South Western and West Central	Liquid Nitrogen	3
South Western and West Central	Other	6
South Western and West Central	Unknown	0
South Central	Anhydrous	0
South Central	Urea	81
South Central	Liquid Nitrogen	14
South Central	Other	0
South Central	Unknown	5
Statewide	Anhydrous	9
Statewide	Urea	80
Statewide	Liquid	2
Statewide	Other	8
Statewide	Unknown	1

Table 22 details the major form of nitrogen used, average nitrogen rate from all sources, and average wheat yield of the 2016 wheat crop (WFQ-8 and WFQ-9).

Table 22. 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 Wheat Yield Bushels per Acre
Northwestern	Anhydrous	120	60
Northwestern	Urea	107	59
Northwestern	Liquid Nitrogen	**	**
Northwestern	Other	102	56
Northwestern	Unknown	**	**
Irrigated and Non-irrigated Sandy Soils	Urea	94	48
Irrigated and Non-irrigated Sandy Soils	Liquid Nitrogen	**	**
Irrigated and Non-irrigated Sandy Soils	Other	93	50
South Western and West Central	Anhydrous	112	62
South Western and West Central	Urea	91	59
South Western and West Central	Liquid Nitrogen	**	**
South Western and West Central	Other	**	**
South Central	Urea	**	**
South Central	Other	**	**
South Central	Unknown	**	**
Statewide	Anhydrous	118	61
Statewide	Urea	101	57
Statewide	Liquid	87	59
Statewide	Other	90	52
Statewide	Unknown	**	**

** Less than five responses

Table 23 details any commercial fertilizer applied in the fall of 2015 for the 2016 wheat crop (WFQ-FERT TABLE).

Table 23. Commercial fertilizer applied in the fall of 2015 for the 2016 wheat crop.

BMP Region	Any Commercial Fertilizer Application in the Fall of 2015	Percent of Respondents
Northwestern	Yes	18
Northwestern	No	82
Irrigated and Non-irrigated Sandy Soils	Yes	0
Irrigated and Non-irrigated Sandy Soils	No	100
South Western and West Central	Yes	23
South Western and West Central	No	77
South Central	Yes	14
South Central	No	86
Statewide	Yes	16
Statewide	No	84

Table 24 details anhydrous ammonia applied in the fall of 2015 for the 2016 wheat crop (WFQ-FERT TABLE).

Table 24. Anhydrous ammonia applied in the fall of 2015 for the 2016 wheat crop.

BMP Region	Anhydrous Ammonia Application in the Fall of 2015	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
South Western and West Central	Yes	7
South Western and West Central	No	93
South Central	Yes	0
South Central	No	100
Statewide	Yes	4
Statewide	No	96

Table 25 details urea applied in the fall of 2015 for the 2016 wheat crop (WFQ-FERT TABLE).

Table 25. Urea applied in the fall of 2015 for the 2016 wheat crop.

BMP Region	Urea Application in the Fall of 2015	Percent of Respondents
Northwestern	Yes	5
Northwestern	No	95
Irrigated and Non-irrigated Sandy Soils	Yes	0
Irrigated and Non-irrigated Sandy Soils	No	100
South Western and West Central	Yes	3
South Western and West Central	No	97
South Central	Yes	5
South Central	No	95
Statewide	Yes	4
Statewide	No	96

Table 26 details liquid nitrogen fertilizer applied in the fall of 2015 for the 2016 wheat crop (WFQ-FERT TABLE).

Table 26. Liquid nitrogen fertilizer applied in the fall of 2015 for the 2016 wheat crop.

BMP Region	Liquid Nitrogen (28%, 32%) Application in the Fall of 2015	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
South Western and West Central	Yes	0
South Western and West Central	No	100
South Central	Yes	0
South Central	No	100
Statewide	Yes	0
Statewide	No	100

Table 27 details other fertilizers containing nitrogen applied in the fall of 2015 for the 2016 wheat crop (WFQ-FERT TABLE).

Table 27. Other fertilizers containing nitrogen applied in the fall of 2015 for the 2016 wheat crop.

BMP Region	Other Sources of Fertilizer Containing Nitrogen in the Fall of 2015	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
South Western and West Central	Yes	1
South Western and West Central	No	99
South Central	Yes	0
South Central	No	100
Statewide	Yes	<1
Statewide	No	>99

Table 28 details phosphorus fertilizer, such as MAP or DAP, applied in the fall of 2015 for the 2016 wheat crop (WFQ-FERT TABLE).

Table 28. Fertilizer containing phosphorus applied in the fall of 2015 for the 2016 wheat crop.

BMP Region	Phosphorus Application in the Fall of 2015	Percent of Respondents
Northwestern	Yes	6
Northwestern	No	94
Irrigated and Non-irrigated Sandy Soils	Yes	0
Irrigated and Non-irrigated Sandy Soils	No	100
South Western and West Central	Yes	14
South Western and West Central	No	86
South Central	Yes	10
South Central	No	90
Statewide	Yes	8
Statewide	No	92

Table 29 details potassium fertilizer applied in the fall of 2015 for the 2016 wheat crop (WFQ-FERT TABLE).¹⁰

Table 29. Fertilizer containing potassium applied in the fall of 2015 for the 2016 wheat crop.

BMP Region	Potassium Application in the Fall of 2015	Percent of Respondents
Northwestern	Yes	7
Northwestern	No	93
Irrigated and Non-irrigated Sandy Soils	Yes	0
Irrigated and Non-irrigated Sandy Soils	No	100
South Western and West Central	Yes	14
South Western and West Central	No	86
South Central	Yes	10
South Central	No	90
Statewide	Yes	8
Statewide	No	92

¹⁰ Potassium, also known as potash (0-0-60), does not contain nitrogen.

Table 30 details sulfur fertilizer, such as AMS, applied in the fall of 2015 for the 2016 wheat crop (WFQ-FERT TABLE).

Table 30. Fertilizer containing sulfur applied in the fall of 2015 for the 2016 wheat crop.

BMP Region	Sulfur Application in the Fall of 2015	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	0
Irrigated and Non-irrigated Sandy Soils	No	100
South Western and West Central	Yes	4
South Western and West Central	No	96
South Central	Yes	5
South Central	No	95
Statewide	Yes	2
Statewide	No	98

Table 31 details commercial fertilizer applied in the spring as a preplant for the 2016 wheat crop (WFQ-FERT TABLE).

Table 31. Commercial fertilizer in the spring applied as a preplant for the 2016 wheat crop.

BMP Region	Any Commercial Fertilizer Application as a Preplant in the Spring of 2016	Percent of Respondents
Northwestern	Yes	86
Northwestern	No	14
Irrigated and Non-irrigated Sandy Soils	Yes	82
Irrigated and Non-irrigated Sandy Soils	No	18
South Western and West Central	Yes	77
South Western and West Central	No	23
South Central	Yes	86
South Central	No	14
Statewide	Yes	83
Statewide	No	17

Table 32 details anhydrous ammonia applied in the spring as a preplant for the 2016 wheat crop (WFQ-FERT TABLE).

Table 32. Anhydrous ammonia applied in the spring as a preplant for the 2016 wheat crop.

BMP Region	Anhydrous Ammonia Application as a Preplant in the Spring of 2016	Percent of Respondents
Northwestern	Yes	9
Northwestern	No	91
Irrigated and Non-irrigated Sandy Soils	Yes	0
Irrigated and Non-irrigated Sandy Soils	No	100
South Western and West Central	Yes	1
South Western and West Central	No	99
South Central	Yes	0
South Central	No	100
Statewide	Yes	5
Statewide	No	95

Table 33 details urea applied in the spring as a preplant for the 2016 wheat crop (WFQ-FERT TABLE).

Table 33. Urea applied in the spring as a preplant for the 2016 wheat crop.

BMP Region	Urea Application as a Preplant in the Spring of 2016	Percent of Respondents
Northwestern	Yes	56
Northwestern	No	44
Irrigated and Non-irrigated Sandy Soils	Yes	54
Irrigated and Non-irrigated Sandy Soils	No	46
South Western and West Central	Yes	50
South Western and West Central	No	50
South Central	Yes	62
South Central	No	38
Statewide	Yes	55
Statewide	No	45

Table 34 details liquid nitrogen fertilizer applied in the spring as a preplant for the 2016 wheat crop (WFQ-FERT TABLE).

Table 34. Liquid nitrogen fertilizer applied in the spring as a preplant for the 2016 wheat crop.

BMP Region	Liquid Nitrogen (28%, 32%) Application as a Preplant in the Spring of 2016	Percent of Respondents
Northwestern	Yes	2
Northwestern	No	98
Irrigated and Non-irrigated Sandy Soils	Yes	5
Irrigated and Non-irrigated Sandy Soils	No	95
South Western and West Central	Yes	1
South Western and West Central	No	99
South Central	Yes	0
South Central	No	100
Statewide	Yes	2
Statewide	No	98

Table 35 details other nitrogen fertilizer sources applied in the spring as a preplant for the 2016 wheat crop (WFQ-FERT TABLE).

Table 35. Other nitrogen sources applied in the spring as a preplant for the 2016 wheat crop.

BMP Region	Other Sources of Nitrogen Fertilizer as a Preplant in the Spring of 2016	Percent of Respondents
Northwestern	Yes	3
Northwestern	No	97
Irrigated and Non-irrigated Sandy Soils	Yes	3
Irrigated and Non-irrigated Sandy Soils	No	97
South Western and West Central	Yes	3
South Western and West Central	No	97
South Central	Yes	10
South Central	No	90
Statewide	Yes	3
Statewide	No	97

Table 36 details phosphorus fertilizer, such as MAP or DAP, applied in the spring as a preplant for the 2016 wheat crop (WFQ-FERT TABLE).

Table 36. Fertilizer containing phosphorus applied in the spring as a preplant for the 2016 wheat crop.

BMP Region	Phosphorus Application as a Preplant in the Spring of 2016	Percent of Respondents
Northwestern	Yes	41
Northwestern	No	59
Irrigated and Non-irrigated Sandy Soils	Yes	46
Irrigated and Non-irrigated Sandy Soils	No	54
South Western and West Central	Yes	40
South Western and West Central	No	60
South Central	Yes	57
South Central	No	43
Statewide	Yes	43
Statewide	No	57

Table 37 details potassium fertilizer applied in the spring as a preplant for the 2016 wheat crop (WFQ-FERT TABLE).

Table 37. Fertilizer containing potassium applied in the spring as a preplant for the 2016 wheat crop.

BMP Region	Potassium Application as a Preplant in the Spring of 2016	Percent of Respondents
Northwestern	Yes	32
Northwestern	No	68
Irrigated and Non-irrigated Sandy Soils	Yes	46
Irrigated and Non-irrigated Sandy Soils	No	54
South Western and West Central	Yes	37
South Western and West Central	No	63
South Central	Yes	57
South Central	No	43
Statewide	Yes	37
Statewide	No	63

Table 38 details sulfur fertilizer, such as AMS, applied in the spring as a preplant for the 2016 wheat crop (WFQ-FERT TABLE).

Table 38. Fertilizer containing sulfur applied in the spring as a preplant for the 2016 wheat crop.

BMP Region	Sulfur Application as a Preplant in the Spring of 2016	Percent of Respondents
Northwestern	Yes	3
Northwestern	No	97
Irrigated and Non-irrigated Sandy Soils	Yes	13
Irrigated and Non-irrigated Sandy Soils	No	87
South Western and West Central	Yes	17
South Western and West Central	No	83
South Central	Yes	24
South Central	No	76
Statewide	Yes	9
Statewide	No	91

Table 39 details commercial fertilizer applied in the spring as a starter or at planting for the 2016 wheat crop (WFQ-FERT TABLE). No anhydrous ammonia was applied as a starter or at planting.

Table 39. Commercial fertilizer applied in the spring at planting for the 2016 wheat crop.

BMP Region	Any Commercial Fertilizer Application as a Starter or at Planting in the Spring of 2016	Percent of Respondents
Northwestern	Yes	13
Northwestern	No	87
Irrigated and Non-irrigated Sandy Soils	Yes	10
Irrigated and Non-irrigated Sandy Soils	No	90
South Western and West Central	Yes	3
South Western and West Central	No	97
South Central	Yes	5
South Central	No	95
Statewide	Yes	9
Statewide	No	91

Table 40 details urea applied in the spring as a starter or at planting for the 2016 wheat crop (WFQ-FERT TABLE).

Table 40. Urea applied in the spring at planting for the 2016 wheat crop.

BMP Region	Urea Application as a Starter or at Planting in the Spring of 2016	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	3
Irrigated and Non-irrigated Sandy Soils	No	97
South Western and West Central	Yes	0
South Western and West Central	No	100
South Central	Yes	5
South Central	No	95
Statewide	Yes	1
Statewide	No	99

Table 41 details liquid nitrogen fertilizer applied in the spring as a starter or at planting for the 2016 wheat crop (WFQ-FERT TABLE).

Table 41. Liquid nitrogen fertilizer applied in the spring at planting for the 2016 wheat crop.

BMP Region	Liquid Nitrogen (28%, 32%) Application as a Starter or at Planting in the Spring of 2016	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	0
Irrigated and Non-irrigated Sandy Soils	No	100
South Western and West Central	Yes	3
South Western and West Central	No	97
South Central	Yes	0
South Central	No	100
Statewide	Yes	1
Statewide	No	99

Table 42 details other nitrogen fertilizers applied in the spring or at planting for the 2016 wheat crop (WFQ-FERT TABLE).

Table 42. Other nitrogen fertilizers applied in the spring at planting for the 2016 wheat crop.

BMP Region	Other Nitrogen Fertilizers as a Starter or at Planting in the Spring of 2016	Percent of Respondents
Northwestern	Yes	3
Northwestern	No	97
Irrigated and Non-irrigated Sandy Soils	Yes	3
Irrigated and Non-irrigated Sandy Soils	No	97
South Western and West Central	Yes	0
South Western and West Central	No	100
South Central	Yes	0
South Central	No	100
Statewide	Yes	2
Statewide	No	98

Table 43 details phosphorus fertilizer, such as MAP or DAP, applied in the spring at planting for the 2016 wheat crop (WFQ-FERT TABLE).

Table 43. Fertilizer containing phosphorus applied in the spring at planting for the 2016 wheat crop.

BMP Region	Phosphorus Application as a Starter or at Planting in the Spring of 2016	Percent of Respondents
Northwestern	Yes	12
Northwestern	No	88
Irrigated and Non-irrigated Sandy Soils	Yes	5
Irrigated and Non-irrigated Sandy Soils	No	95
South Western and West Central	Yes	3
South Western and West Central	No	97
South Central	Yes	0
South Central	No	100
Statewide	Yes	8
Statewide	No	92

Table 44 details potassium fertilizer applied in the spring at planting for the 2016 wheat crop (WFQ-FERT TABLE).

Table 44. Fertilizer containing potassium applied in the spring at planting for the 2016 wheat crop.

BMP Region	Potassium Application as a Starter or at Planting in the Spring of 2016	Percent of Respondents
Northwestern	Yes	8
Northwestern	No	92
Irrigated and Non-irrigated Sandy Soils	Yes	8
Irrigated and Non-irrigated Sandy Soils	No	92
South Western and West Central	Yes	3
South Western and West Central	No	97
South Central	Yes	0
South Central	No	100
Statewide	Yes	6
Statewide	No	94

Table 45 details sulfur fertilizer, such as AMS, applied in the spring at planting for the 2016 wheat crop (WFQ-FERT TABLE).

Table 45. Fertilizer containing sulfur applied in the spring at planting for the 2016 wheat crop.

BMP Region	Sulfur Application as a Starter or at Planting in the Spring of 2016	Percent of Respondents
Northwestern	Yes	5
Northwestern	No	95
Irrigated and Non-irrigated Sandy Soils	Yes	0
Irrigated and Non-irrigated Sandy Soils	No	100
South Western and West Central	Yes	1
South Western and West Central	No	99
South Central	Yes	0
South Central	No	100
Statewide	Yes	3
Statewide	No	97

Table 46 details commercial fertilizers applied as a post planting or sidedress for the 2016 wheat crop (WFQ-FERT TABLE).

Table 46. Commercial fertilizers applied as a post planting or sidedress for the 2016 wheat crop.

BMP Region	Any Commercial Fertilizer Application After Planting such as a Sidedress	Percent of Respondents
Northwestern	Yes	5
Northwestern	No	95
Irrigated and Non-irrigated Sandy Soils	Yes	18
Irrigated and Non-irrigated Sandy Soils	No	82
South Western and West Central	Yes	9
South Western and West Central	No	91
South Central	Yes	5
South Central	No	95
Statewide	Yes	8
Statewide	No	92

Table 47 details anhydrous ammonia applied as a post planting or sidedress for the 2016 wheat crop (WFQ-FERT TABLE).

Table 47. Anhydrous ammonia applied as a post planting or sidedress for the 2016 wheat crop.

BMP Region	Anhydrous Ammonia Application After Planting such as a Sidedress in 2016	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
South Western and West Central	Yes	0
South Western and West Central	No	100
South Central	Yes	0
South Central	No	100
Statewide	Yes	0
Statewide	No	100

Table 48 details urea applied as a post planting or sidedress for the 2016 wheat crop (WFQ-FERT TABLE).

Table 48. Urea applied as a post planting or sidedress for the 2016 wheat crop.

BMP Region	Urea Application After Planting such as a Sidedress in 2016	Percent of Respondents
Northwestern	Yes	3
Northwestern	No	97
Irrigated and Non-irrigated Sandy Soils	Yes	13
Irrigated and Non-irrigated Sandy Soils	No	87
South Western and West Central	Yes	4
South Western and West Central	No	96
South Central	Yes	0
South Central	No	100
Statewide	Yes	4
Statewide	No	96

Table 49 details liquid nitrogen fertilizer applied as a post planting or sidedress for the 2016 wheat crop (WFQ-FERT TABLE).

Table 49. Liquid nitrogen fertilizer (28%, 32%) applied as a post planting or sidedress for the 2016 wheat crop.

BMP Region	Liquid Nitrogen (28%, 32%) Application After Planting such as a Sidedress in 2016	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	0
Irrigated and Non-irrigated Sandy Soils	No	100
South Western and West Central	Yes	0
South Western and West Central	No	100
South Central	Yes	0
South Central	No	100
Statewide	Yes	<1
Statewide	No	>99

Table 50 details other nitrogen fertilizers applied as a post planting or sidedress the 2016 wheat crop (WFQ-FERT TABLE).

Table 50. Other nitrogen fertilizers applied in the spring at planting for the 2016 wheat crop.

BMP Region	Other Nitrogen Fertilizers After Planting such as a Sidedress in 2016	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	3
Irrigated and Non-irrigated Sandy Soils	No	97
South Western and West Central	Yes	0
South Western and West Central	No	100
South Central	Yes	0
South Central	No	100
Statewide	Yes	1
Statewide	No	99

Table 51 details phosphorus fertilizer, such as MAP or DAP, applied as a post planting or sidedress for the 2016 wheat crop (WFQ-FERT TABLE).

Table 51. Fertilizer containing phosphorus applied as a post planting or sidedress for the 2016 wheat crop.

BMP Region	Phosphorus Application After Planting such as a Sidedress in 2016	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	3
Irrigated and Non-irrigated Sandy Soils	No	97
South Western and West Central	Yes	0
South Western and West Central	No	100
South Central	Yes	0
South Central	No	100
Statewide	Yes	1
Statewide	No	99

Table 52 details potassium fertilizer applied as a post planting or sidedress for the 2016 wheat crop (WFQ-FERT TABLE).

Table 52. Fertilizer containing potassium applied as a post planting or sidedress for the 2016 wheat crop.

BMP Region	Potassium Application After Planting such as a Sidedress in 2016	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	3
Irrigated and Non-irrigated Sandy Soils	No	97
South Western and West Central	Yes	1
South Western and West Central	No	99
South Central	Yes	5
South Central	No	95
Statewide	Yes	1
Statewide	No	99

Table 53 details sulfur fertilizer, such as AMS, applied as a post planting or sidedress for the 2016 wheat crop (WFQ-FERT TABLE).

Table 53. Fertilizer containing sulfur applied as a post planting or sidedress for the 2016 wheat crop.

BMP Region	Sulfur Application after Planting such as a Sidedress in 2016	Percent of Respondents
Northwestern	Yes	1
Northwestern	No	99
Irrigated and Non-irrigated Sandy Soils	Yes	3
Irrigated and Non-irrigated Sandy Soils	No	97
South Western and West Central	Yes	1
South Western and West Central	No	99
South Central	Yes	5
South Central	No	95
Statewide	Yes	1
Statewide	No	99

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

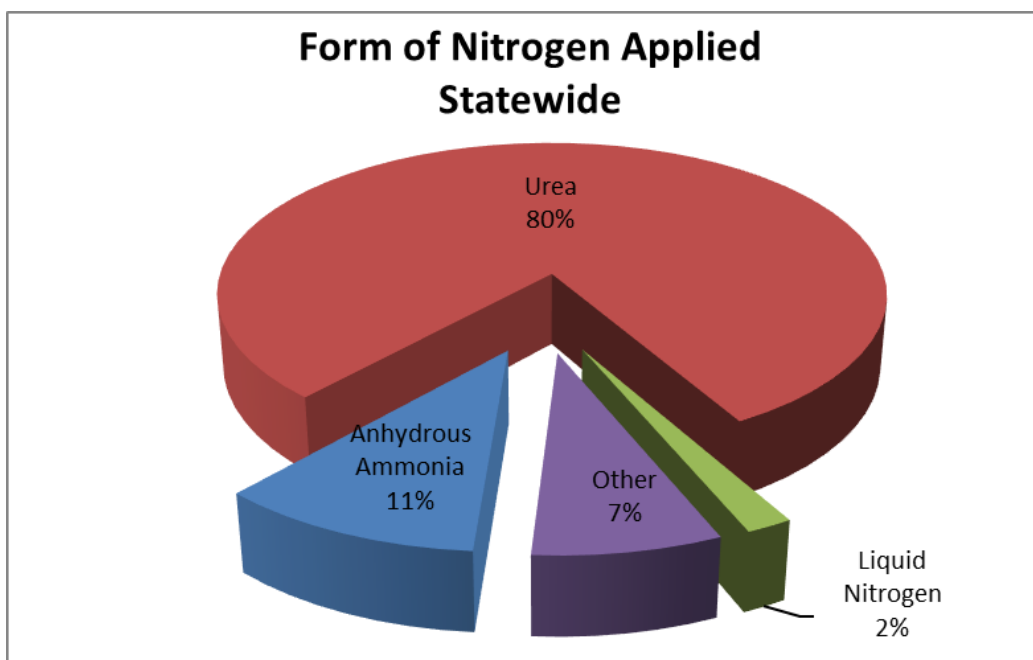


Figure 2. The form of the nitrogen applied to wheat acres in state for the 2016 survey for all fields applied with nitrogen fertilizer (Based on total pounds applied).

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

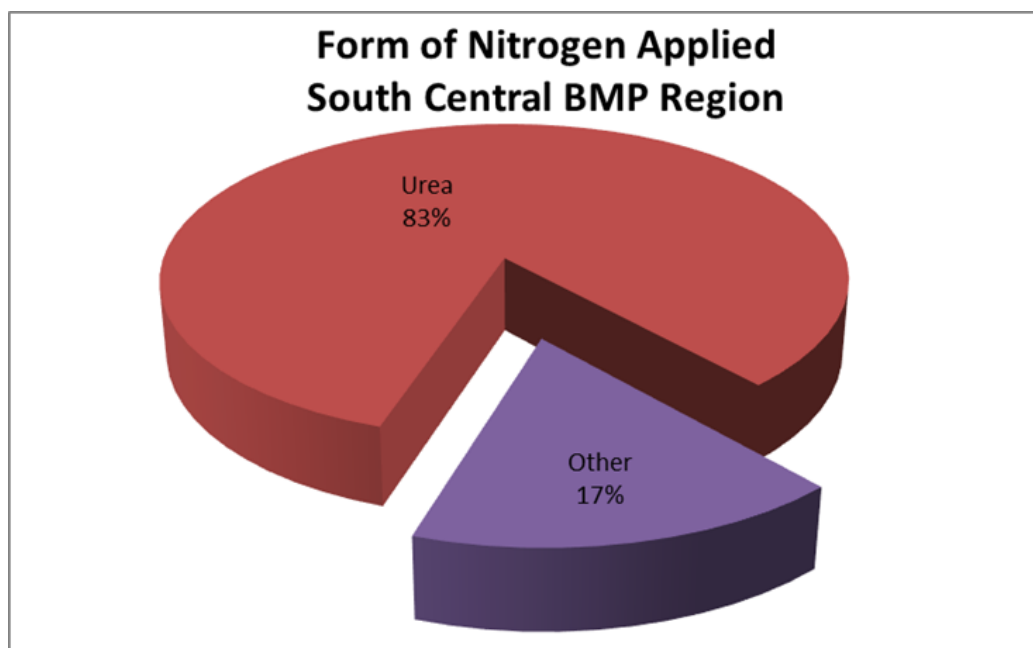


Figure 3. The form of the nitrogen applied to wheat acres in the SC BMP region for the 2016 survey for all fields applied with nitrogen fertilizer.

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

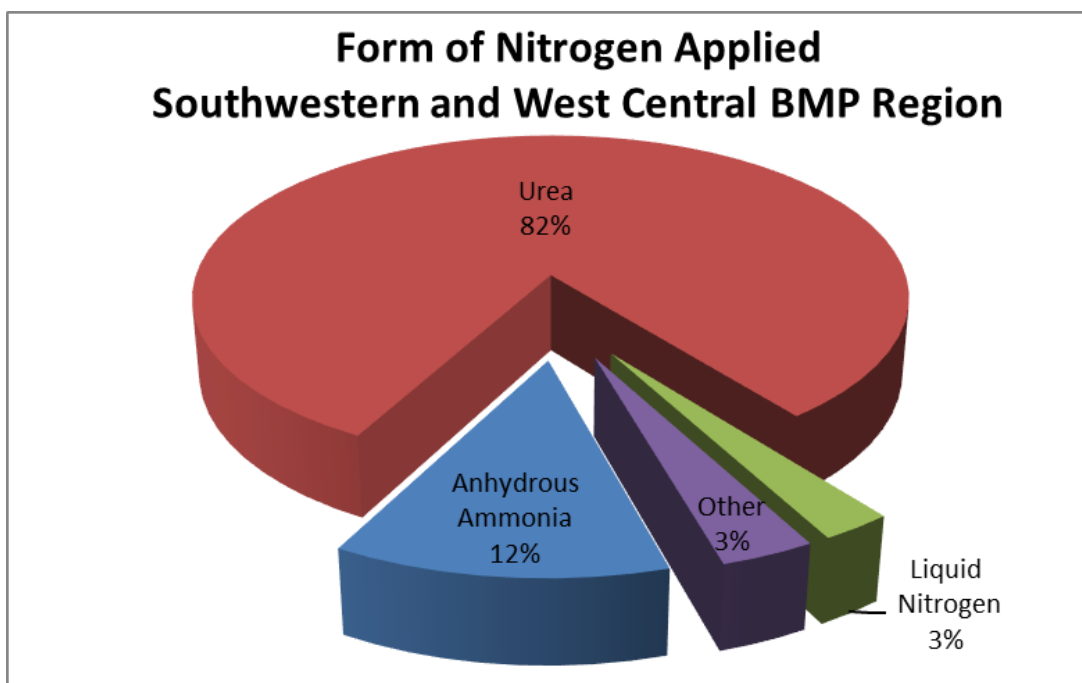


Figure 4. The form of the nitrogen applied to wheat acres in the SW BMP region for the 2016 survey for all fields applied with nitrogen fertilizer.

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

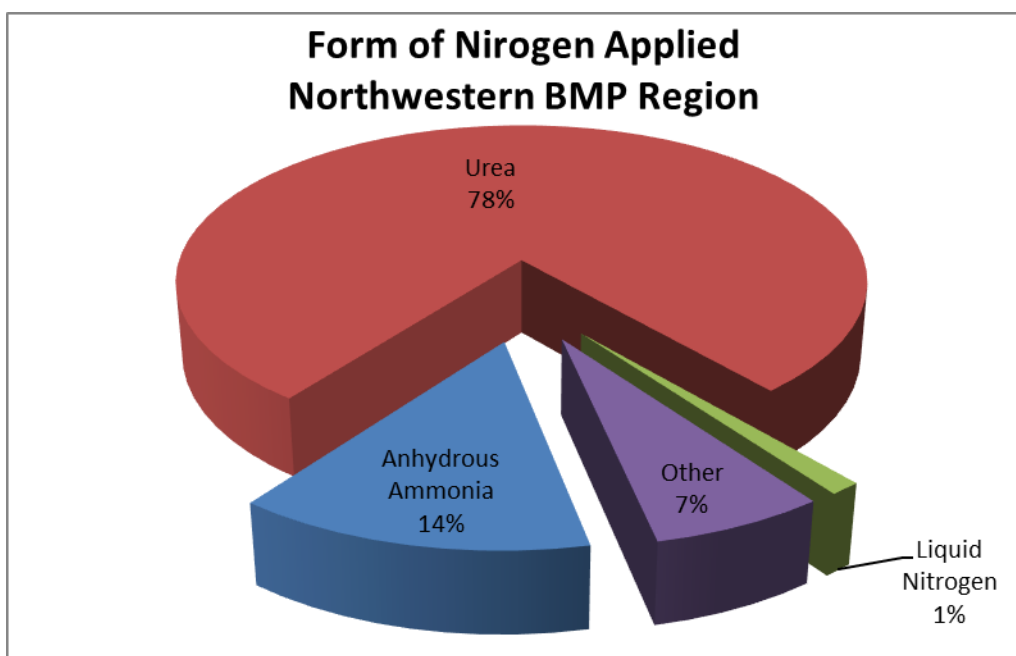


Figure 5. The form of the nitrogen applied to wheat acres in the NW BMP region for the 2016 survey for all fields applied with nitrogen fertilizer.

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

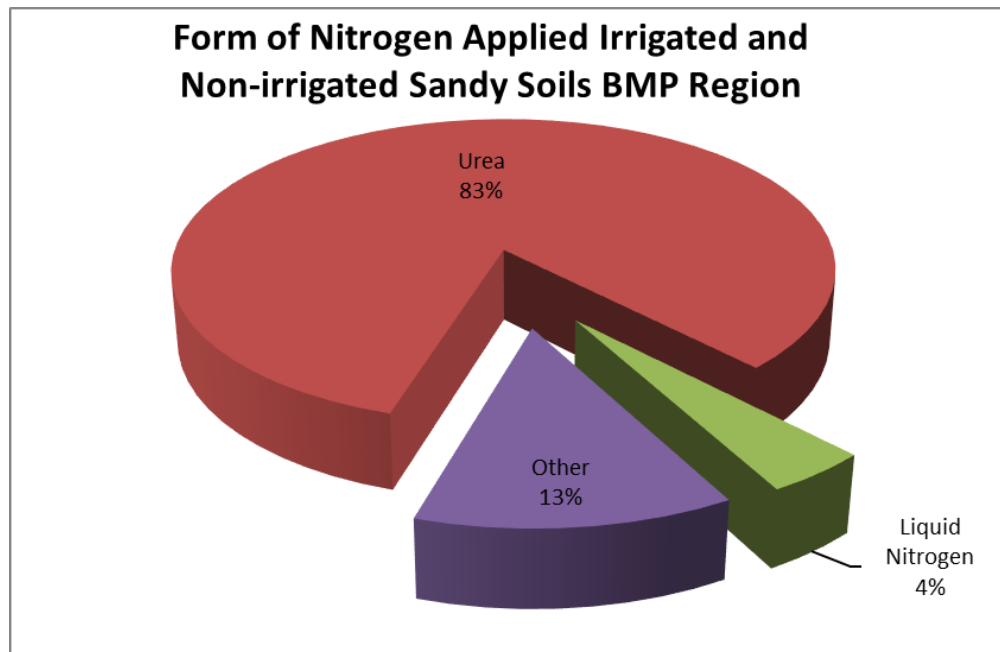


Figure 6. The form of the nitrogen applied to wheat acres in the IRR BMP region for the 2016 survey for all fields applied with nitrogen fertilizer.

Figure 7 details the application timing of anhydrous ammonia on wheat acres in Minnesota for the largest field by pounds of nitrogen applied (WFQ-FERT TABLE).

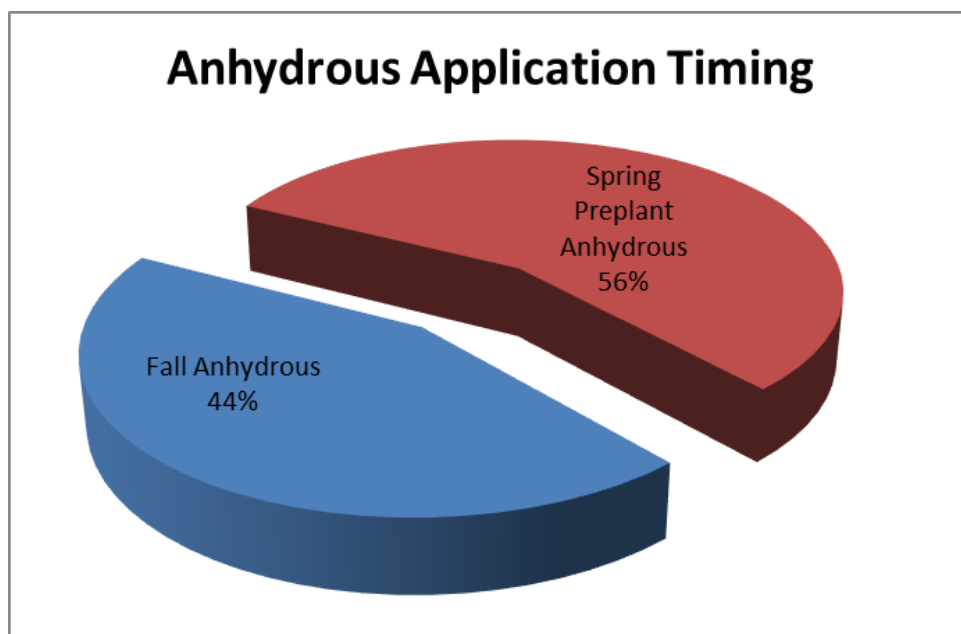


Figure 7. The application timing of anhydrous ammonia to wheat acres in Minnesota by pounds of nitrogen applied in the 2016 survey.

Figure 8 details the application timing of urea on wheat acres in Minnesota for the largest field by pounds of nitrogen applied (WFQ-FERT TABLE).

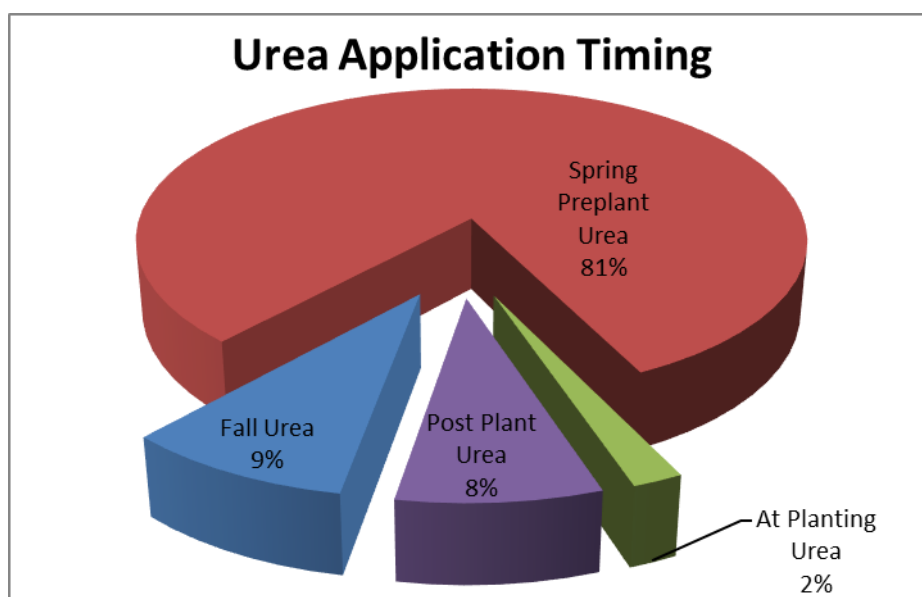


Figure 8. The application timing of urea to wheat acres in Minnesota by pounds of nitrogen applied in the 2016 survey.

Figure 9 details the application timing of liquid nitrogen fertilizer on wheat acres in Minnesota for the largest field by pounds of nitrogen applied (WFQ-FERT TABLE).

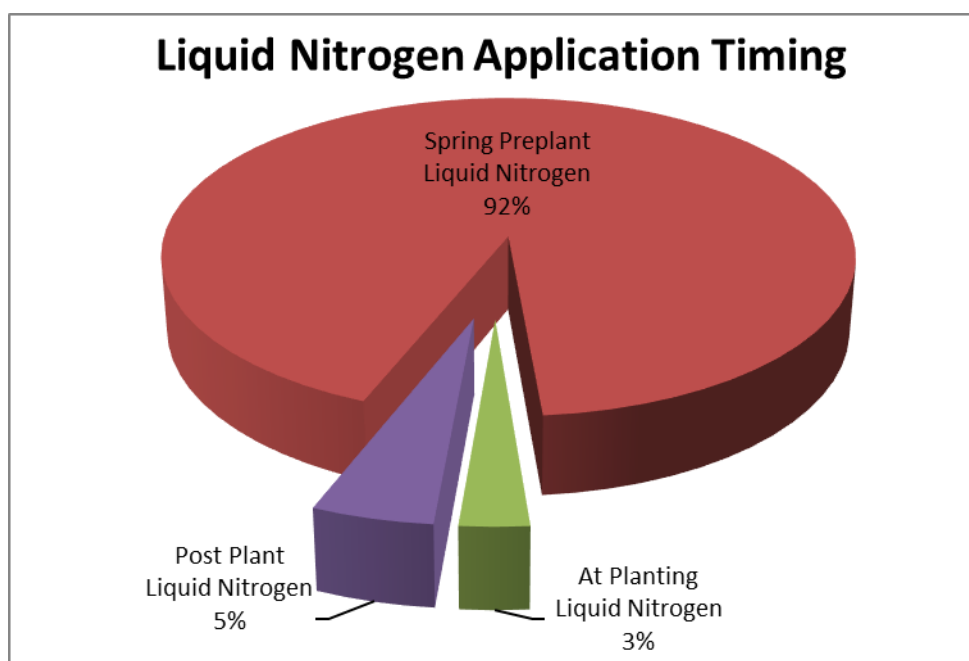


Figure 9. The application timing of liquid nitrogen fertilizer to wheat acres in Minnesota by pounds of nitrogen applied in the 2016 survey.

Figure 10 details the application timing of other nitrogen sources on wheat acres in Minnesota for the largest field by pounds of nitrogen applied (WFQ-FERT TABLE).

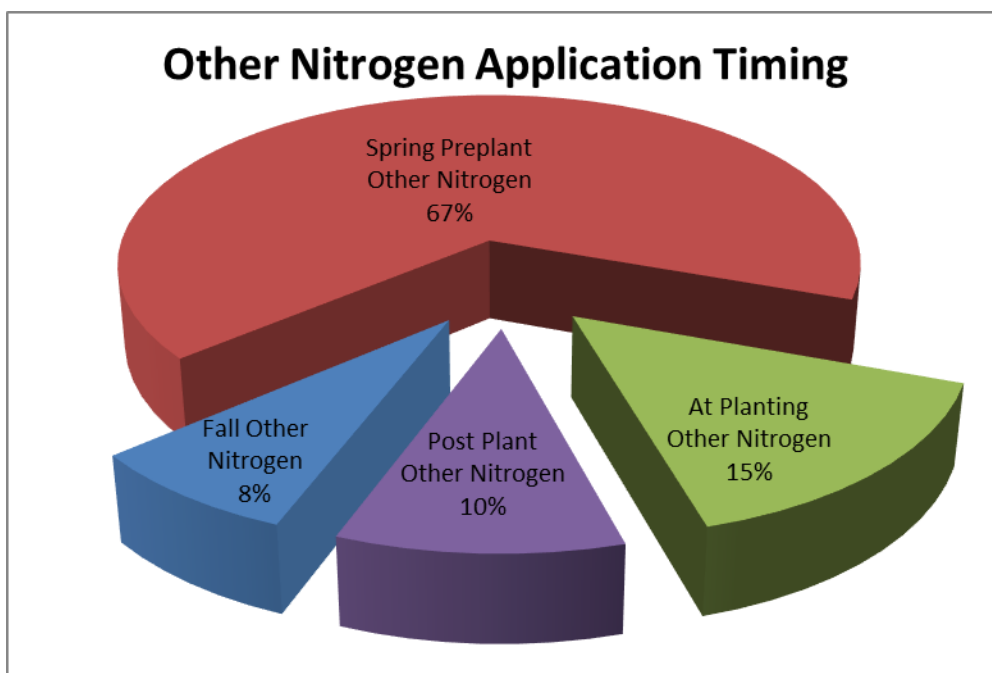


Figure 10. The application timing of other nitrogen sources to wheat acres in Minnesota by pounds of nitrogen applied in the 2016 survey.

Figure 11 details the application timing of phosphorus on wheat acres in Minnesota for the largest field by pounds of phosphorus applied (WFQ-FERT TABLE).

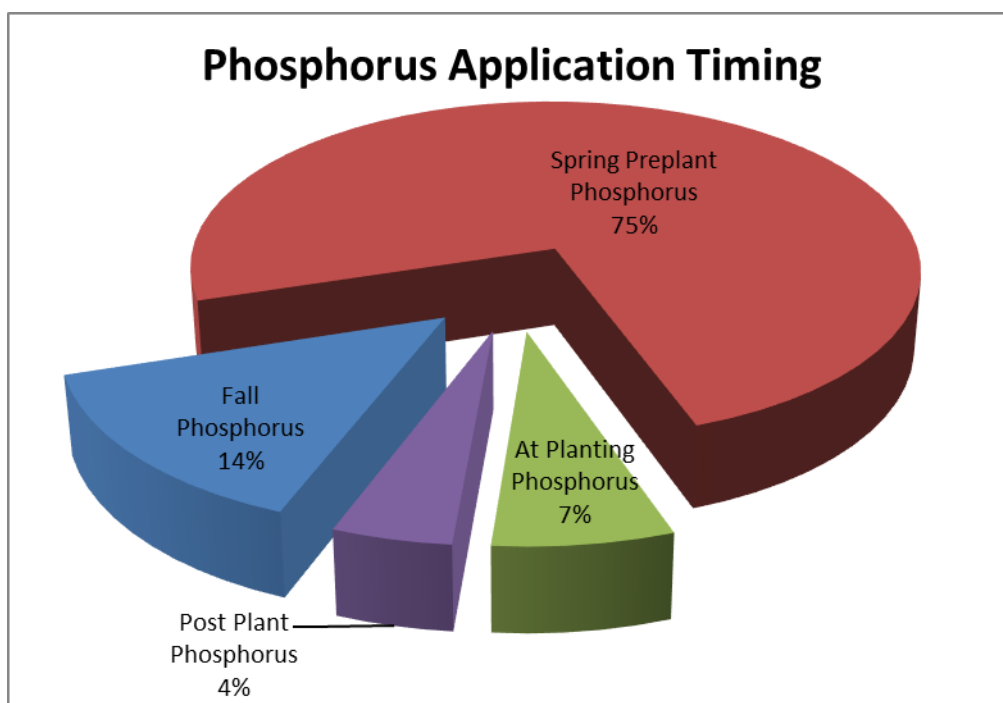


Figure 11. The application timing of phosphorus to wheat acres in Minnesota by pounds of phosphorus applied in the 2016 survey.

Figure 12 details the application timing of potassium on wheat acres in Minnesota for the largest field by pounds of potassium applied (WFQ-FERT TABLE).

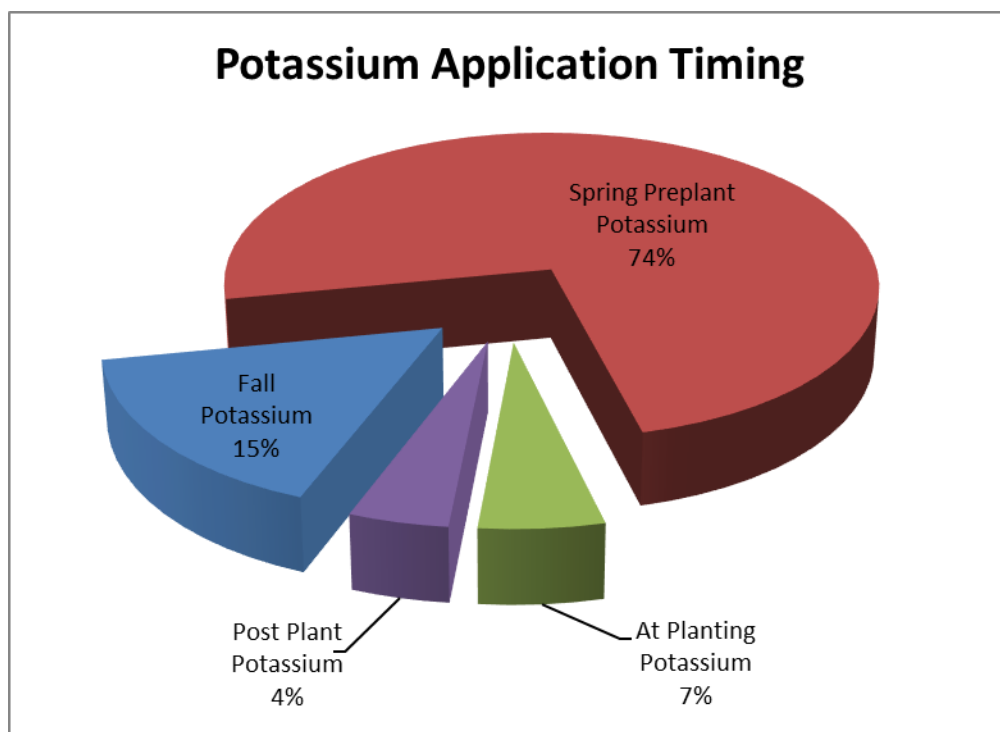


Figure 12. The application timing of potassium to wheat acres in Minnesota by pounds of potassium applied in the 2016 survey.

Figure 13 details the application timing of sulfur on wheat acres in Minnesota for the largest field by pounds of sulfur applied (WFQ-FERT TABLE).

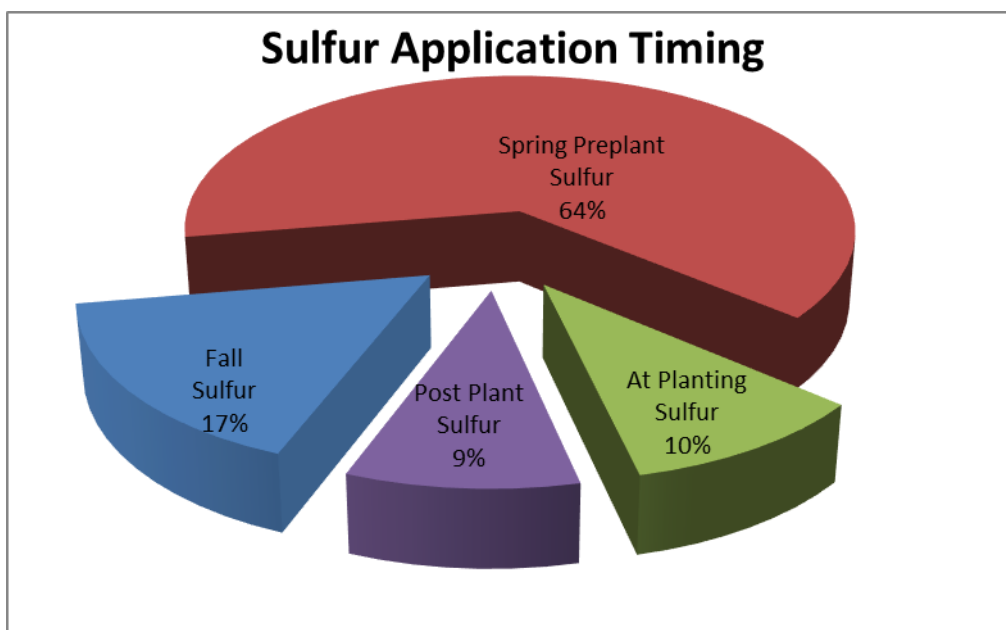


Figure 13. The application timing of sulfur to wheat acres in Minnesota by pounds of sulfur applied in the 2016 survey.

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

Table 54 details the percent of respondents that used a nitrogen inhibitor or stabilizer in 2015 or 2016 for the 2016 wheat crop on the farmers largest field (WFQ-5 and WFQ-10).

Table 54. Nitrogen inhibitor or stabilizer use for the 2016 wheat crop.

BMP Region	Nitrogen Inhibitor or Stabilizer Use	Percent of Respondents	Average Wheat Yield Bushels per Acre
Northwestern	All	**	**
Northwestern	Some	**	**
Northwestern	None	87	59
Irrigated and Non-irrigated Sandy Soils	All	**	**
Irrigated and Non-irrigated Sandy Soils	Some	**	**
Irrigated and Non-irrigated Sandy Soils	None	81	49
South Western and West Central	All	**	**
South Western and West Central	Some	**	**
South Western and West Central	None	77	58
South Central	All	**	**
South Central	Some	**	**
South Central	None	100	51
Statewide	All	13	60
Statewide	Some	3	52
Statewide	None	84	57

** Less than five responses

The following tables and figures in the remaining wheat section represent the 277 respondents that reported on their largest wheat 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: Wheat Following Soybeans

Statewide, eighty three percent of the fields reported were wheat following soybeans. Figure 14 details the BMP regions where farmers reported on fields with wheat following soybeans. There were 230 fields surveyed in Minnesota.¹¹

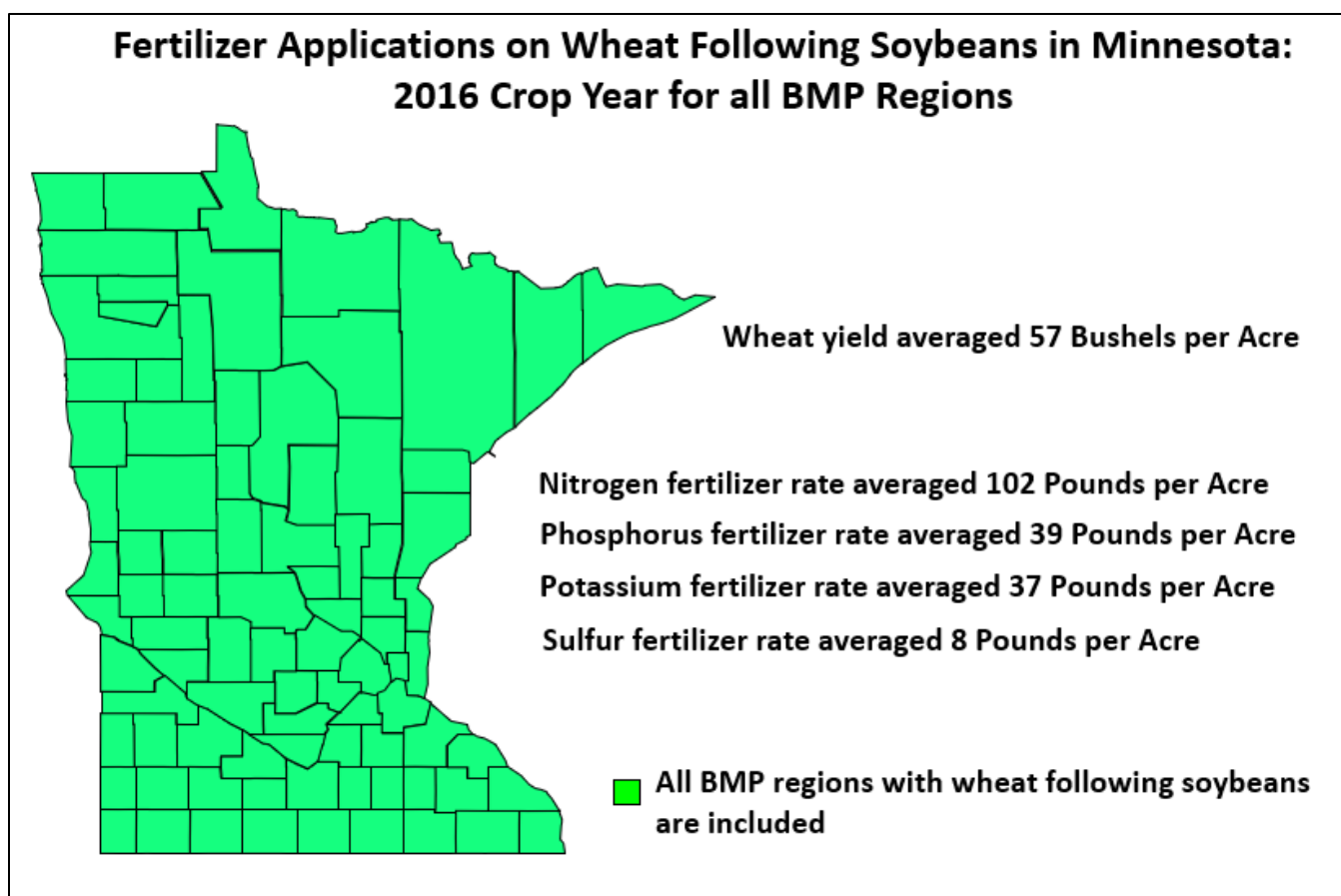


Figure 14. The average wheat yield and average fertilizer rate for wheat following soybeans in Minnesota.

¹¹ The published averages are for respondents that applied commercial fertilizer on wheat fields without manure to the 2016 wheat crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 61% applied phosphorus, 55% applied potassium, and 16% applied sulfur on fields with wheat following soybeans.

Figure 15 provides the distribution of average nitrogen fertilizer rate in Minnesota for wheat following soybeans; the corresponding wheat yield is detailed in red. Nitrogen rates are only from commercial fertilizer.

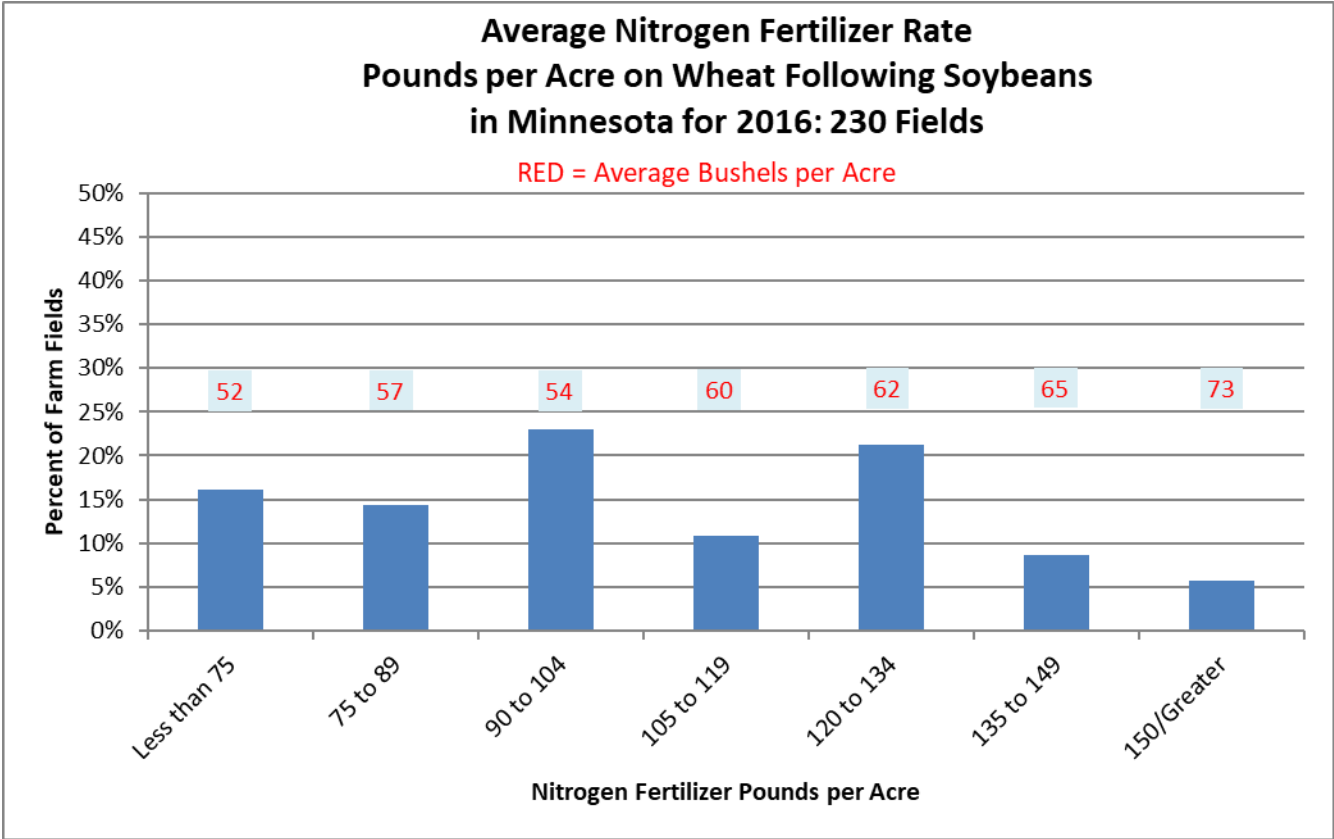


Figure 15. Average nitrogen fertilizer rate and yield on wheat following soybeans in Minnesota for 2016: 230 fields.

In Minnesota, the percent of fertilized wheat 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 wheat following soybeans are shown in Table 55.

Table 55. Average fertilizer rate and yield on fertilized wheat fields in Minnesota for wheat following soybeans.

Nutrients Applied	Percent of Fertilized Wheat Fields	Average Nutrient Rate on Fields Treated with Same Nutrient ¹² Pounds per Acre	Average Wheat Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Wheat Fields ¹³ Pounds per Acre
Nitrogen	100	102	56	102
Phosphorus	61	39	58	24

¹² Represents the average rate of a nutrient on fields receiving the same nutrient. For example, 39 pounds per acre of phosphorus was applied on fields receiving phosphorus. Fields not receiving phosphorus were not included.

¹³ Represents the average rate of a nutrient on all fields receiving fertilizer. For example, 24 pounds per acre of phosphorus was applied on fields receiving fertilizer. This could include MAP, DAP, urea, anhydrous ammonia, etc.

Nutrients Applied	Percent of Fertilized Wheat Fields	Average Nutrient Rate on Fields Treated with Same Nutrient ¹² Pounds per Acre	Average Wheat Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Wheat Fields ¹³ Pounds per Acre
Potassium	55	37	58	20
Sulfur	16	8	55	1

South Central and Southeastern BMP Regions: Wheat Following Soybeans

There were 13 fields that were included in the SC and SE BMP regions for the wheat following soybeans analysis. Figure 16 details the location, average rate of nitrogen, phosphorus, potassium, sulfur and average yield for wheat following soybeans in the SC and SE BMP regions.¹⁴

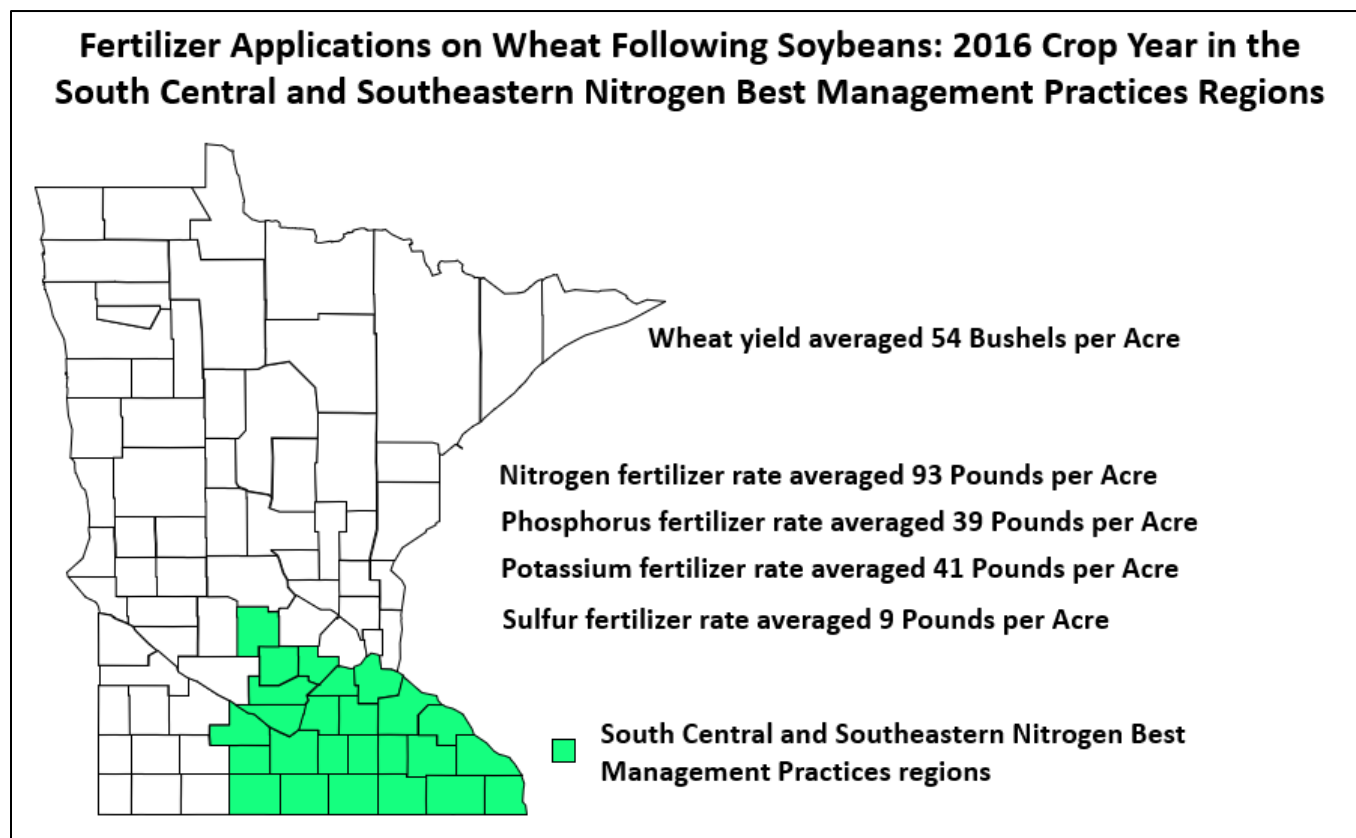


Figure 16. The average wheat yield and average fertilizer rate for wheat following soybeans in the SC and SE BMP regions.

¹⁴ The published averages are for respondents that applied commercial fertilizer on wheat fields without manure to the 2016 wheat crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 77% applied phosphorus, 77% applied potassium, and 46% applied sulfur on fields with wheat following soybeans.

Figure 17 provides the distribution of nitrogen fertilizer rate in the SC and SE BMP regions for wheat following soybeans; the corresponding wheat yield are detailed in red.¹⁵ Nitrogen rates are only from commercial fertilizer.

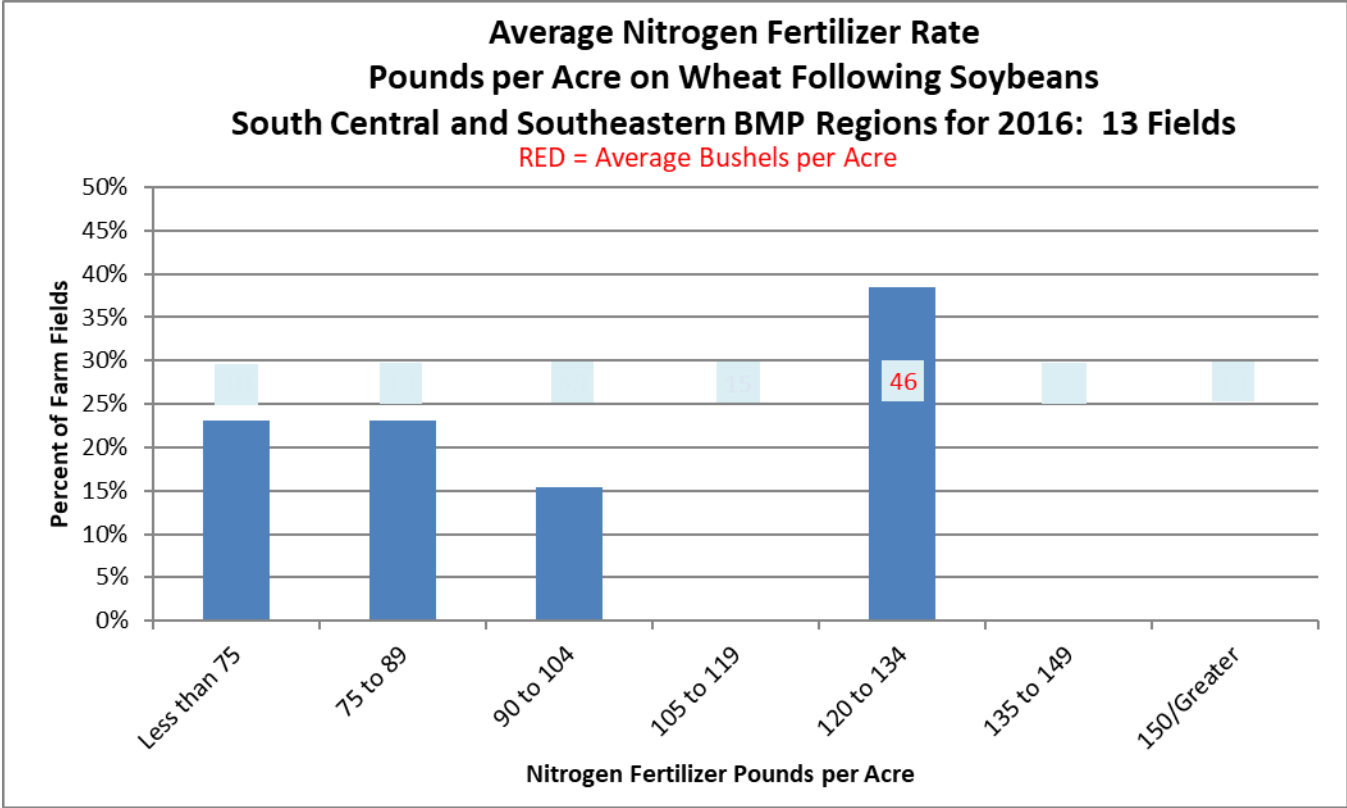


Figure 17. Average nitrogen fertilizer rate and yield on wheat following soybeans in the SC and SE BMP regions for 2016: 13 fields.

In the SC and SE BMP regions, the percent of fertilized wheat 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 wheat following soybeans are shown in Table 56.

Table 56. Average fertilizer rate and yield in the SC and SE BMP regions for wheat following soybeans.

Nutrients Applied	Percent of Fertilized Wheat Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Wheat Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Wheat Fields Pounds per Acre
Nitrogen	100	93	54	93
Phosphorus	77	39	53	30
Potassium	77	53	41	41
Sulfur	46	9	51	4

¹⁵ Yields are not published if there are less than five responses.

Southwestern and West Central BMP Region: Wheat Following Soybeans

There were 57 fields that were included in the SW BMP region for the wheat following soybeans analysis. Figure 18 details the location, average rate of nitrogen, phosphorus, potassium, and sulfur fertilizer and average yield for wheat following soybeans in the SW BMP region.¹⁶

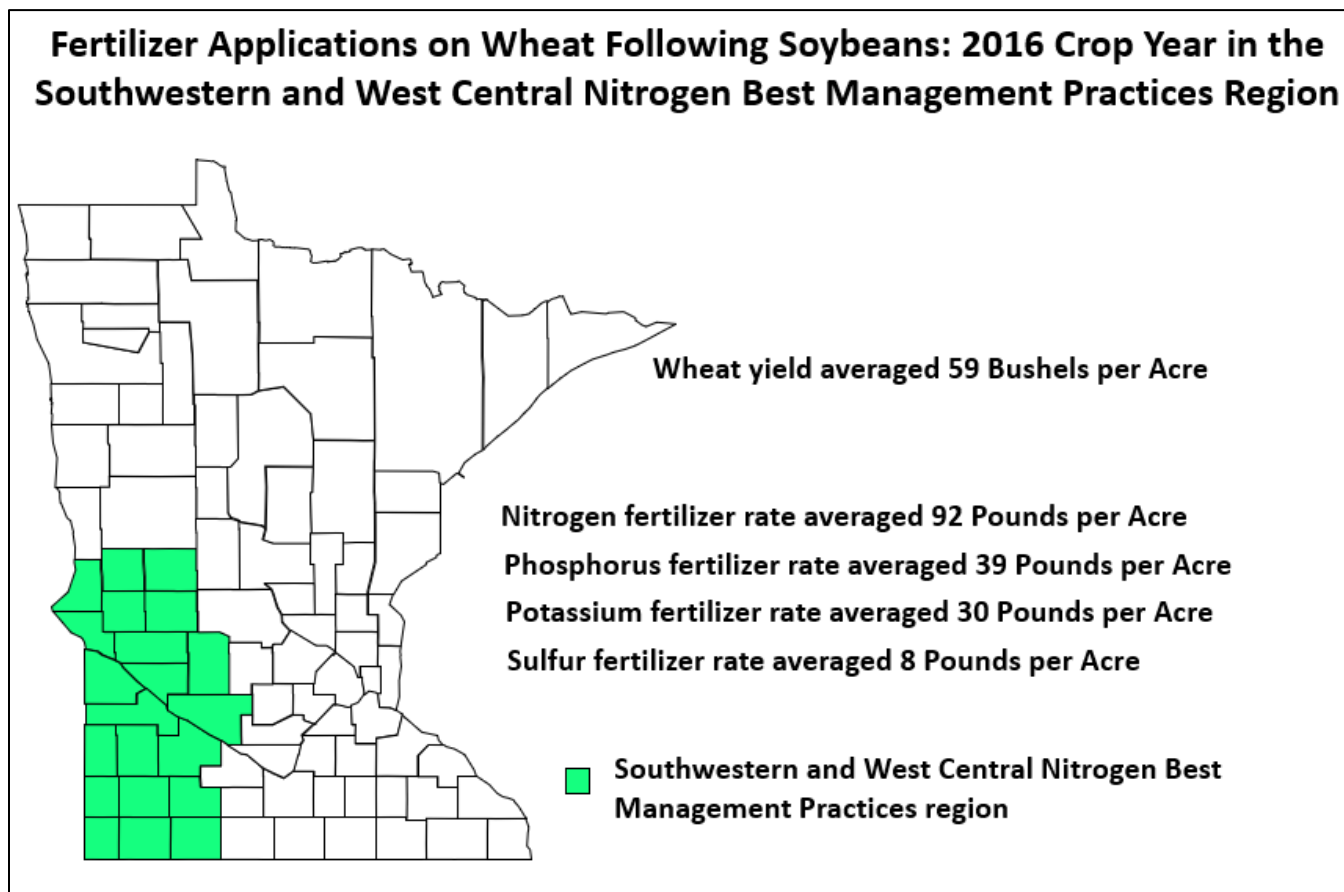


Figure 18. The average wheat yield and average fertilizer rate for wheat following soybeans in the SW BMP region.

¹⁶ The published averages are for respondents that applied commercial fertilizer on wheat fields without manure to the 2016 wheat crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 67% applied phosphorus, 65% applied potassium, and 26% applied sulfur on fields with wheat following soybeans.

Figure 19 provides the distribution of nitrogen fertilizer rate in the SW BMP region for wheat following soybeans; the corresponding wheat yield is detailed in red.¹⁷ Nitrogen rates are only from commercial fertilizer.

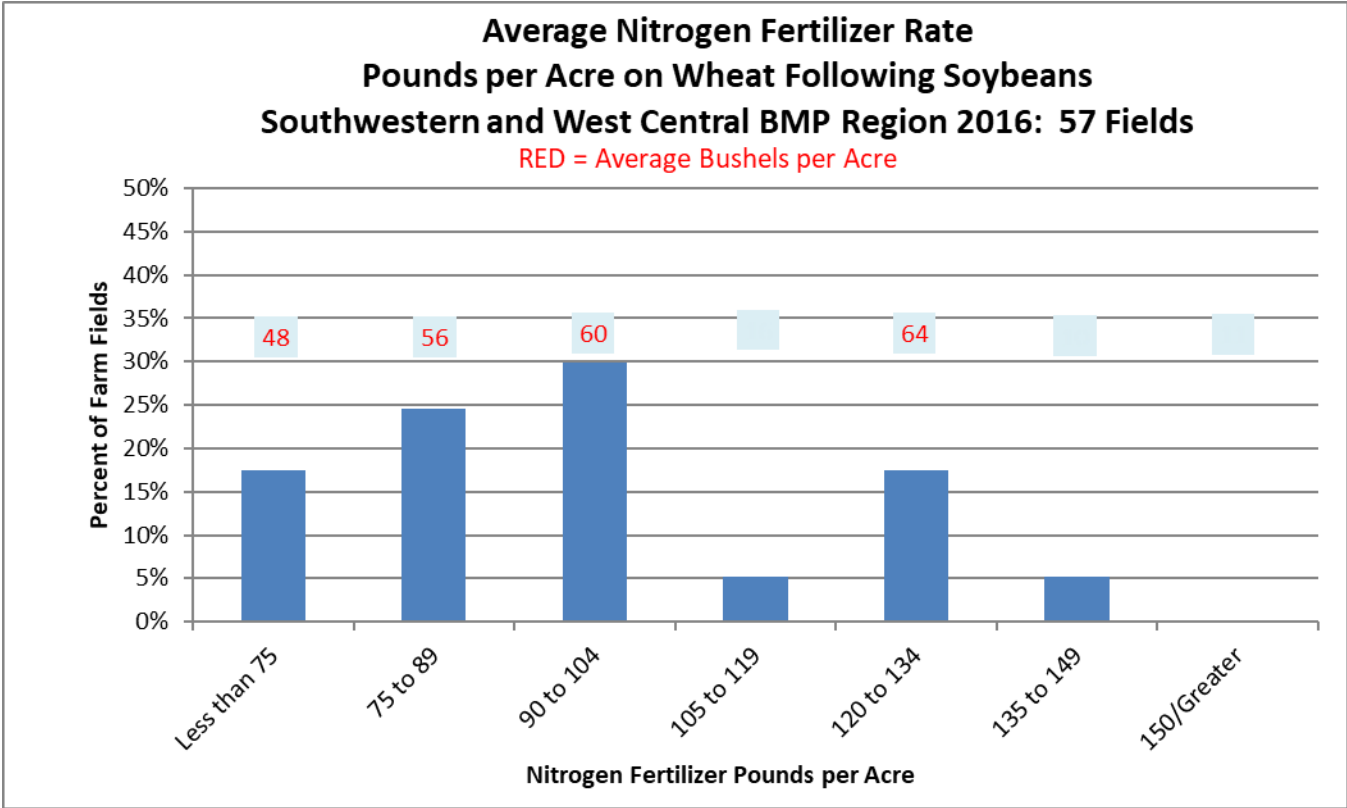


Figure 19. Average nitrogen fertilizer rate and yield on wheat following soybeans in the SW BMP region for 2016: 57 fields.

In the SW BMP region, the percent of fertilized wheat 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 wheat following soybeans are shown in Table 57.

Table 57. Average fertilizer rate and wheat yield in the SW BMP region for wheat following soybeans.

Nutrients Applied	Percent of Fertilized Wheat Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Wheat Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Wheat Fields Pounds per Acre
Nitrogen	100	92	59	92
Phosphorus	67	39	60	26
Potassium	65	30	59	20
Sulfur	26	8	55	2

¹⁷ Yields are not published if there are less than five responses.

Northwestern BMP Region: Wheat Following Soybeans

There were 129 fields that were included in the NW BMP region for the wheat following soybean analysis. Figure 20 details the location, average rate of nitrogen, phosphorus, potassium, and sulfur fertilizer and average yield for wheat following soybeans in the NW BMP region.¹⁸

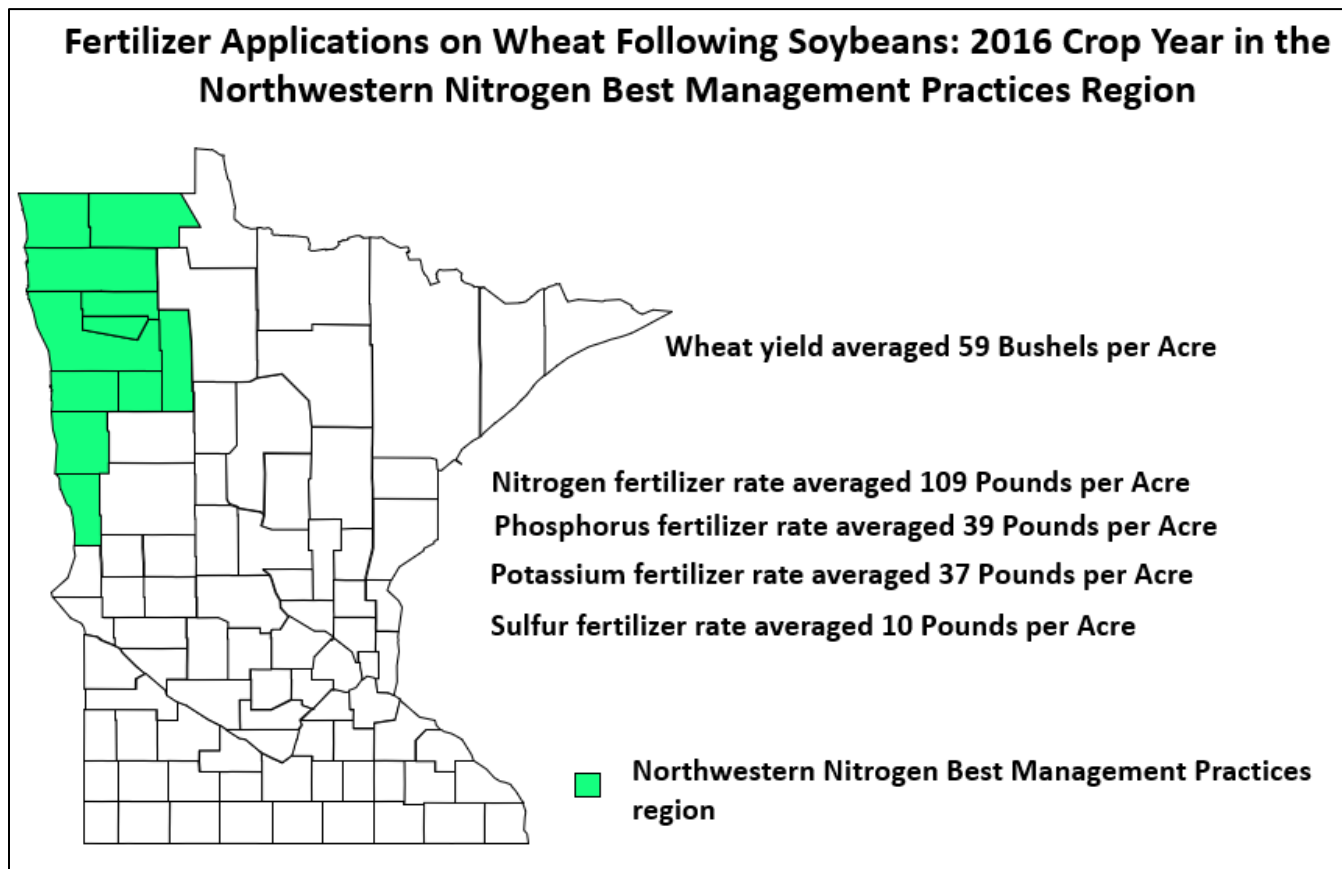


Figure 20. The average wheat yield and average fertilizer rate for wheat following soybeans in the NW BMP region.

¹⁸ The published averages are for respondents that applied commercial fertilizer on wheat fields without manure to the 2016 wheat crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 57% applied phosphorus, 47% applied potassium, and 7% applied sulfur on fields with wheat following soybeans.

Figure 21 provides the distribution of nitrogen fertilizer rate in the NW BMP region for wheat following soybeans; the corresponding wheat yield is detailed in red. Nitrogen rates are only from commercial fertilizer.

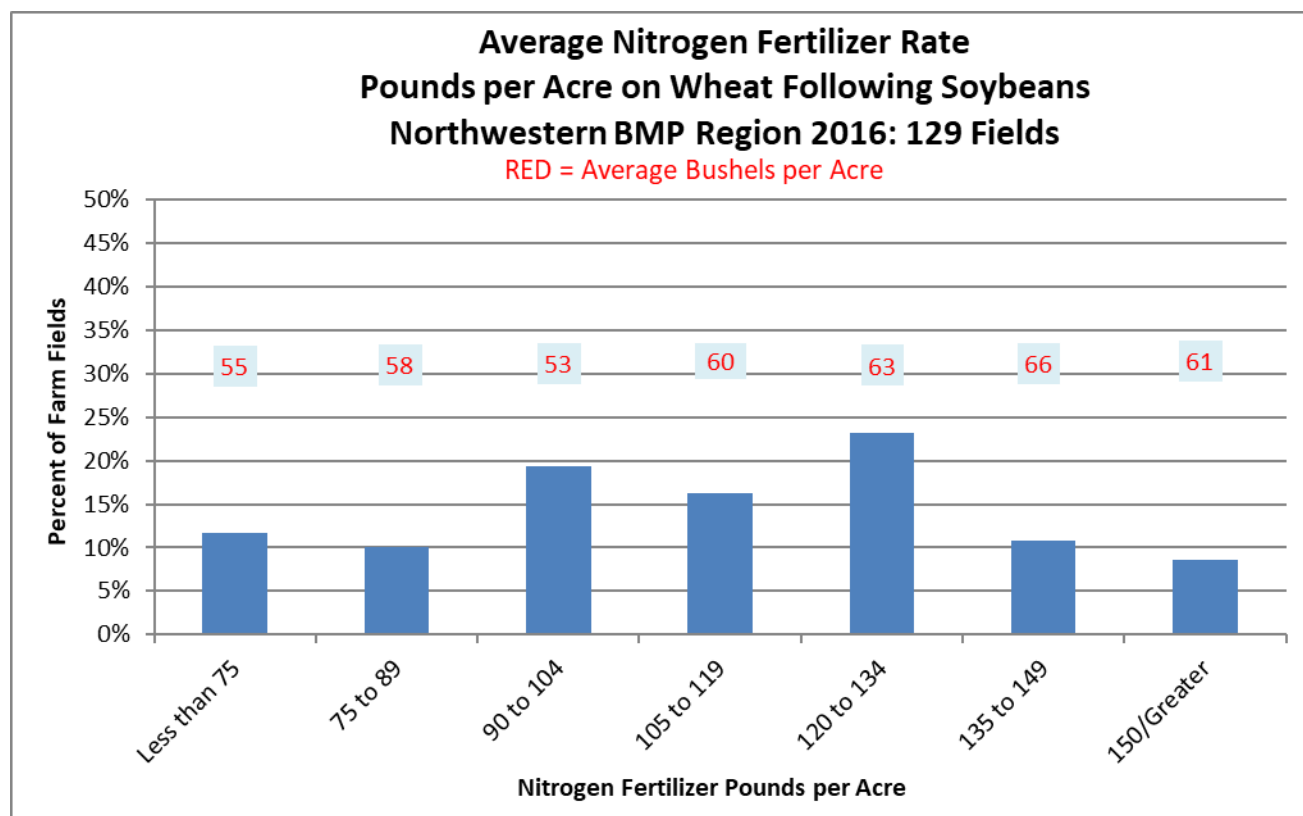


Figure 21. Average nitrogen fertilizer rate and yield on wheat following soybeans in the NW BMP region for 2016: 129 fields.

In the NW BMP region, the percent of fertilized wheat 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 wheat following soybeans are shown in Table 58.

Table 58. Average fertilizer rate and wheat yield in the NW BMP region for wheat following soybeans.

Nutrients Applied	Percent of Fertilized Wheat Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Wheat Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Wheat Fields Pounds per Acre
Nitrogen	100	109	59	109
Phosphorus	57	39	60	22
Potassium	47	37	60	17
Sulfur	7	10	61	1

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

There were 31 fields that were included in the IRR BMP region for the wheat following soybean analysis. Figure 22 details the location, average rate of nitrogen, phosphorus, potassium, and sulfur fertilizer and average yield for wheat following soybeans in the IRR BMP region.¹⁹

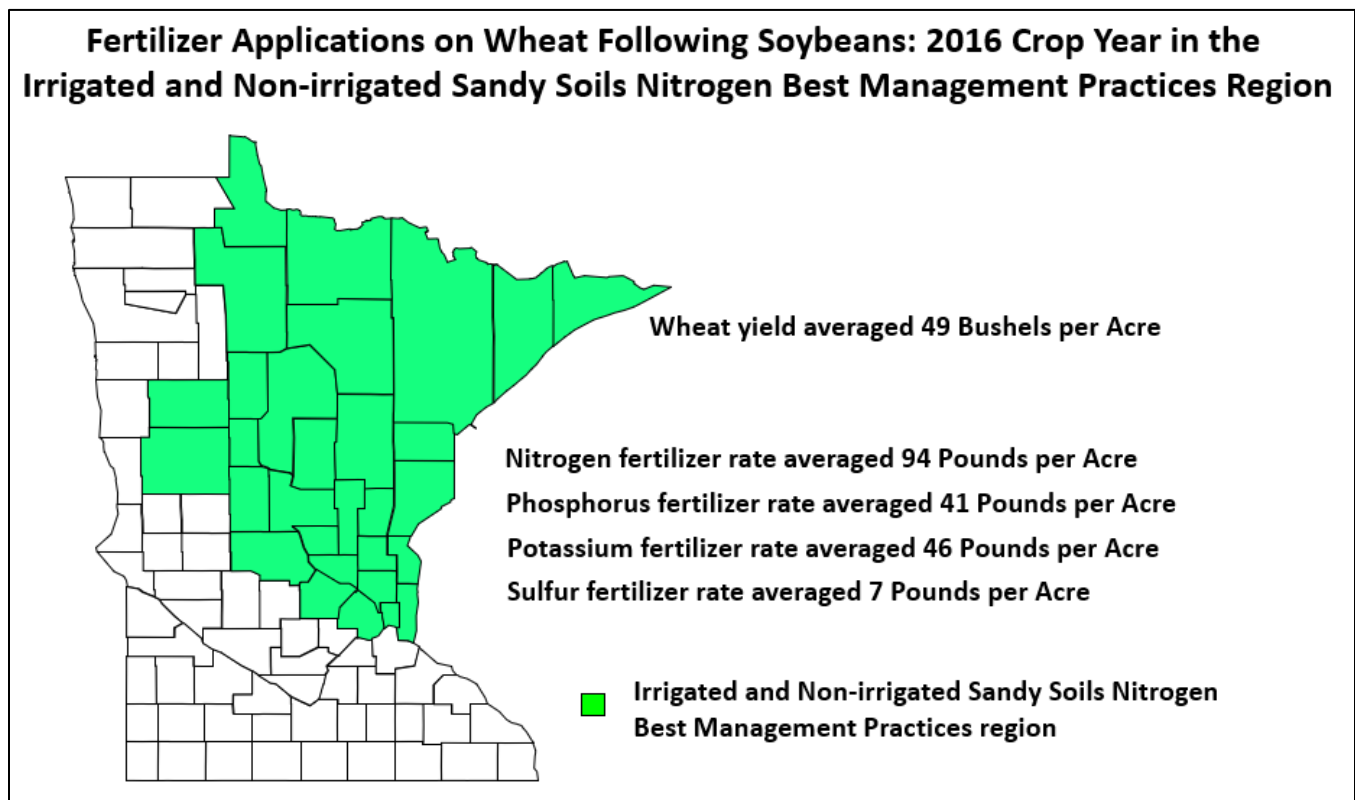


Figure 22. The average wheat yield and average fertilizer rate for wheat following soybeans in the IRR BMP region.

¹⁹ The published averages are for respondents that applied commercial fertilizer on wheat fields without manure to the 2016 wheat crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 61% applied phosphorus, 61% applied potassium, and 19% applied sulfur on fields with wheat following soybeans.

Figure 23 provides the distribution of nitrogen fertilizer rate in the IRR BMP region for wheat following soybeans; the corresponding wheat yield is detailed in red.²⁰ Nitrogen rates are only from commercial fertilizer.

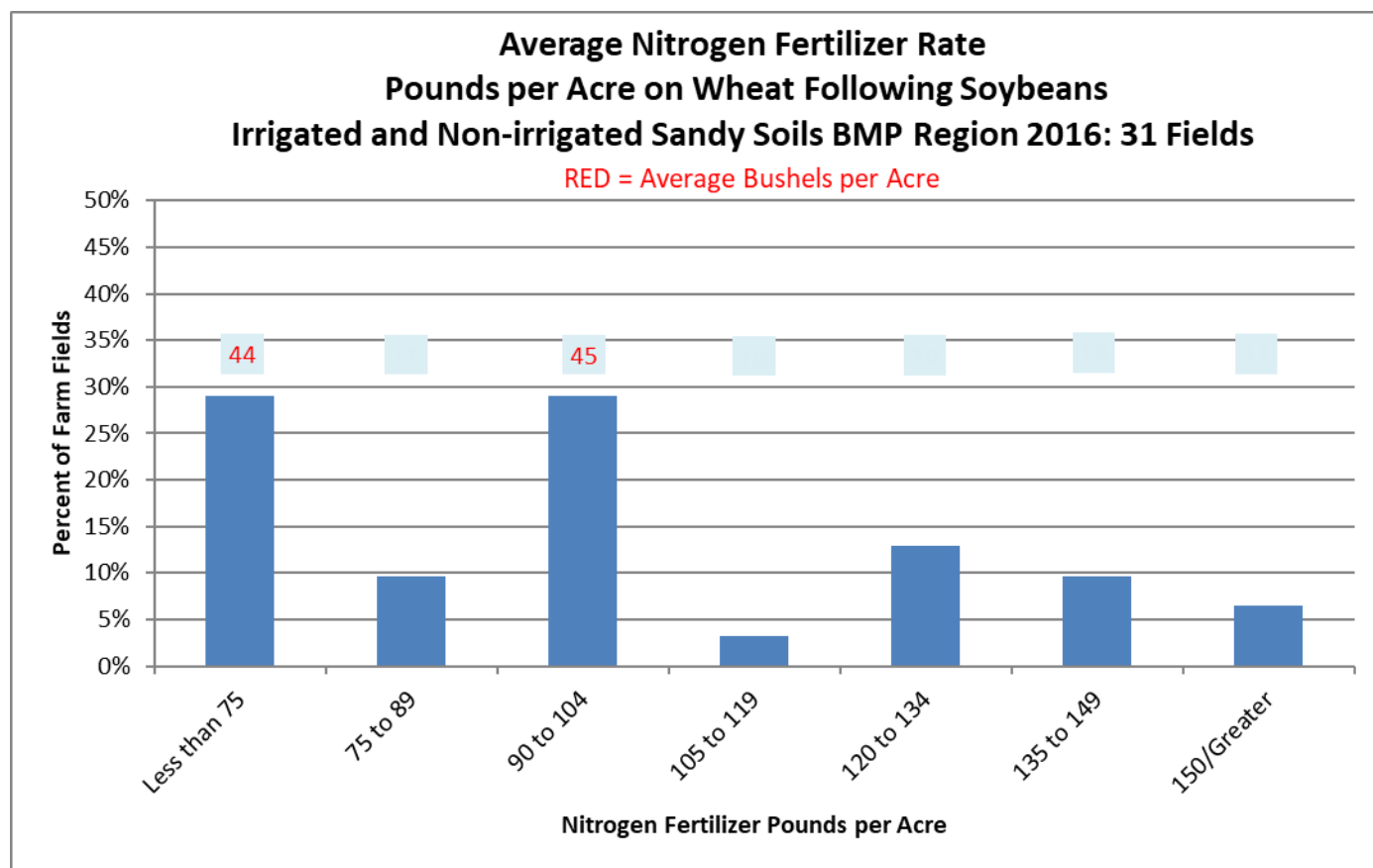


Figure 23. Average nitrogen fertilizer rate and yield on wheat following soybeans in the IRR BMP region for 2016: 31 fields.

In the IRR BMP region, the percent of fertilized wheat 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 wheat following soybeans are shown in Table 59.

Table 59. Average fertilizer rate and wheat yield in the IRR BMP region for wheat following soybeans.

Nutrients Applied	Percent of Fertilized Wheat Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Wheat Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Wheat Fields Pounds per Acre
Nitrogen	100	94	49	94
Phosphorus	61	41	50	25
Potassium	61	46	50	28
Sulfur	19	7	51	1

²⁰ Yields are not published if there are less than five responses.

Statewide: Wheat Following Corn

Statewide, seven percent of the fields reported were wheat following corn. Figure 24 details the BMP regions where farmers reported on fields with wheat following corn. There were 19 fields surveyed in Minnesota.²¹

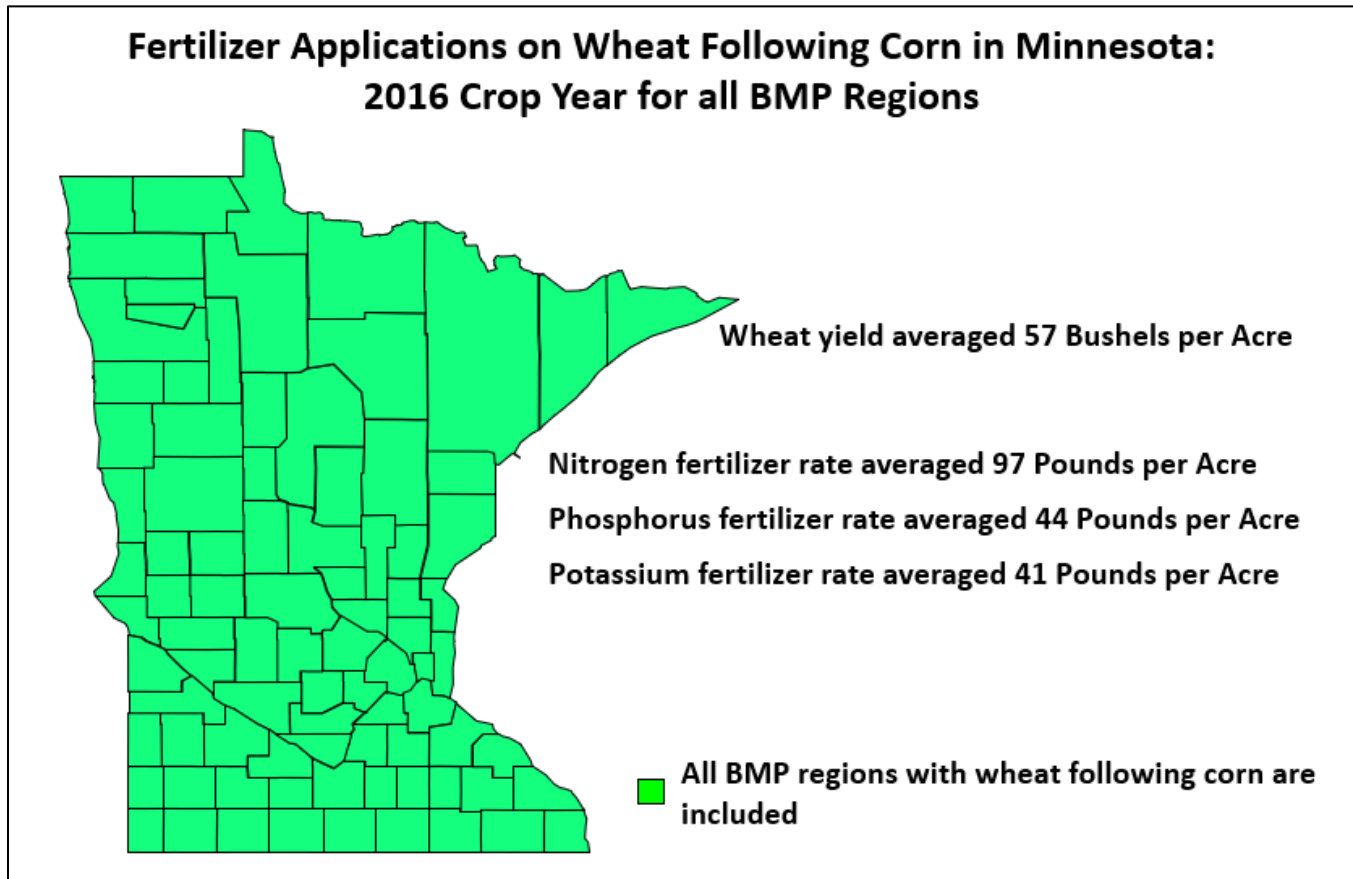


Figure 24. The average wheat yield and average fertilizer rate for wheat following corn in Minnesota.

²¹ The published averages are for respondents that applied commercial fertilizer on wheat fields without manure to the 2016 wheat crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 42% applied phosphorus, and 42% applied potassium on fields with wheat following corn. Less than five respondents reported applying sulfur.

Figure 25 provides the distribution of average nitrogen fertilizer rate in Minnesota for wheat following corn; the corresponding wheat yield is detailed in red.²² Nitrogen rates are only from commercial fertilizer.

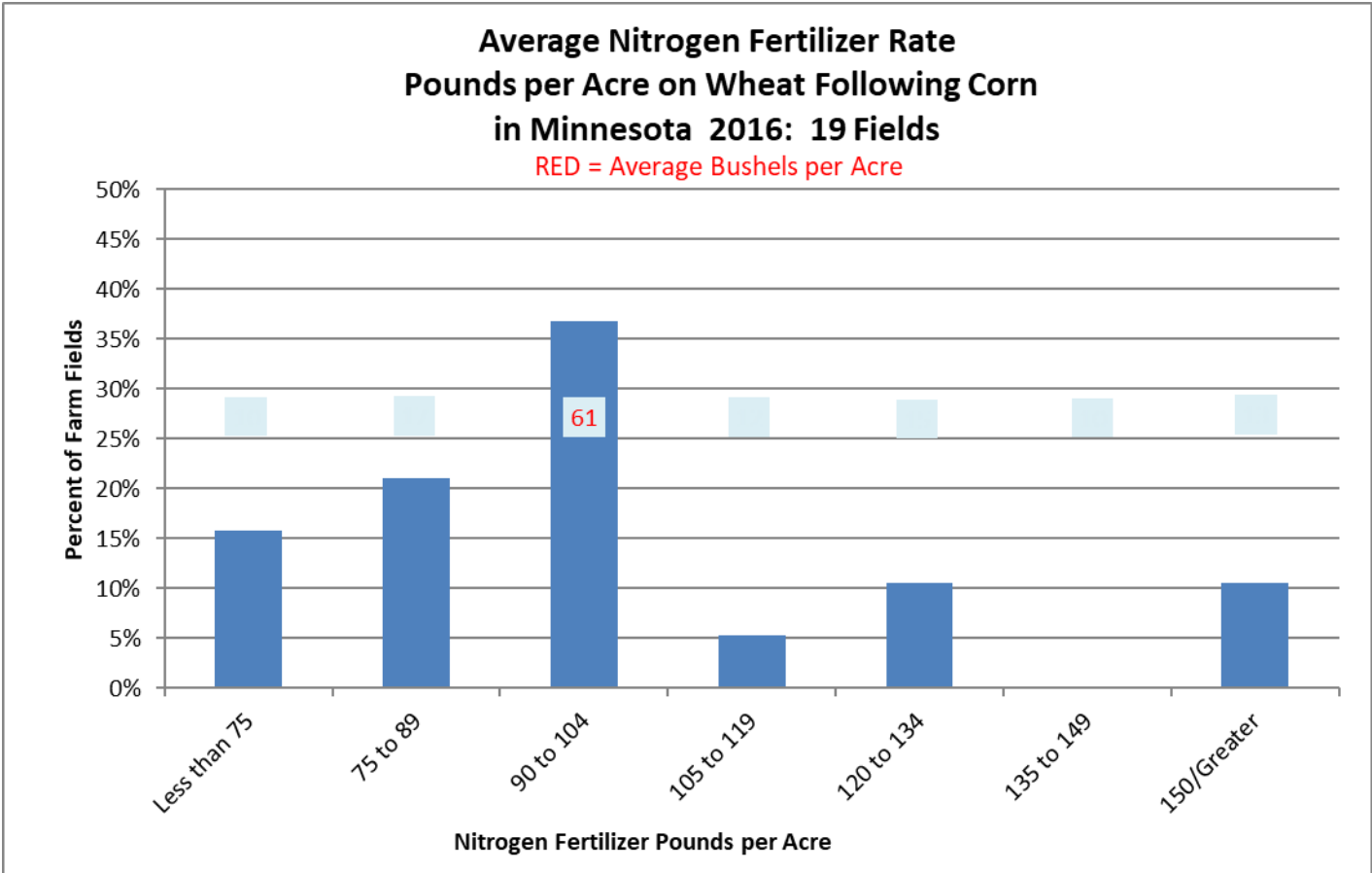


Figure 25. Average nitrogen fertilizer rate and yield on wheat following corn in Minnesota for 2016: 19 fields.

In Minnesota, the percent of fertilized wheat 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 wheat following corn are shown in Table 60.

Table 60. Average fertilizer rate and wheat yield in Minnesota for wheat following corn.

Nutrients Applied	Percent of Fertilized Wheat Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Wheat Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Wheat Fields Pounds per Acre
Nitrogen	100	97	57	97
Phosphorus	42	44	55	18
Potassium	42	41	55	17
Sulfur	**	**	**	**

** Less than five responses

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

South Central and Southeastern BMP Regions: Wheat Following Corn

There were 5 fields that were included in the SC and SE BMP regions for the wheat following corn analysis. Figure 26 details the location, average rate of nitrogen, phosphorus, potassium, and sulfur fertilizer and average yield for wheat following corn in the SC and SE BMP regions.²³

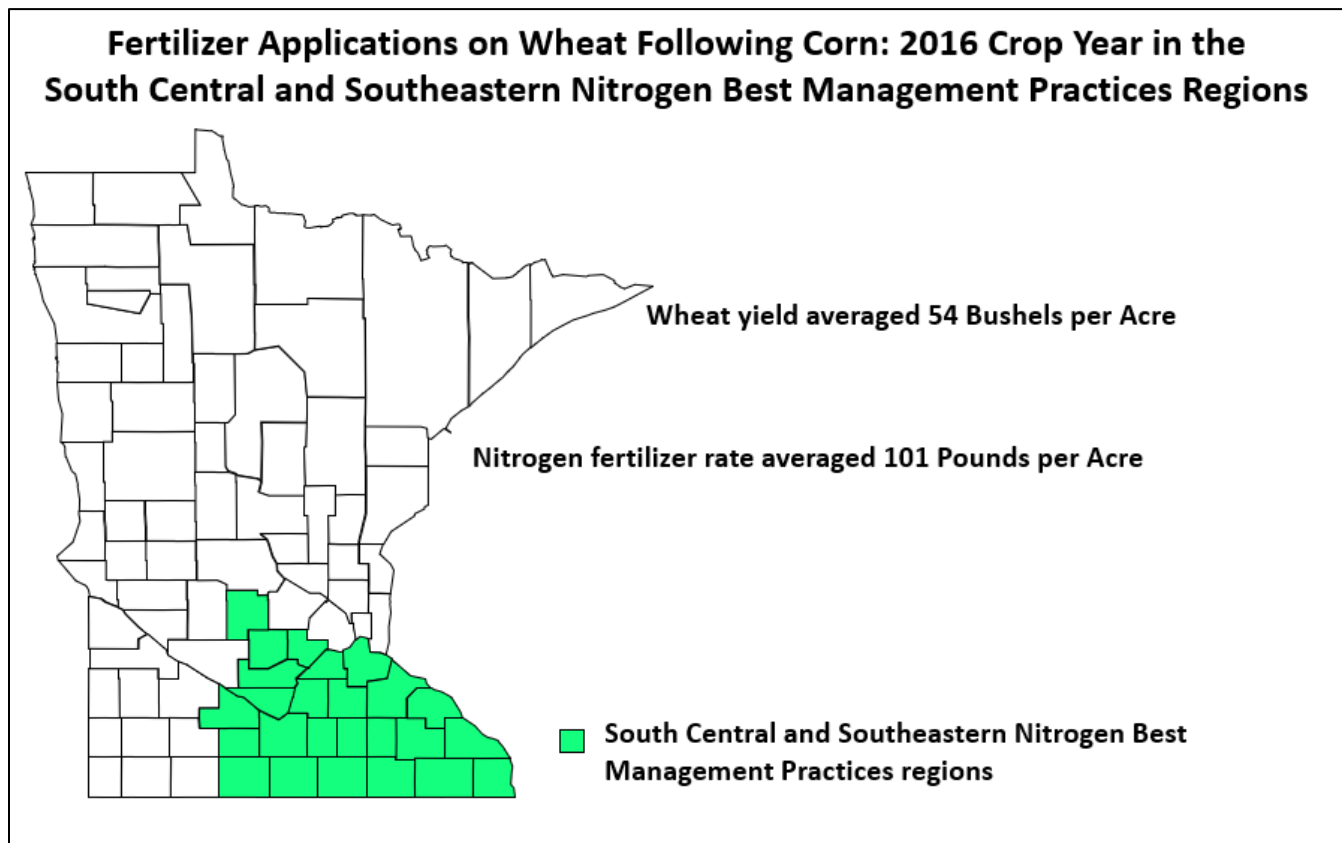


Figure 26. The average wheat yield and average fertilizer rate for wheat following corn in the SC and SE BMP regions.

²³ The published averages are for respondents that applied commercial fertilizer on wheat fields without manure to the 2016 wheat crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen on fields with wheat following corn. Less than five respondents reported applying phosphorus, potassium, or sulfur.

Figure 27 provides the distribution of average nitrogen fertilizer rate in the SC and SE BMP regions for wheat following corn; the corresponding wheat yield is detailed in red.²⁴ Nitrogen rates are only from commercial fertilizer.

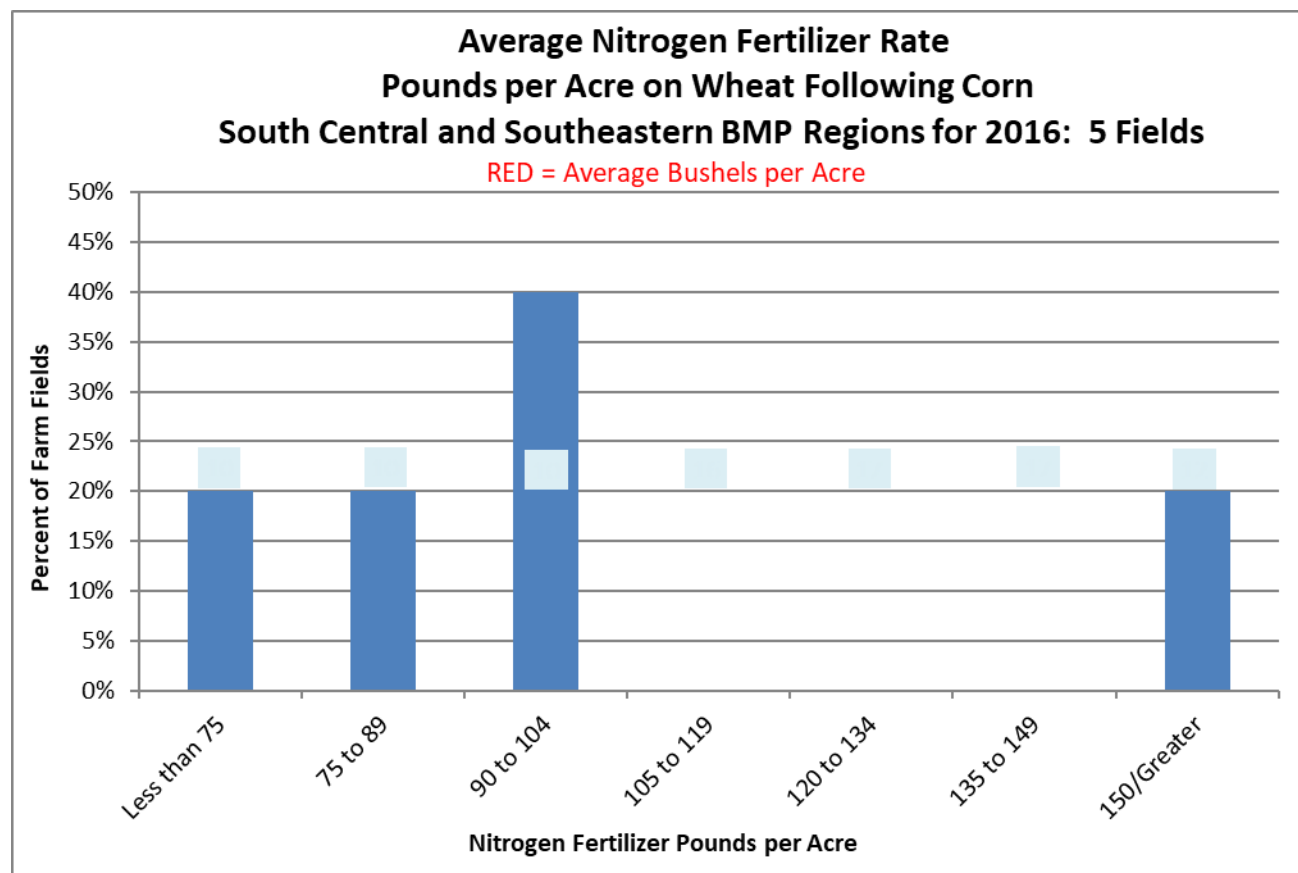


Figure 27. Average nitrogen fertilizer rate and yield on wheat following corn in the SC and SE BMP regions for 2016: 5 fields.

In the SC and SE BMP regions, the percent of fertilized wheat 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 wheat following corn are shown in Table 61.

Table 61. Average fertilizer rate and wheat yield in SC and SE BMP regions for wheat following corn.

Nutrients Applied	Percent of Fertilized Wheat Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Wheat Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Wheat Fields Pounds per Acre
Nitrogen	100	101	54	101
Phosphorus	**	**	**	**
Potassium	**	**	**	**
Sulfur	**	**	**	**

** Less than five responses

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

Southwestern and West Central BMP Region: Wheat Following Corn

There were 10 fields that were included in the SW BMP region for wheat following corn analysis. Figure 28 details the location, average rate of nitrogen, phosphorus, potassium, and sulfur fertilizer and average yield for wheat following corn in the SW BMP region.²⁵

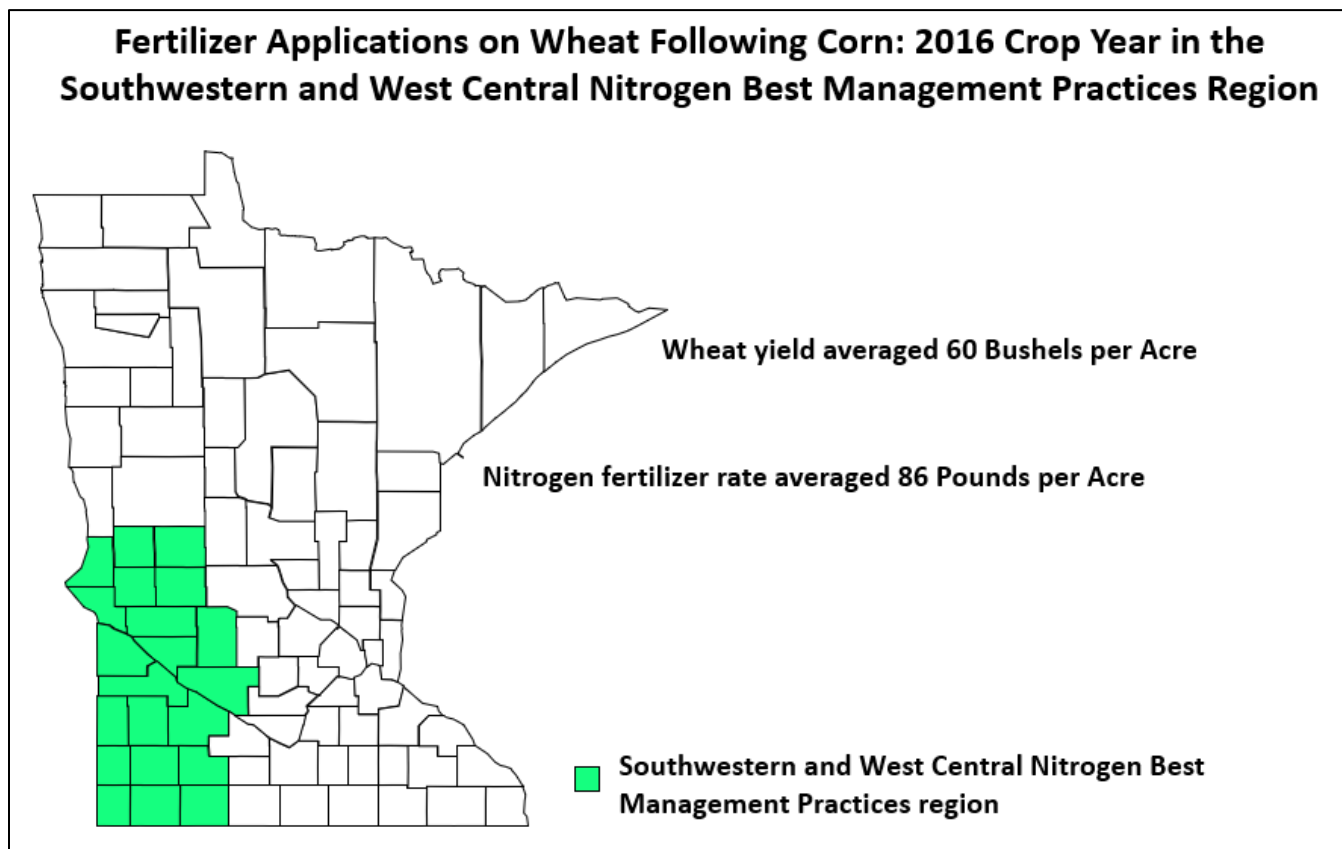


Figure 28. The wheat yield averaged 60 bushels per acre and the nitrogen fertilizer rate averaged 86 pounds per acre on fields with wheat following corn in the SW BMP region.

²⁵ The published averages are for respondents that applied commercial fertilizer on wheat fields without manure to the 2016 wheat crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen on fields with wheat following corn. Less than five respondents reported applying phosphorus, potassium, or sulfur.

Figure 29 provides the distribution of nitrogen fertilizer rate in the SW BMP region for wheat following corn; the corresponding wheat yield is detailed in red.²⁶

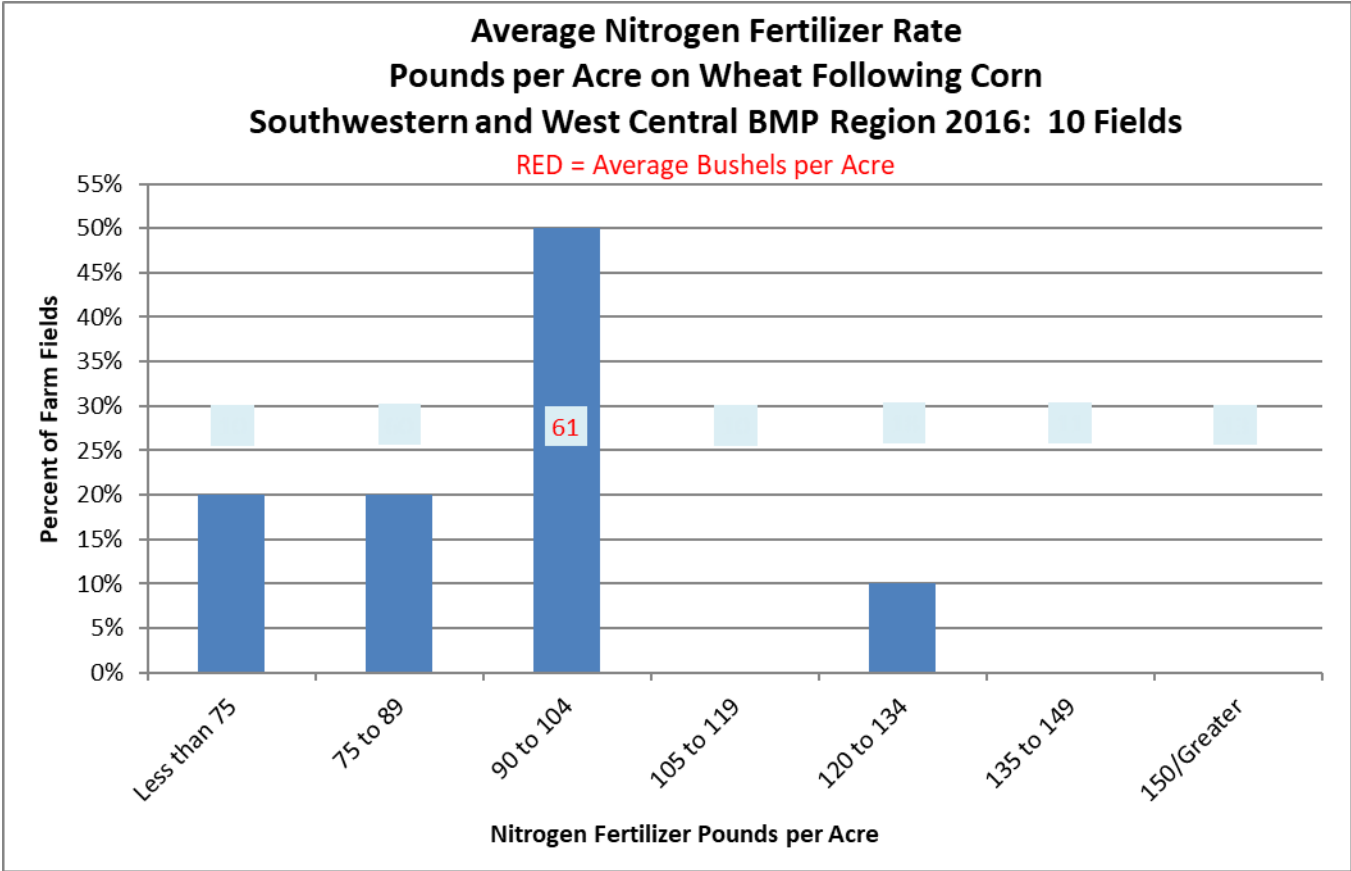


Figure 29. Average nitrogen fertilizer rate and yield on wheat following corn in the SW BMP region for 2016: 10 fields.

In the SW BMP region, the percent of fertilized wheat 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 wheat following corn are shown in Table 62.

Table 62. Average fertilizer rate and wheat yield in SW BMP region for wheat following corn.

Nutrients Applied	Percent of Fertilized Wheat Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Wheat Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Wheat Fields Pounds per Acre
Nitrogen	100	86	60	86
Phosphorus	**	**	**	**
Potassium	**	**	**	**
Sulfur	**	**	**	**

** Less than five responses

²⁶ Yields are not published if there are less than five responses.

Northwestern BMP Region: Wheat Following Corn

The NW BMP region had less than five responses for wheat following corn.

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

The IRR BMP region had less than five responses for wheat following corn.

Statewide: Wheat Following Alfalfa

Statewide, no responses for wheat following alfalfa.

Statewide: Wheat Following Small Grains

Statewide, seven percent of the fields reported were wheat following small grains. Figure 30 details the BMP regions where farmers reported on fields with wheat following small grains. There were 19 fields surveyed in Minnesota.²⁷

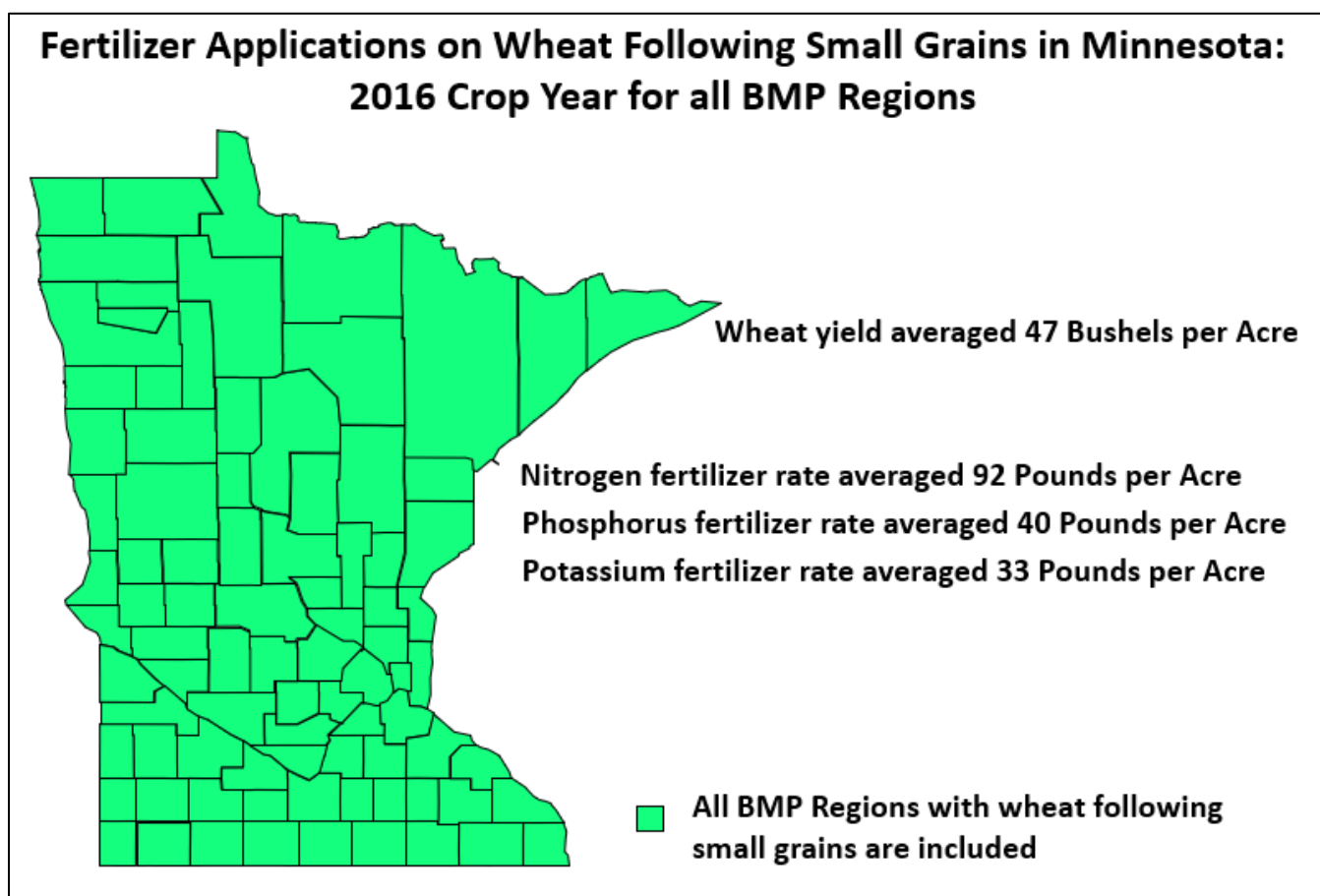


Figure 30. The average wheat yield and average fertilizer rate for wheat following small grains in Minnesota.

²⁷ The published averages are for respondents that applied commercial fertilizer on wheat fields without manure to the 2016 wheat crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 58% applied phosphorus, and 42% applied potassium on fields with wheat following small grains. Less than five respondents reported applying sulfur.

Figure 31 provides the distribution of average nitrogen fertilizer rate in Minnesota for wheat following small grains; the corresponding wheat yield is detailed in red.²⁸ Nitrogen rates are only from commercial fertilizer.

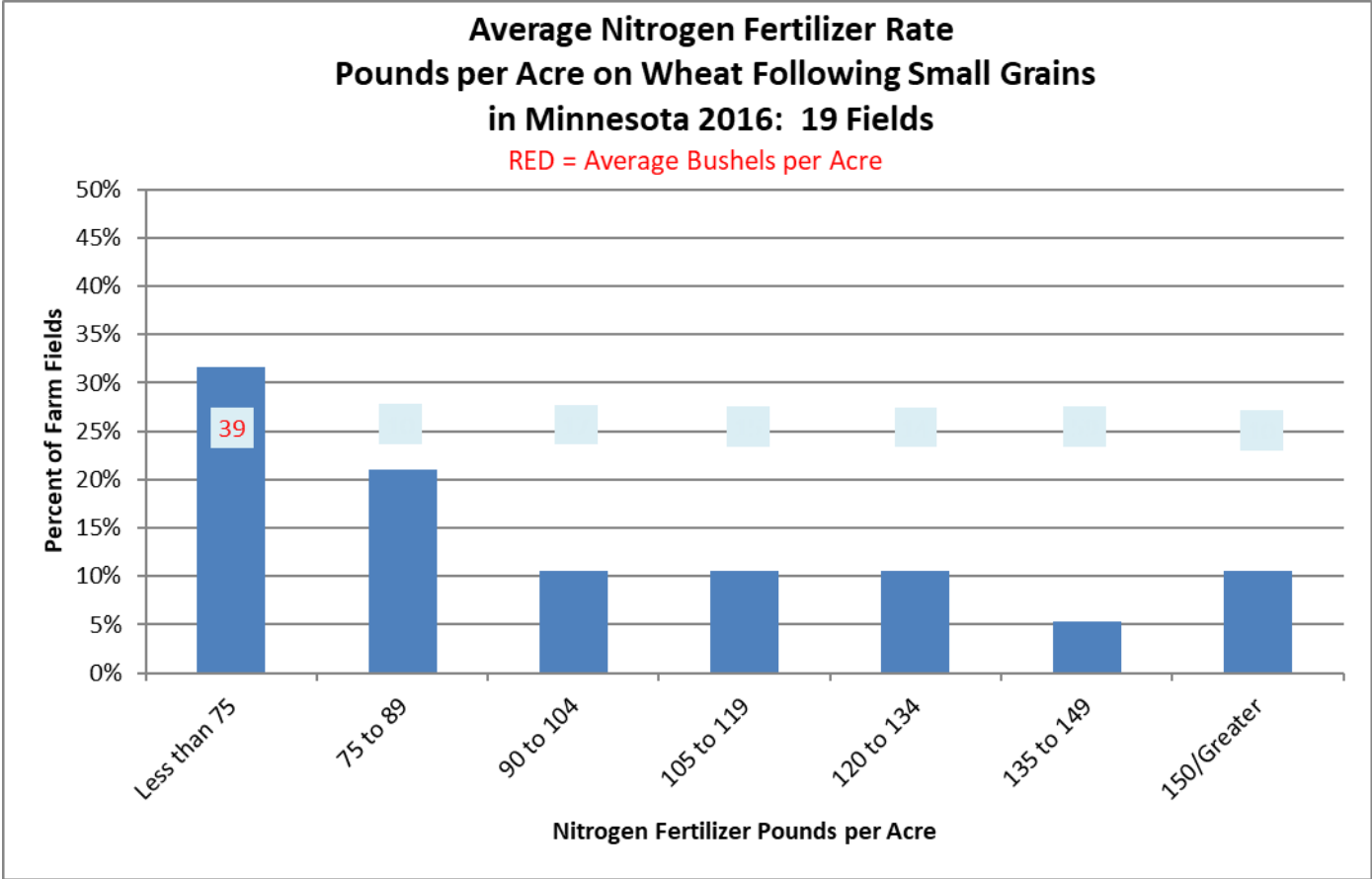


Figure 31. Average nitrogen fertilizer rate and yield on wheat following small grains in Minnesota for 2016: 19 fields.

In Minnesota, the percent of fertilized wheat 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 wheat following small grains are shown in Table 63.

Table 63. Average fertilizer rate and wheat yield in Minnesota for wheat following small grains.

Nutrients Applied	Percent of Fertilized Wheat Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Wheat Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Wheat Fields Pounds per Acre
Nitrogen	100	92	47	92
Phosphorus	58	40	46	23
Potassium	42	33	43	14
Sulfur	**	**	**	**

** Less than five responses

²⁸ Yields are not published if there are less than five responses.

South Central and Southeastern BMP Region: Wheat Following Small Grains

The SC and SE BMP region had less than five responses for wheat following small grains.

Southwestern and West Central BMP Region: Wheat Following Small Grains

The SW BMP region had less than five responses for wheat following small grains.

Northwestern BMP Region: Wheat Following Small Grains

There were 8 fields that were included in the NW BMP region for wheat following small grains analysis. Figure 32 details the location, average rate of nitrogen, phosphorus, potassium, and sulfur fertilizer and average yield for wheat following small grains in the NW BMP region.²⁹

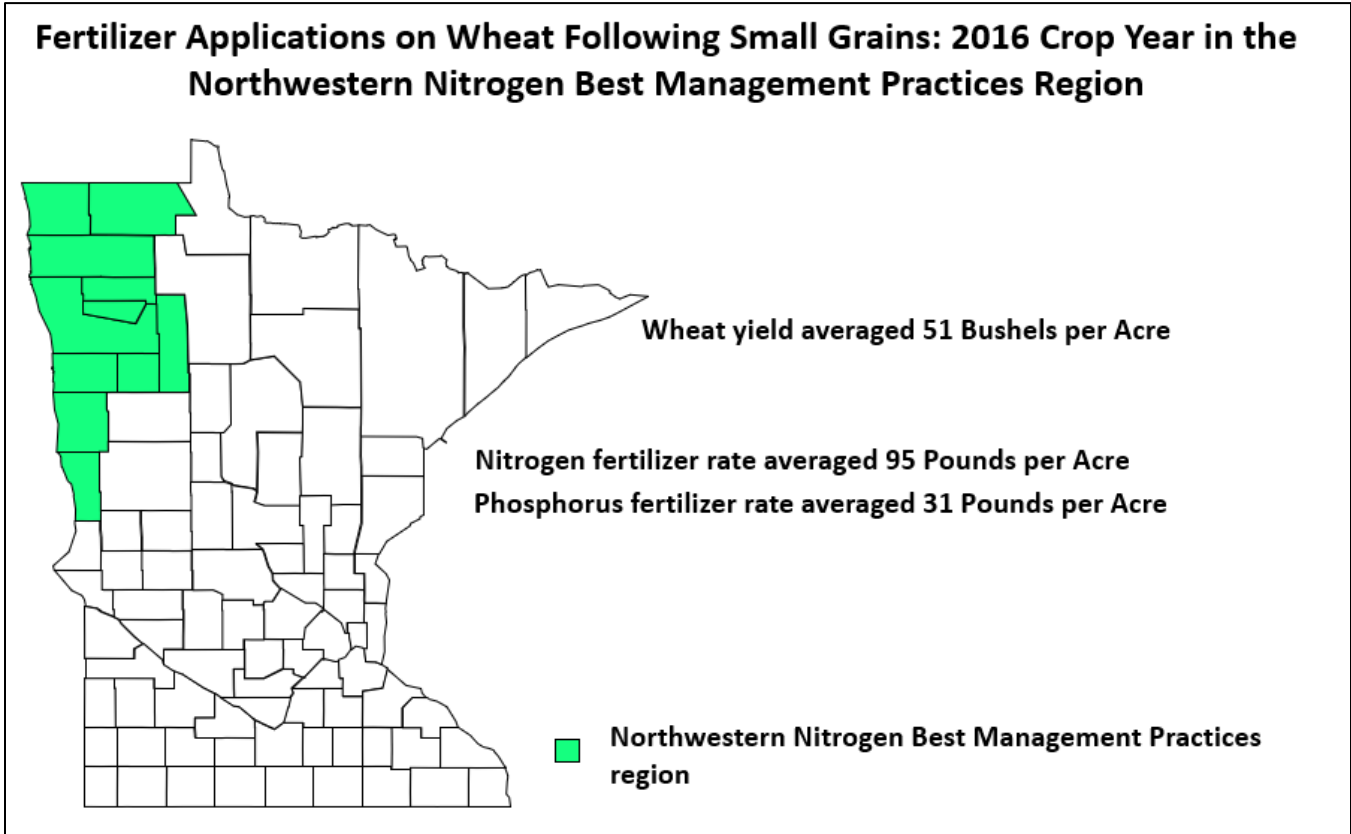


Figure 32. The average wheat yield and average fertilizer rate for wheat following small grains in the NW BMP region.

²⁹ The published averages are for respondents that applied commercial fertilizer on wheat fields without manure to the 2016 wheat crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen and 75% applied phosphorus on fields with wheat following small grains. Less than five respondents reported applying potassium or sulfur.

Figure 33 provides the distribution of nitrogen fertilizer rate in the NW BMP region for wheat following small grains; the corresponding wheat yield is detailed in red.³⁰

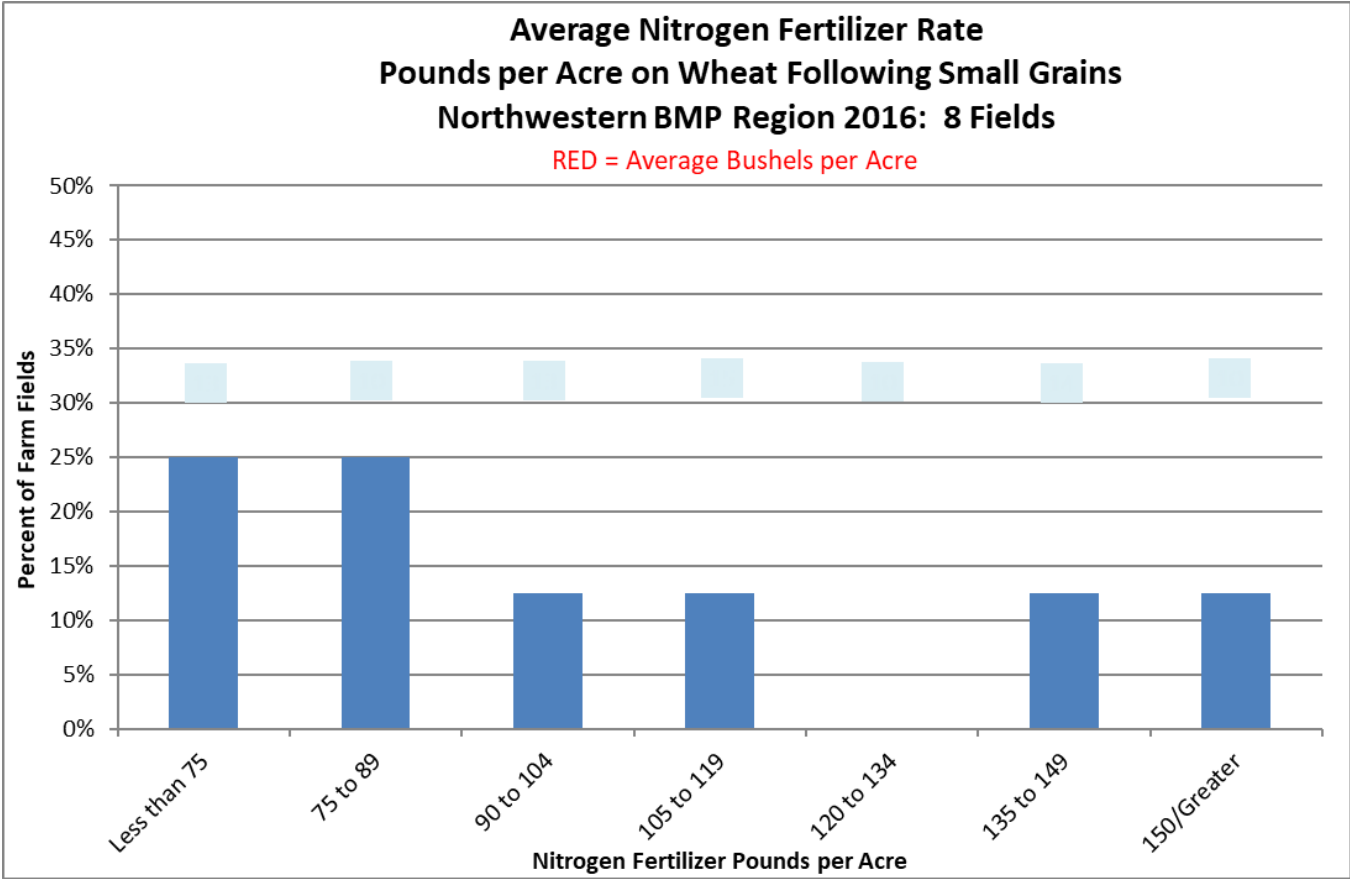


Figure 33. Average nitrogen fertilizer rate and yield on wheat following small grains in the NW BMP region for 2016: 8 fields.

In the NW BMP region, the percent of fertilized wheat 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 wheat following small grains are shown in Table 64.

Table 64. Average fertilizer rate and wheat yield in the NW BMP region for wheat following small grains.

Nutrients Applied	Percent of Fertilized Wheat Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Wheat Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Wheat Fields Pounds per Acre
Nitrogen	100	95	51	95
Phosphorus	75	31	46	22
Potassium	**	**	**	**
Sulfur	**	**	**	**

** Less than five responses

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

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

There were 5 fields that were included in the IRR BMP region for wheat following small grains analysis. Figure 34 details the location, average rate of nitrogen, phosphorus, potassium, and sulfur fertilizer and average yield for wheat following small grains in the IRR BMP region.³¹

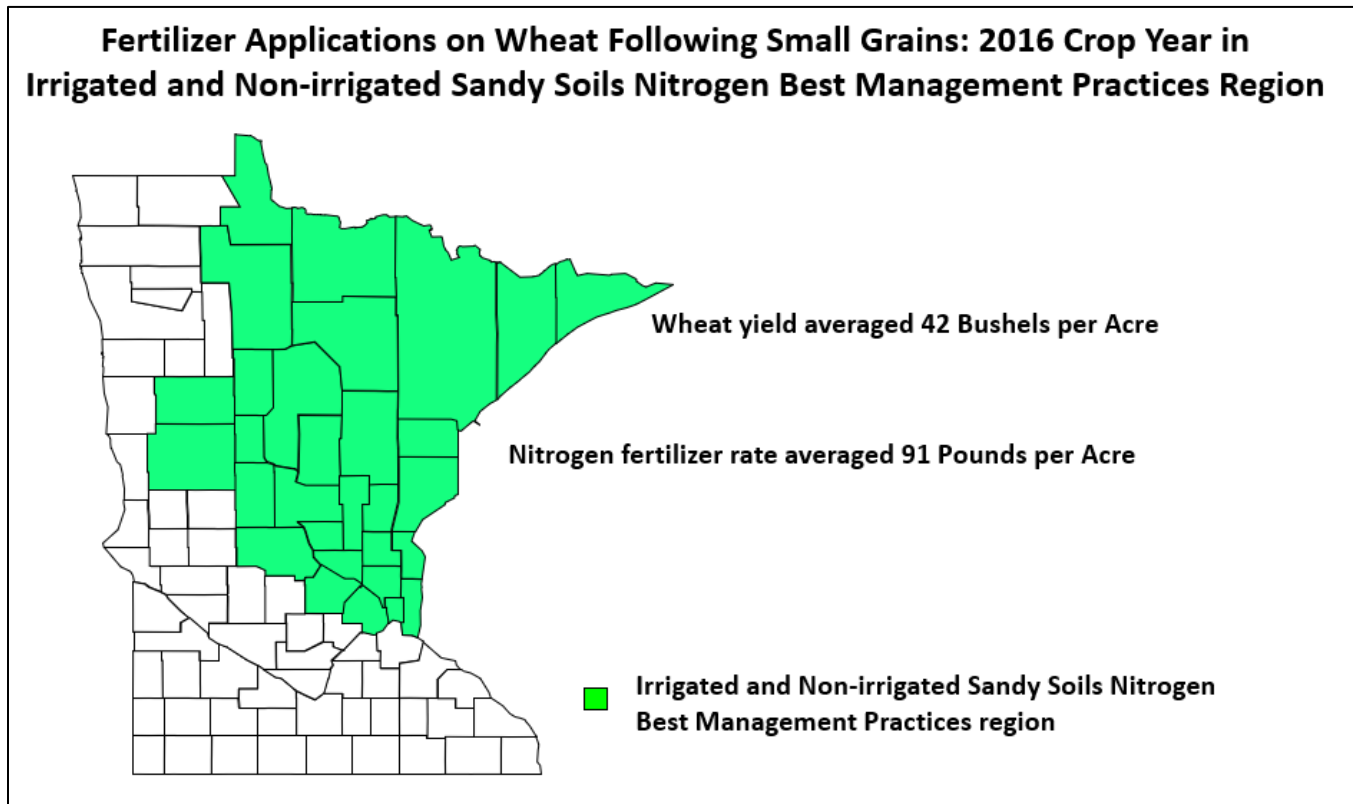


Figure 34. The average wheat yield and average fertilizer rate for wheat following small grains in the IRR BMP region.

³¹ The published averages are for respondents that applied commercial fertilizer on wheat fields without manure to the 2016 wheat crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen on fields with wheat following small grains. Less than five respondents reported applying phosphorus, potassium or sulfur.

Figure 35 provides the distribution of nitrogen fertilizer rate in the IRR BMP region for wheat following small grains; the corresponding wheat yield is detailed in red.³²

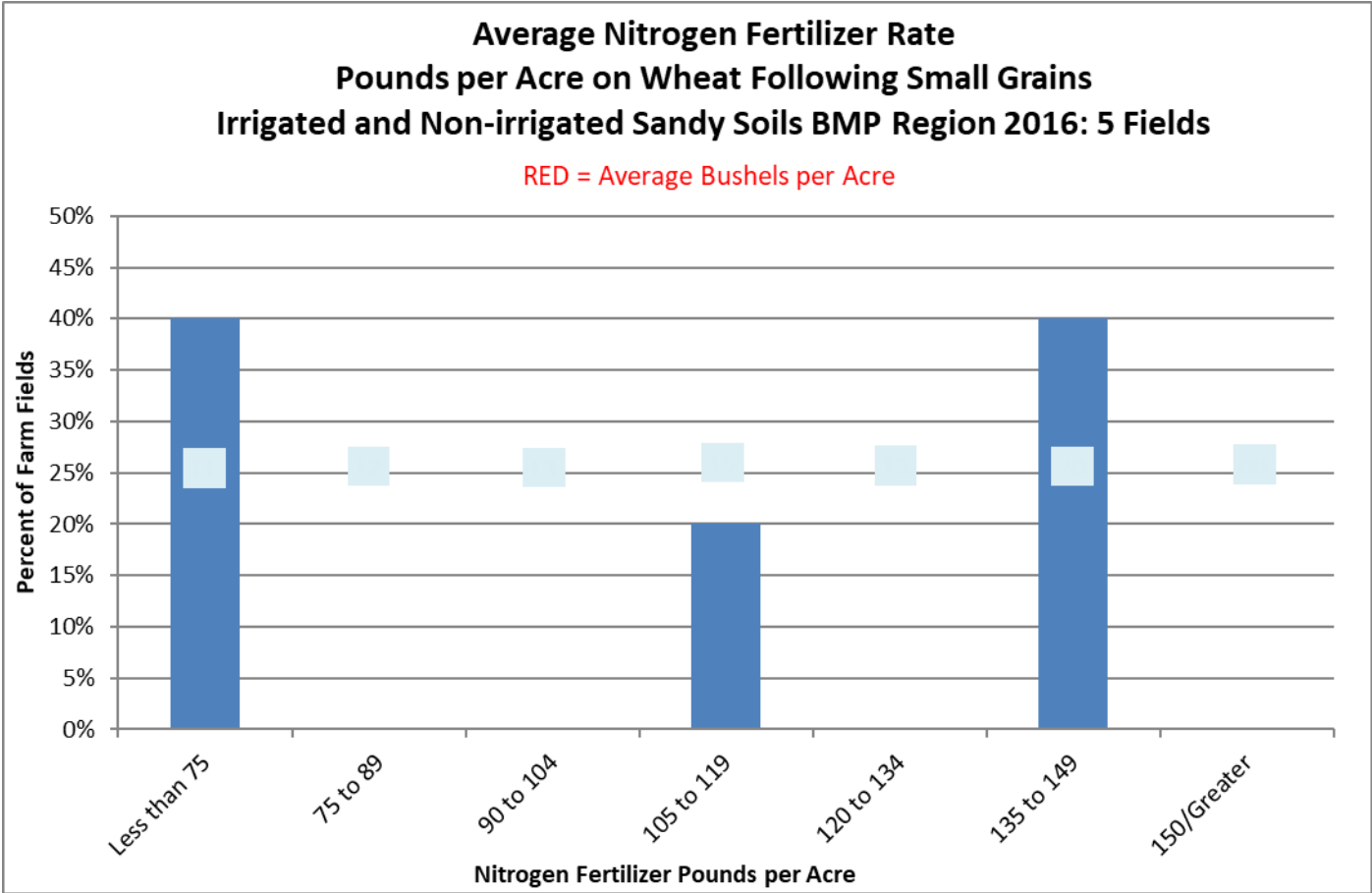


Figure 35. Average nitrogen fertilizer rate and yield on wheat following small grains in the IRR BMP region for 2016: 5 fields.

In the IRR BMP region, the percent of fertilized wheat 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 wheat following small grains are shown in Table 65.

Table 65. Average fertilizer rate and wheat yield in the IRR BMP region for wheat following small grains.

Nutrients Applied	Percent of Fertilized Wheat Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Wheat Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Wheat Fields Pounds per Acre
Nitrogen	100	91	42	91
Phosphorus	**	**	**	**
Potassium	**	**	**	**
Sulfur	**	**	**	**

** Less than five responses

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

Statewide: Wheat Following Other Crops

Statewide, three percent of the fields reported were wheat following small grains. Figure 36 details the BMP regions where farmers reported on fields with wheat following other crops. There were 9 fields surveyed in Minnesota.³³

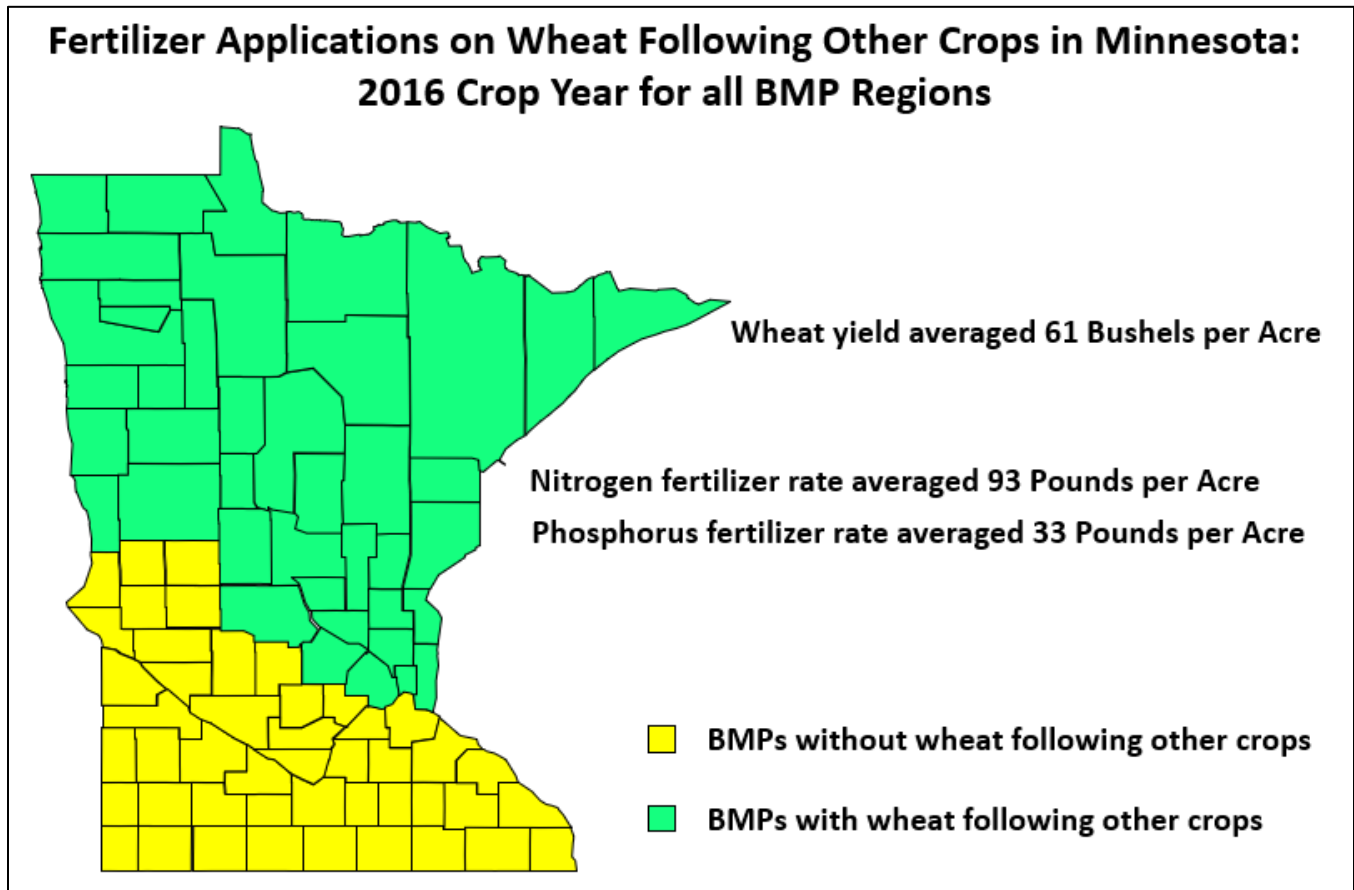


Figure 36. The average wheat yield and average fertilizer rate for wheat following other crops in Minnesota.

³³ The published averages are for respondents that applied commercial fertilizer on wheat fields without manure to the 2016 wheat crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen and 67% applied phosphorus on fields with wheat following other crops. Less than five respondents reported applying potassium or sulfur.

Figure 37 provides the distribution of average nitrogen fertilizer rate in Minnesota for wheat following other crops; the corresponding wheat yield is detailed in red.³⁴ Nitrogen rates are only from commercial fertilizer.

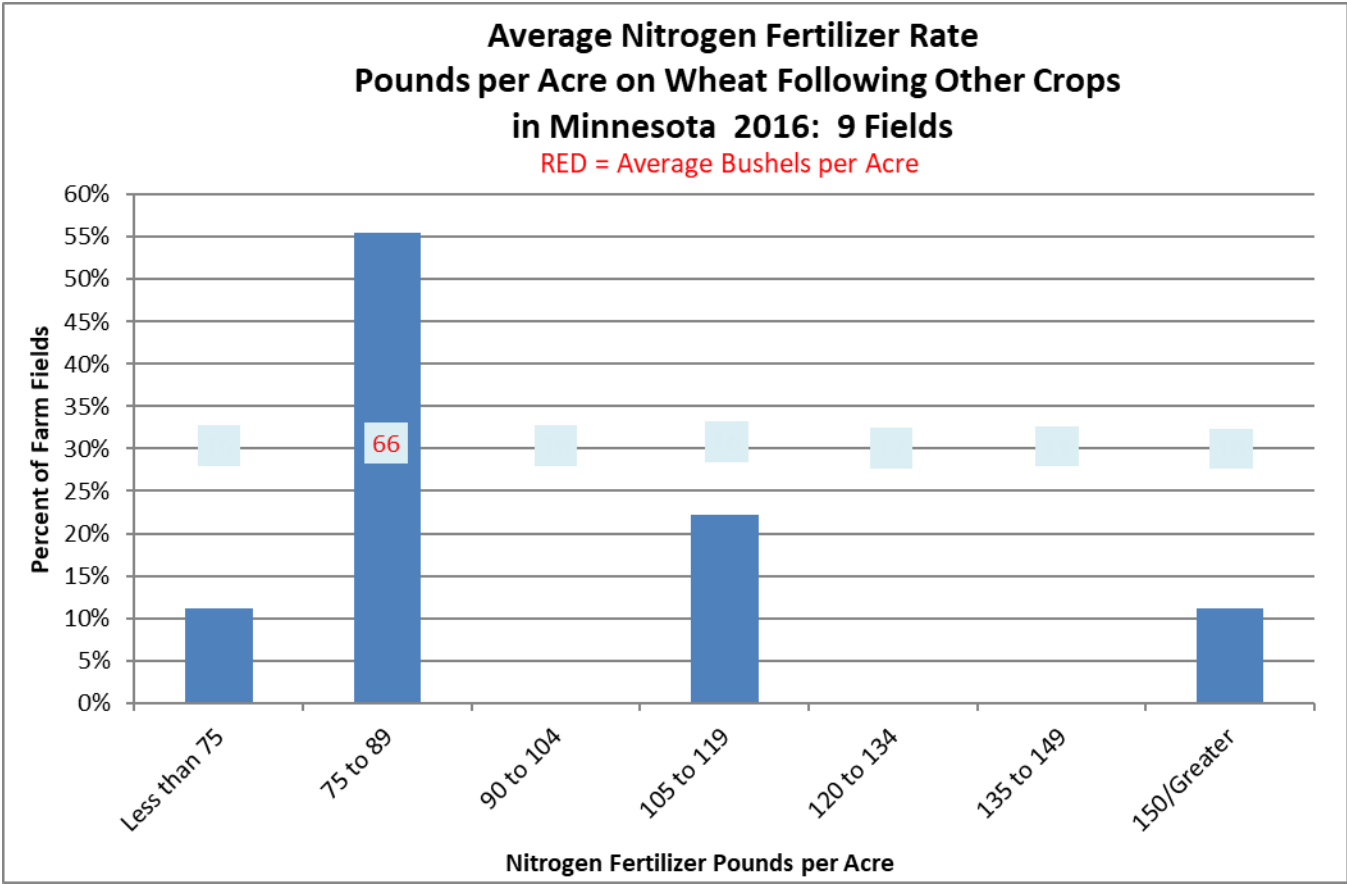


Figure 37. Average nitrogen fertilizer rate and yield on wheat following other crops in Minnesota for 2016: 9 fields.

In Minnesota, the percent of fertilized wheat 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 wheat following other crops are shown in Table 66.

Table 66. Average fertilizer rate and wheat yield in Minnesota for wheat following other crops.

Nutrients Applied	Percent of Fertilized Wheat Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Wheat Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Wheat Fields Pounds per Acre
Nitrogen	100	93	61	93
Phosphorus	67	33	63	22
Potassium	**	**	**	**
Sulfur	**	**	**	**

** Less than five responses

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

South Central and Southeastern BMP Region: Wheat Following Other Crops

The SC and SE BMP region had no responses for wheat following other crops.

Southwestern and West Central BMP Region: Wheat Following Other Crops

The SW BMP region had no responses for wheat following other crops.

Northwestern BMP Region: Wheat Following Other Crops

There were 8 fields that were included in the NW BMP region for wheat following other crops analysis. Figure 38 details the location, average rate of nitrogen, phosphorus, potassium, and sulfur fertilizer and average yield for wheat following other crops in the NW BMP region.³⁵

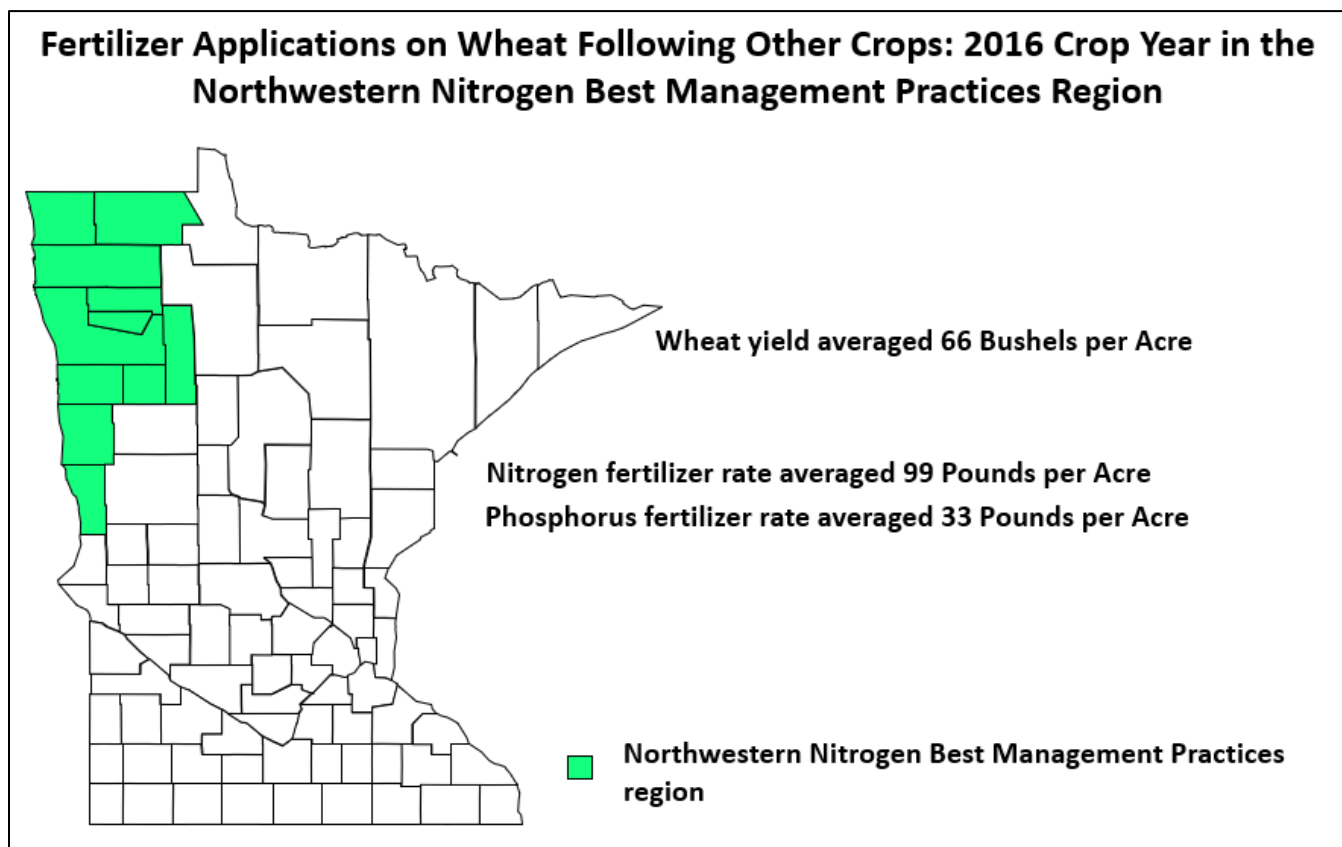


Figure 38. The average wheat yield and average fertilizer rate for wheat following other crops in the NW BMP region.

³⁵ The published averages are for respondents that applied commercial fertilizer on wheat fields without manure to the 2016 wheat crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen and 67% applied phosphorus on fields with wheat following other crops. Less than five respondents reported applying potassium or sulfur.

Figure 39 provides the distribution of average nitrogen fertilizer rate in the NW BMP region for wheat following other crops; the corresponding wheat yield is detailed in red.³⁶ Nitrogen rates are only from commercial fertilizer.

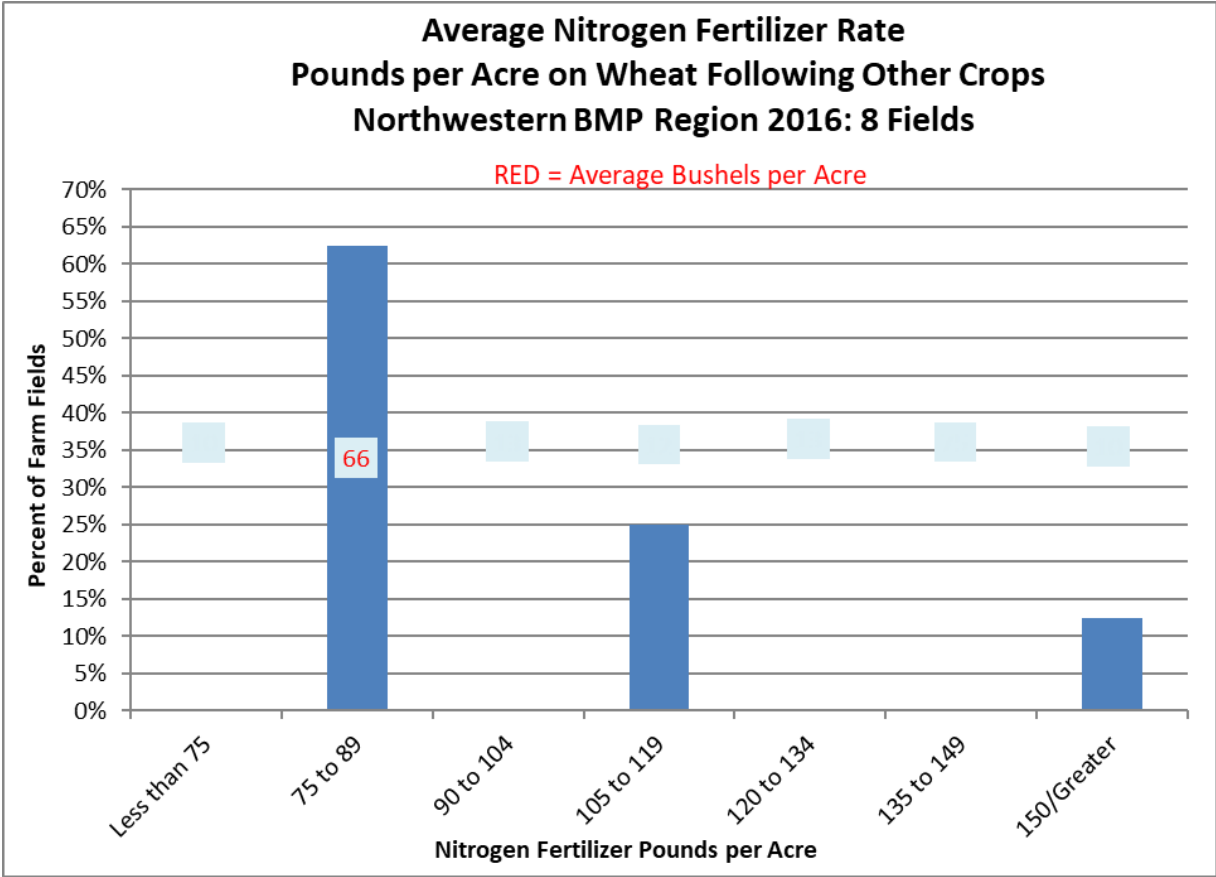


Figure 39. Average nitrogen fertilizer rate and yield on wheat following other crops in the NW BMP region for 2016: 8 fields.

In the NW BMP region, the percent of fertilized wheat 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 wheat following other crops are shown in Table 67.

Table 67. Average fertilizer rate and wheat yield in the NW BMP region for wheat following other crops.

Nutrients Applied	Percent of Fertilized Wheat Fields	Average Nutrient Rate on Fields Treated with Same Nutrient Pounds per Acre	Average Wheat Yield Bushels per Acre	Average Commercial Nutrient Rate Across All Fertilized Wheat Fields Pounds per Acre
Nitrogen	100	93	61	93
Phosphorus	75	33	63	25
Potassium	**	**	**	**
Sulfur	**	**	**	**

** Less than five responses

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

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

The IRR BMP region had less than five responses for wheat following other crops.

Soybean Section

Farmers in the survey were first asked “How many acres of soybeans did you plant?” Table 68 details the number of farmers and corresponding soybean acres planted by BMP region for the 2016 crop year (SAQ-1³⁷).

Table 68. Summary of respondents and corresponding soybean acres planted by BMP region for the 2016 crop year.

BMP Region	Number of Respondents	Number of Soybean Acres
Northwestern	259	156,597
Irrigated and Non-irrigated Sandy Soils	379	74,741
South Western and West Central	525	173,661
South Central	439	124,026
Southeastern	194	27,560
Statewide	1,796	556,585

Farmers in the survey were then asked, “Do you have a soybean field without manure?” Table 69 details the percent of farmers who had a soybean field without manure applied by BMP region (SFQ-1). Farmers that answered no to this question applied manure on all their soybean fields for the 2016 growing year.

Table 69. Percent of respondents with a soybean field without manure applied.

BMP Region	Soybean Field Without Manure Applied	Percent of Respondents
Northwestern	Yes	89
Northwestern	No	11
Irrigated and Non-irrigated Sandy Soils	Yes	94
Irrigated and Non-irrigated Sandy Soils	No	6
South Western and West Central	Yes	87
South Western and West Central	No	13
South Central	Yes	89
South Central	No	11
Southeastern	Yes	92
Southeastern	No	8
Statewide	Yes	90
Statewide	No	10

³⁷ 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 70 details the number of respondents and all soybean acres who reported having a field without manure applied to the 2016 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 fertilizer with soybeans. Excluded are acres from farmers from Table 68 who applied manure on all soybean acres. Farmers with only manured acres will be excluded from fertilizer analysis from this point forward.

Table 70. Summary of respondents and corresponding soybean acres by BMP region for all fields without manure applied in the fall of 2015 or anytime in the 2016 crop year.

BMP Region	Number of Respondents	Number of Soybean Acres
Northwestern	231	142,283
Irrigated and Non-irrigated Sandy Soils	356	69,086
South Western and West Central	457	148,926
South Central	393	109,653
Southeastern	179	23,676
Statewide	1,616	493,624

All soybean fields without manure applied are included in the analysis for the following table. There were 1,616 soybean fields in the commercial fertilizer analysis.

Farmers were then told by the phone enumerator³⁸ “I will now ask you about your fertilizer inputs on your soybean acres. First on a soybean field with no manure. Think about your largest soybean field that you planted in 2016 without any manure.” 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 71 details the percent of farmers who had irrigated their largest soybean field without manure applied by BMP region (SFQ-2).

Table 71. Percent of respondents who irrigated their 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	4
Irrigated and Non-irrigated Sandy Soils	No	96
South Western and West Central	Yes	4
South Western and West Central	No	96
South Central	Yes	1
South Central	No	99
Southeastern	Yes	5
Southeastern	No	95
Statewide	Yes	3
Statewide	No	97

³⁸ 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 2015 before the 2016 soybean crop?” Table 72 details the previous crop planted before the current soybean crop by BMP region and corresponding yield (SFQ-3, SFQ-3b and SFQ-5). For the previous crop of corn/alfalfa, the definition would be soybeans in 2016, corn in 2015 and alfalfa in 2014. 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 39 bushels per acre in the Northwestern BMP region, 43 bushels per acre in the Irrigated and Non-irrigated Sandy Soils BMP region, 50 bushels per acre in the South Western and West Central BMP region, 53 bushels per acre in the South Central BMP region and 53 bushels per acre. The average soybean yield across all soybean fields in Minnesota was 48 bushels per acre.

Table 72. Percent of fields by previous crop and the corresponding soybean yield in 2016.

BMP Region	Previous Crop	Percent of Fields	Average Soybean Yield Bushels per Acre
Northwestern	Soybeans	15	38
Northwestern	Corn	30	41
Northwestern	Corn/Alfalfa	**	**
Northwestern	Small Grains	41	38
Northwestern	Other	14	37
Irrigated and Non-irrigated Sandy Soils	Soybeans	15	39
Irrigated and Non-irrigated Sandy Soils	Corn	71	44
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	2	42
Irrigated and Non-irrigated Sandy Soils	Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	10	40
Irrigated and Non-irrigated Sandy Soils	Other	2	41
South Western and West Central	Soybeans	4	46
South Western and West Central	Corn	91	50
South Western and West Central	Corn/Alfalfa	**	**
South Western and West Central	Small Grains	4	47
South Western and West Central	Other	1	48
South Central	Soybeans	3	50
South Central	Corn	94	54
South Central	Corn/Alfalfa	**	**
South Central	Alfalfa	**	**
South Central	Small Grains	1	53
South Central	Other	**	**
Southeastern	Soybeans	**	**
Southeastern	Corn	96	52
Southeastern	Corn/Alfalfa	**	**
Southeastern	Other	**	**
Statewide	Soybeans	7	41
Statewide	Corn	79	50
Statewide	Corn/Alfalfa	1	45
Statewide	Alfalfa	**	**
Statewide	Small Grains	9	40
Statewide	Other	3	41

** Less than five responses

Commercial Fertilizer Applications on Soybeans

Farmers were then asked, “Was any commercial fertilizer applied to this soybean field for the 2016 soybean crop?” Table 73 details the percent of non-manured soybean fields applied with commercial fertilizer (SFQ-6).

Table 73. Commercial fertilizer applied to non-manured soybean fields.

BMP Region	Fertilizer Applied	Percent of Respondents
Northwestern	Yes	48
Northwestern	No	52
Irrigated and Non-irrigated Sandy Soils	Yes	52
Irrigated and Non-irrigated Sandy Soils	No	48
South Western and West Central	Yes	29
South Western and West Central	No	71
South Central	Yes	22
South Central	No	78
Southeastern	Yes	36
Southeastern	No	64
Statewide	Yes	36
Statewide	No	64

There were 1,616 soybean fields in the commercial fertilizer analysis and farmers provided complete information for all 1,616 fields. Of the 1,616 farmers that reported complete data, 580 farmers reported applying fertilizer that included the nutrient rate and timing on their soybean fields. The following soybean fertilizer tables are based on those 580 fields.

Farmers were asked “Was any commercial fertilizer applied to this soybean field with a variable rate or more than one rate such as by management zone or grid?” Table 74 details the percent of respondents using variable rate commercial fertilizer applied by BMP region on their largest soybean field (SFQ-7).

Table 74. Variable rate commercial fertilizer application by BMP region on the farmers 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	12
Irrigated and Non-irrigated Sandy Soils	One Rate	88
South Western and West Central	Variable Rate	33
South Western and West Central	One Rate	67
South Central	Variable Rate	29
South Central	One Rate	71
Southeastern	Variable Rate	30
Southeastern	One Rate	70
Statewide	Variable Rate	23
Statewide	One Rate	77

Table 75 details the percent of all surveyed soybean fields with fertilizer applications and the percent of fertilized fields treated with nitrogen, phosphorus, potassium, and sulfur by BMP region (SFQ-6 and SFQ-FERT TABLE).

Table 75. 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 Surveyed 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	48	96	89	63	14
Irrigated and Non-irrigated Sandy Soils	52	66	54	91	23
South Western and West Central	29	89	86	77	12
South Central	22	67	66	87	11
Southeastern	36	58	53	91	16
Statewide	36	76	70	82	16

Table 76 details the percent of all surveyed 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, 76% 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 76. The percent of all surveyed 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	12	11
Irrigated and Non-irrigated Sandy Soils	66	16	11
South Western and West Central	89	16	14
South Central	67	14	9
Southeastern	58	16	9
Statewide	76	15	11

Table 77 details the percent of all surveyed 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 soybean fields by BMP region (SFQ-6 and SFQ-FERT TABLE). Statewide, 70% 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 77. The percent of all surveyed 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	89	36	32
Irrigated and Non-irrigated Sandy Soils	54	33	18
South Western and West Central	86	44	38
South Central	66	37	24
Southeastern	53	40	21
Statewide	70	38	27

Table 78 details the percent of all surveyed 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, 82% of all 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 78. The percent of all surveyed 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	63	39	25
Irrigated and Non-irrigated Sandy Soils	91	63	58
South Western and West Central	77	47	36
South Central	87	60	52
Southeastern	91	66	60
Statewide	82	56	46

Table 79 details the percent of all surveyed 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, 16% of all 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 79. The percent of all surveyed 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	14	11	2
Irrigated and Non-irrigated Sandy Soils	23	12	3
South Western and West Central	12	9	1
South Central	11	10	1
Southeastern	16	15	2
Statewide	16	12	2

Table 80 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. For the previous crop of corn/alfalfa, the definition would be soybeans in 2016, corn in 2015 and alfalfa in 2014.

Table 80. 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	11	34
Northwestern	Corn	12	40
Northwestern	Corn/Alfalfa	**	**
Northwestern	Small Grains	11	39
Northwestern	Other	13	35
Irrigated and Non-irrigated Sandy Soils	Soybeans	14	38
Irrigated and Non-irrigated Sandy Soils	Corn	18	45
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	13	43
Irrigated and Non-irrigated Sandy Soils	Other	15	39
South Western and West Central	Soybeans	24	45
South Western and West Central	Corn	16	51
South Western and West Central	Small Grains	13	46
South Western and West Central	Other	**	**
South Central	Soybeans	**	**
South Central	Corn	14	56
South Central	Small Grains	**	**
South Central	Other	**	**
Southeastern	Corn	16	55
Statewide	Soybeans	15	38
Statewide	Corn	16	50
Statewide	Corn/Alfalfa	10	43
Statewide	Small Grains	12	41
Statewide	Other	13	37

** Less than five responses

Table 81 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. For the previous crop of corn/alfalfa, the definition would be soybeans in 2016, corn in 2015 and alfalfa in 2014.

Table 81. 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	33	34
Northwestern	Corn	41	40
Northwestern	Corn/Alfalfa	**	**
Northwestern	Small Grains	39	37
Northwestern	Other	33	35
Irrigated and Non-irrigated Sandy Soils	Soybeans	32	37
Irrigated and Non-irrigated Sandy Soils	Corn	34	45
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	43	29
Irrigated and Non-irrigated Sandy Soils	Other	**	**
South Western and West Central	Soybeans	45	45
South Western and West Central	Corn	44	51
South Western and West Central	Small Grains	46	35
South Western and West Central	Other	**	**
South Central	Soybeans	**	**
South Central	Corn	38	56
South Central	Small Grains	**	**
South Central	Other	**	**
Southeastern	Corn	40	55
Statewide	Soybeans	35	38
Statewide	Corn	40	50
Statewide	Corn/Alfalfa	**	**
Statewide	Small Grains	35	41
Statewide	Other	36	37

** Less than five responses

Table 82 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. For the previous crop of corn/alfalfa, the definition would be soybeans in 2016, corn in 2015 and alfalfa in 2014.

Table 82. 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	43	35
Northwestern	Corn	40	40
Northwestern	Corn/Alfalfa	**	**
Northwestern	Small Grains	42	39
Northwestern	Other	28	35
Irrigated and Non-irrigated Sandy Soils	Soybeans	68	38
Irrigated and Non-irrigated Sandy Soils	Corn	64	45
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	50	43
Irrigated and Non-irrigated Sandy Soils	Other	57	39
South Western and West Central	Soybeans	53	44
South Western and West Central	Corn	47	50
South Western and West Central	Small Grains	47	45
South Western and West Central	Other	**	**
South Central	Soybeans	**	**
South Central	Corn	60	55
South Central	Alfalfa	**	**
South Central	Small Grains	**	**
South Central	Other	**	**
Southeastern	Corn	66	53
Southeastern	Corn/Alfalfa	**	**
Statewide	Soybeans	58	39
Statewide	Corn	49	58
Statewide	Corn/Alfalfa	43	56
Statewide	Alfalfa	**	**
Statewide	Small Grains	41	45
Statewide	Other	38	36

** Less than five responses

Table 83 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. For the previous crop of corn/alfalfa, the definition would be soybeans in 2016, corn in 2015 and alfalfa in 2014.

Table 83. 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	13	39
Northwestern	Small Grains	12	41
Northwestern	Other	**	**
Irrigated and Non-irrigated Sandy Soils	Soybeans	12	42
Irrigated and Non-irrigated Sandy Soils	Corn	12	48
Irrigated and Non-irrigated Sandy Soils	Corn/Alfalfa	**	**
Irrigated and Non-irrigated Sandy Soils	Small Grains	**	**
Irrigated and Non-irrigated Sandy Soils	Other	**	**
South Western and West Central	Soybeans	**	**
South Western and West Central	Corn	10	53
South Western and West Central	Small Grains	**	**
South Western and West Central	Other	**	**
South Central	Soybeans	**	**
South Central	Corn	10	56
Southeastern	Corn	15	55
Statewide	Soybeans	11	39
Statewide	Corn	12	58
Statewide	Corn/Alfalfa	**	**
Statewide	Small Grains	10	45
Statewide	Other	**	**

Fertilizer Sources and Timing

Table 84 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 applications.

Table 84. Average amount of nitrogen fall applied 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	23	11	39
Irrigated and Non-irrigated Sandy Soils	8	17	48
South Western and West Central	37	16	53
South Central	21	14	56
Southeastern	14	15	57
Statewide	20	14	50

Table 85 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 applications.

Table 85. Average amount of phosphorus fall applied 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	21	39	39
Irrigated and Non-irrigated Sandy Soils	6	36	49
South Western and West Central	37	48	53
South Central	21	49	56
Southeastern	14	46	57
Statewide	19	45	50

Table 86 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 applications.

Table 86. Average amount of potassium fall applied 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	19	45	39
Irrigated and Non-irrigated Sandy Soils	13	64	46
South Western and West Central	35	54	51
South Central	37	70	57
Southeastern	23	79	55
Statewide	24	61	50

Table 87 details the 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 applications.

Table 87. Average amount of sulfur fall applied 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	4	14	53
South Western and West Central	5	11	53
South Central	**	**	**
Southeastern	**	**	**
Statewide	3	12	53

** Less than five responses

Table 88 details the major form of nitrogen fertilizer applied in each BMP region and statewide and the percent of respondents for those forms (SFQ-9). ‘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 88. The major form of nitrogen applied to the field.

BMP Region	Major Form of Fertilizer Containing Nitrogen Applied	Percent of Fertilized Fields
Northwestern	Anhydrous	0
Northwestern	Urea	4
Northwestern	Liquid Nitrogen	0
Northwestern	Other	92
Northwestern	Unknown	0
Northwestern	None	4
Irrigated and Non-irrigated Sandy Soils	Anhydrous	0
Irrigated and Non-irrigated Sandy Soils	Urea	6
Irrigated and Non-irrigated Sandy Soils	Liquid Nitrogen	0
Irrigated and Non-irrigated Sandy Soils	Other	61
Irrigated and Non-irrigated Sandy Soils	Unknown	0
Irrigated and Non-irrigated Sandy Soils	None	33
South Western and West Central	Anhydrous	0
South Western and West Central	Urea	5
South Western and West Central	Liquid Nitrogen	0
South Western and West Central	Other	84
South Western and West Central	Unknown	0
South Western and West Central	None	11
South Central	Anhydrous	0
South Central	Urea	2
South Central	Liquid Nitrogen	0
South Central	Other	64
South Central	Unknown	0
South Central	None	34
Southeastern	Anhydrous	0
Southeastern	Urea	0
Southeastern	Liquid Nitrogen	0
Southeastern	Other	58
Southeastern	Unknown	0
Southeastern	None	42
Statewide	Anhydrous	0
Statewide	Urea	4
Statewide	Liquid	0
Statewide	Other	72
Statewide	Unknown	0
Statewide	None	24

No anhydrous ammonia was applied on soybeans and therefore will not be included in any other analysis in this report.

Table 89 details the major form of nitrogen, average soybean yield, and average soybean yield of the 2016 soybean crop (SFQ-8 and SFQ-9).

Table 89. 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 Pounds per Acre	Average Soybean Yield Bushels per Acre
Northwestern	Urea	19	40
Northwestern	Other	11	38
Irrigated and Non-irrigated Sandy Soils	Urea	20	44
Irrigated and Non-irrigated Sandy Soils	Other	16	43
South Western and West Central	Urea	24	54
South Western and West Central	Other	16	50
South Central	Urea	37	53
South Central	Other	13	56
Southeastern	Urea	**	**
Southeastern	Other	16	55
Statewide	Urea	22	46
Statewide	Other	14	46

** Less than five responses

Table 90 details any commercial fertilizer applied in the fall of 2015 for the 2016 soybean crop (SFQ-FERT TABLE).

Table 90. Commercial fertilizer applied in the fall of 2015 for the 2016 soybean crop.

BMP Region	Any Commercial Fertilizer Application in the Fall of 2015	Percent of Respondents
Northwestern	Yes	13
Northwestern	No	87
Irrigated and Non-irrigated Sandy Soils	Yes	7
Irrigated and Non-irrigated Sandy Soils	No	93
South Western and West Central	Yes	13
South Western and West Central	No	87
South Central	Yes	9
South Central	No	91
Southeastern	Yes	9
Southeastern	No	91
Statewide	Yes	10
Statewide	No	90

Table 91 details the urea applied in the fall of 2015 for the 2016 soybean crop (SFQ-FERT TABLE).

Table 91. Urea applied in the fall of 2015 for the 2016 soybean crop.

BMP Region	Urea Application in the Fall of 2015	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
South Western and West Central	Yes	0
South Western 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 92 details liquid nitrogen fertilizer applied in the fall of 2015 for the 2016 soybean crop (SFQ-FERT TABLE).

Table 92. Liquid nitrogen fertilizer applied in the fall of 2015 for the 2016 soybean crop.

BMP Region	Liquid Nitrogen (28%, 32%) Application in the Fall of 2015	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
South Western and West Central	Yes	0
South Western 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 93 details other fertilizers containing nitrogen applied in the fall of 2015 for the 2016 soybean crop (SFQ-FERT TABLE).

Table 93. Other fertilizers containing nitrogen applied in the fall of 2015 for the 2016 soybean crop.

BMP Region	Other Sources of Fertilizer Containing Nitrogen in the Fall of 2015	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
South Western and West Central	Yes	2
South Western and West Central	No	98
South Central	Yes	1
South Central	No	99
Southeastern	Yes	2
Southeastern	No	98
Statewide	Yes	1
Statewide	No	99

Table 94 details phosphorus fertilizer, such as MAP or DAP, applied in the fall of 2015 for the 2016 soybean crop (SFQ-FERT TABLE).

Table 94. Fertilizer containing phosphorus applied in the fall of 2015 for the 2016 soybean crop.

BMP Region	Phosphorus Application in the Fall of 2015	Percent of Respondents
Northwestern	Yes	21
Northwestern	No	79
Irrigated and Non-irrigated Sandy Soils	Yes	6
Irrigated and Non-irrigated Sandy Soils	No	94
South Western and West Central	Yes	37
South Western and West Central	No	63
South Central	Yes	21
South Central	No	79
Southeastern	Yes	14
Southeastern	No	86
Statewide	Yes	19
Statewide	No	81

Table 95 details potassium fertilizer applied in the fall of 2015 for the 2016 soybean crop (SFQ-FERT TABLE).³⁹

Table 95. Fertilizer containing potassium applied in the fall of 2015 for the 2016 soybean crop.

BMP Region	Potassium Application in the Fall of 2015	Percent of Respondents
Northwestern	Yes	19
Northwestern	No	81
Irrigated and Non-irrigated Sandy Soils	Yes	13
Irrigated and Non-irrigated Sandy Soils	No	87
South Western and West Central	Yes	35
South Western and West Central	No	65
South Central	Yes	37
South Central	No	63
Southeastern	Yes	23
Southeastern	No	77
Statewide	Yes	24
Statewide	No	76

Table 96 details sulfur fertilizer, such as AMS, applied in the fall of 2015 for the 2016 soybean crop (SFQ-FERT TABLE).

Table 96. Fertilizer containing sulfur applied in the fall of 2015 for the 2016 soybean crop.

BMP Region	Sulfur Application in the Fall of 2015	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
South Western and West Central	Yes	5
South Western and West Central	No	95
South Central	Yes	3
South Central	No	97
Southeastern	Yes	2
Southeastern	No	98
Statewide	Yes	3
Statewide	No	97

³⁹ Potassium, also known as potash (0-0-60), does not contain nitrogen.

Table 97 details commercial fertilizer applied in the spring as a preplant for the 2016 soybean crop (SFQ-FERT TABLE).

Table 97. Commercial fertilizer applied in the spring as a preplant for the 2016 soybean crop.

BMP Region	Any Commercial Fertilizer Application as a Preplant in the Spring of 2016	Percent of Respondents
Northwestern	Yes	67
Northwestern	No	33
Irrigated and Non-irrigated Sandy Soils	Yes	70
Irrigated and Non-irrigated Sandy Soils	No	30
South Western and West Central	Yes	49
South Western and West Central	No	51
South Central	Yes	48
South Central	No	52
Southeastern	Yes	70
Southeastern	No	30
Statewide	Yes	67
Statewide	No	33

Table 98 details urea applied in the spring as a preplant for the 2016 soybean crop (SFQ-FERT TABLE).

Table 98. Urea applied in the spring as a preplant for the 2016 soybean crop.

BMP Region	Urea Application as a Preplant in the Spring of 2016	Percent of Respondents
Northwestern	Yes	3
Northwestern	No	97
Irrigated and Non-irrigated Sandy Soils	Yes	3
Irrigated and Non-irrigated Sandy Soils	No	97
South Western and West Central	Yes	3
South Western and West Central	No	97
South Central	Yes	1
South Central	No	99
Southeastern	Yes	0
Southeastern	No	100
Statewide	Yes	2
Statewide	No	98

Table 99 details liquid nitrogen fertilizer applied in the spring as a preplant for the 2016 soybean crop (SFQ-FERT TABLE).

Table 99. Liquid nitrogen fertilizer applied in the spring as a preplant for the 2016 soybean crop.

BMP Region	Liquid Nitrogen (28%, 32%) Application as a Preplant in the Spring of 2016	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
South Western and West Central	Yes	<1
South Western 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 100 details other nitrogen sources applied in the spring as a preplant for the 2016 soybean crop (SFQ-FERT TABLE).

Table 100. Other nitrogen sources applied in the spring as a preplant for the 2016 soybean crop.

BMP Region	Other Sources of Nitrogen Fertilizer as a Preplant in the Spring of 2016	Percent of Respondents
Northwestern	Yes	4
Northwestern	No	96
Irrigated and Non-irrigated Sandy Soils	Yes	3
Irrigated and Non-irrigated Sandy Soils	No	97
South Western and West Central	Yes	3
South Western and West Central	No	97
South Central	Yes	2
South Central	No	98
Southeastern	Yes	2
Southeastern	No	98
Statewide	Yes	3
Statewide	No	97

Table 101 details phosphorus, such as MAP or DAP, applied in the spring as a preplant for the 2016 soybean crop (SFQ-FERT TABLE).

Table 101. Fertilizer containing phosphorus applied in the spring as a preplant for the 2016 soybean crop.

BMP Region	Phosphorus Application as a Preplant in the Spring of 2016	Percent of Respondents
Northwestern	Yes	48
Northwestern	No	52
Irrigated and Non-irrigated Sandy Soils	Yes	35
Irrigated and Non-irrigated Sandy Soils	No	65
South Western and West Central	Yes	39
South Western and West Central	No	61
South Central	Yes	23
South Central	No	77
Southeastern	Yes	23
Southeastern	No	77
Statewide	Yes	36
Statewide	No	64

Table 102 details potassium applied in the spring as a preplant for the 2016 soybean crop (SFQ-FERT TABLE).

Table 102. Fertilizer containing potassium applied in the spring as a preplant for the 2016 soybean crop.

BMP Region	Potassium Application as a Preplant in the Spring of 2016	Percent of Respondents
Northwestern	Yes	33
Northwestern	No	67
Irrigated and Non-irrigated Sandy Soils	Yes	64
Irrigated and Non-irrigated Sandy Soils	No	36
South Western and West Central	Yes	33
South Western and West Central	No	67
South Central	Yes	38
South Central	No	62
Southeastern	Yes	50
Southeastern	No	50
Statewide	Yes	46
Statewide	No	54

Table 103 details sulfur, such as AMS, applied in the spring as a preplant for the 2016 soybean crop (SFQ-FERT TABLE).

Table 103. Fertilizer containing sulfur applied in the spring as a preplant for the 2016 soybean crop.

BMP Region	Sulfur Application as a Preplant in the Spring of 2016	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
South Western and West Central	Yes	5
South Western and West Central	No	95
South Central	Yes	5
South Central	No	95
Southeastern	Yes	9
Southeastern	No	91
Statewide	Yes	10
Statewide	No	90

Table 104 details commercial fertilizer applied in the spring as a starter or at planting for the 2016 soybean crop (SFQ-FERT TABLE).

Table 104. Commercial fertilizer applied in the spring at planting for the 2016 soybean crop.

BMP Region	Any Commercial Fertilizer in the Spring as a Starter or at Planting of 2016	Percent of Respondents
Northwestern	Yes	19
Northwestern	No	81
Irrigated and Non-irrigated Sandy Soils	Yes	16
Irrigated and Non-irrigated Sandy Soils	No	84
South Western and West Central	Yes	8
South Western and West Central	No	92
South Central	Yes	13
South Central	No	87
Southeastern	Yes	12
Southeastern	No	88
Statewide	Yes	14
Statewide	No	86

Table 105 details urea applied in the spring as a starter or at planting for the 2016 soybean crop (SFQ-FERT TABLE).

Table 105. Urea applied in the spring at planting for the 2016 soybean crop.

BMP Region	Urea Application as a Starter or at Planting in the Spring of 2016	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
South Western and West Central	Yes	2
South Western and West Central	No	98
South Central	Yes	0
South Central	No	100
Southeastern	Yes	0
Southeastern	No	100
Statewide	Yes	1
Statewide	No	99

Table 106 details liquid nitrogen fertilizer applied in the spring as a starter or at planting for the 2016 soybean crop (SFQ-FERT TABLE).

Table 106. Liquid nitrogen fertilizer applied in the spring at planting for the 2016 soybean crop.

BMP Region	Liquid Nitrogen (28%, 32%) Application as a Starter or at Planting in the Spring of 2016	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
South Western and West Central	Yes	1
South Western 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 107 details other nitrogen fertilizers applied in the spring at planting for the 2016 soybean crop (SFQ-FERT TABLE).

Table 107. Other nitrogen fertilizers applied in the spring at planting for the 2016 soybean crop.

BMP Region	Other Nitrogen Fertilizers as a Starter or at Planting in the Spring of 2016	Percent of Respondents
Northwestern	Yes	4
Northwestern	No	96
Irrigated and Non-irrigated Sandy Soils	Yes	4
Irrigated and Non-irrigated Sandy Soils	No	96
South Western and West Central	Yes	2
South Western and West Central	No	98
South Central	Yes	2
South Central	No	98
Southeastern	Yes	3
Southeastern	No	97
Statewide	Yes	3
Statewide	No	97

Table 108 details phosphorus, such as MAP or DAP, fertilizer applied in the spring at planting for the 2016 soybean crop (SFQ-FERT TABLE).

Table 108. Fertilizer containing phosphorus applied in the spring at planting for the 2016 soybean crop.

BMP Region	Phosphorus Application as a Starter or at Planting in the Spring of 2016	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
South Western and West Central	Yes	8
South Western and West Central	No	92
South Central	Yes	11
South Central	No	89
Southeastern	Yes	9
Southeastern	No	91
Statewide	Yes	11
Statewide	No	89

Table 109 details potassium fertilizer applied in the spring at planting for the 2016 soybean crop (SFQ-FERT TABLE).

Table 109. Fertilizer containing potassium applied in the spring at planting for the 2016 soybean crop.

BMP Region	Potassium Application as a Starter or at Planting in the Spring of 2016	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
South Western and West Central	Yes	7
South Western and West Central	No	93
South Central	Yes	11
South Central	No	89
Southeastern	Yes	9
Southeastern	No	91
Statewide	Yes	11
Statewide	No	89

Table 110 details sulfur fertilizer, such as AMS, applied in the spring at planting for the 2016 soybean crop (SFQ-FERT TABLE).

Table 110. Fertilizer containing sulfur applied in the spring at planting for the 2016 soybean crop.

BMP Region	Sulfur Application as a Starter or at Planting in the Spring of 2016	Percent of Respondents
Northwestern	Yes	4
Northwestern	No	96
Irrigated and Non-irrigated Sandy Soils	Yes	4
Irrigated and Non-irrigated Sandy Soils	No	96
South Western and West Central	Yes	2
South Western and West Central	No	98
South Central	Yes	2
South Central	No	98
Southeastern	Yes	2
Southeastern	No	98
Statewide	Yes	3
Statewide	No	97

Table 111 details commercial fertilizer applied post planting or sidedress for the 2016 soybean crop (SFQ-FERT TABLE).

Table 111. Commercial fertilizer applied post planting or sidedress for the 2016 soybean crop.

BMP Region	Any Commercial Fertilizer Application After Planting such as a Sidedress in 2016	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
South Western and West Central	Yes	4
South Western and West Central	No	96
South Central	Yes	6
South Central	No	94
Southeastern	Yes	2
Southeastern	No	98
Statewide	Yes	3
Statewide	No	97

Table 112 details urea applied as a post planting or sidedress for the 2016 soybean crop (SFQ-FERT TABLE).

Table 112. Urea applied as a post planting or sidedress for the 2016 soybean crop.

BMP Region	Urea Application after Planting such as a Sidedress in 2016	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
South Western and West Central	Yes	0
South Western and West Central	No	100
South Central	Yes	0
South Central	No	100
Southeastern	Yes	0
Southeastern	No	100
Statewide	Yes	0
Statewide	No	100

Table 113 details liquid nitrogen fertilizer applied as a post planting or sidedress for the 2016 soybean crop (SFQ-FERT TABLE).

Table 113. Liquid nitrogen fertilizer applied as a post planting or sidedress for the 2016 soybean crop.

BMP Region	Liquid Nitrogen (28%, 32%) Application after Planting such as a Sidedress in 2016	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
South Western and West Central	Yes	0
South Western and West Central	No	100
South Central	Yes	0
South Central	No	100
Southeastern	Yes	0
Southeastern	No	100
Statewide	Yes	0
Statewide	No	100

Table 114 details other nitrogen fertilizers applied as a post planting or sidedress the 2016 soybean crop (SFQ-FERT TABLE).

Table 114. Other nitrogen fertilizers applied in the spring at planting for the 2016 soybean crop.

BMP Region	Other Nitrogen Fertilizers after Planting such as a Sidedress in 2016	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
South Western and West Central	Yes	0
South Western 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 115 details phosphorus fertilizer, such as MAP or DAP, applied as a post planting or sidedress for the 2016 soybean crop (SFQ-FERT TABLE).

Table 115. Fertilizer containing phosphorus applied as a post planting or sidedress for the 2016 soybean crop.

BMP Region	Phosphorus Application after Planting such as a Sidedress in 2016	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
South Western and West Central	Yes	2
South Western and West Central	No	98
South Central	Yes	6
South Central	No	94
Southeastern	Yes	2
Southeastern	No	98
Statewide	Yes	2
Statewide	No	98

Table 116 details potassium fertilizer applied as a post planting or sidedress of the 2016 soybean crop (SFQ-FERT TABLE).

Table 116. Fertilizer containing potassium applied as a post planting or sidedress for the 2016 soybean crop.

BMP Region	Potassium Application after Planting such as a Sidedress in 2016	Percent of Respondents
Northwestern	Yes	2
Northwestern	No	98
Irrigated and Non-irrigated Sandy Soils	Yes	2
Irrigated and Non-irrigated Sandy Soils	No	98
South Western and West Central	Yes	2
South Western and West Central	No	98
South Central	Yes	2
South Central	No	98
Southeastern	Yes	0
Southeastern	No	100
Statewide	Yes	2
Statewide	No	98

Table 117 details sulfur fertilizer, such as AMS, applied as a post planting or sidedress for the 2016 soybean crop (SFQ-FERT TABLE).

Table 117. Fertilizer containing sulfur applied as a post planting or sidedress for the 2016 soybean crop.

BMP Region	Sulfur Application after Planting such as a Sidedress in 2016	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
South Western and West Central	Yes	0
South Western 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

Figure 40 details the form of nitrogen that was applied to soybean acres statewide based on total pounds of nitrogen applied (SFQ-FERT TABLE).

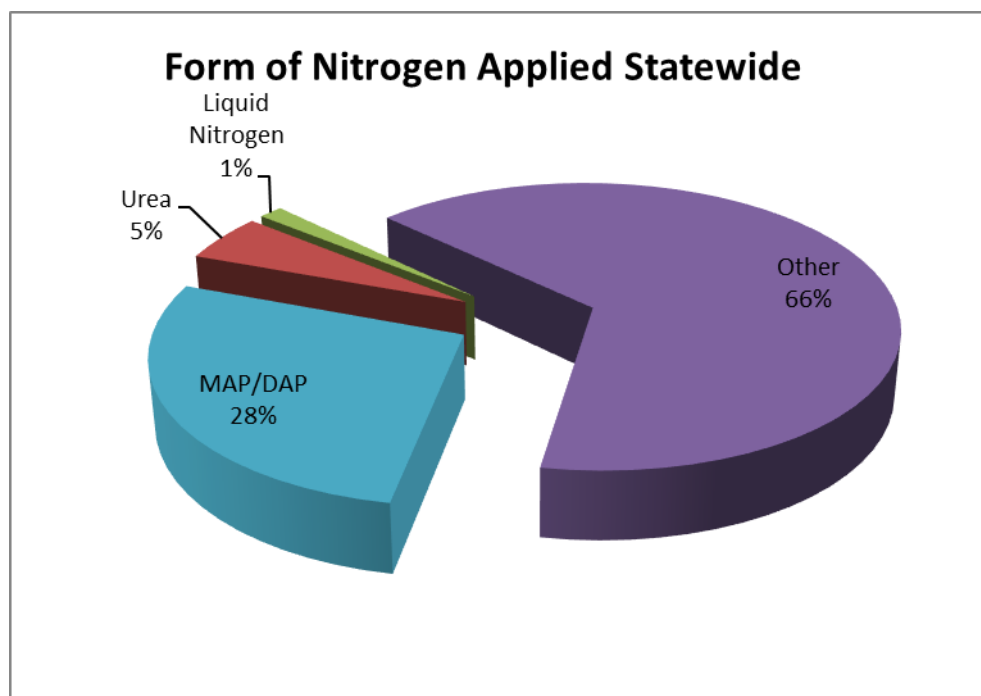


Figure 40. The form of the nitrogen applied to soybean acres in state for the 2016 survey for all fields applied with nitrogen fertilizer (Based on total pounds applied).

Figure 41 details the form of nitrogen that was applied to soybean acres in the SE BMP region based (SFQ-FERT TABLE).

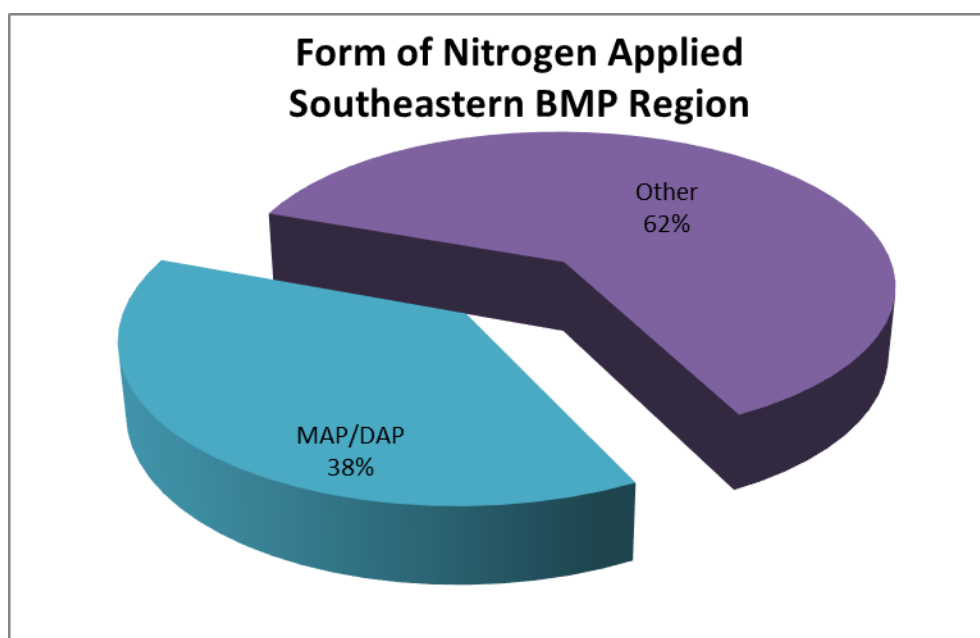


Figure 41. The form of the nitrogen applied to soybean acres in the SE BMP region for the 2016 survey for all fields applied with nitrogen fertilizer.

Figure 42 details the form of nitrogen that was applied to soybean acres in the SC BMP region based (SFQ-FERT TABLE).

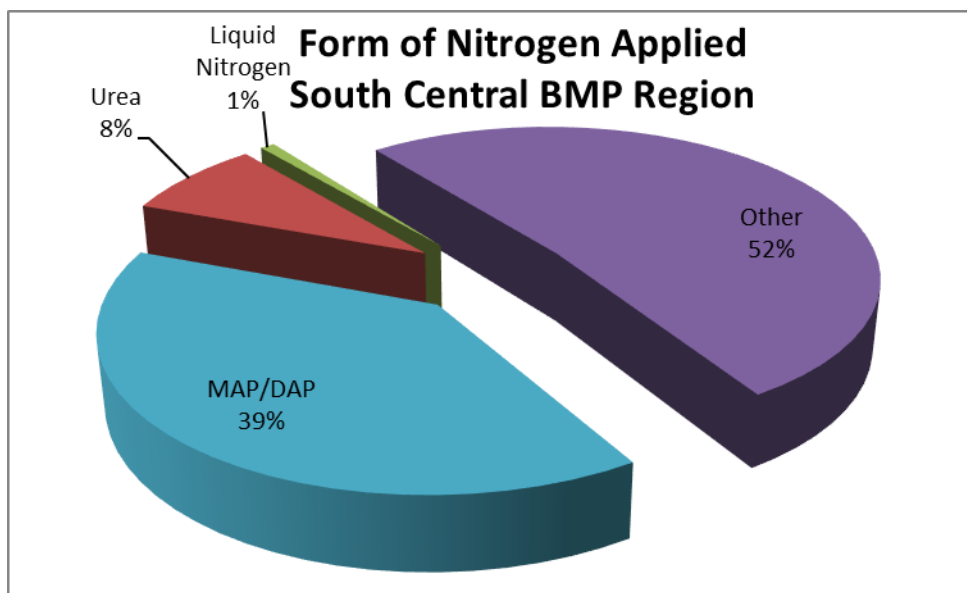


Figure 42. The form of the nitrogen applied to soybean acres in the SC BMP region for the 2016 survey for all fields applied with nitrogen fertilizer.

Figure 43 details the form of nitrogen that was applied to soybean acres in the SW BMP region based (SFQ-FERT TABLE).

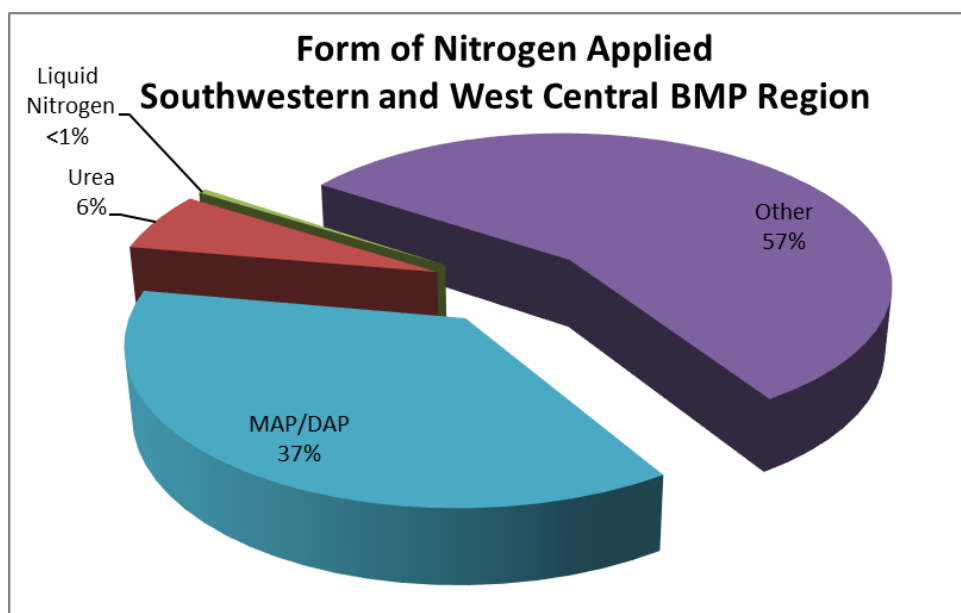


Figure 43. The form of the nitrogen applied to soybean acres in the SW BMP region for the 2016 survey for all fields applied with nitrogen fertilizer.

Figure 44 details the form of nitrogen that was applied to soybean acres in the NW BMP region based (SFQ-FERT TABLE).

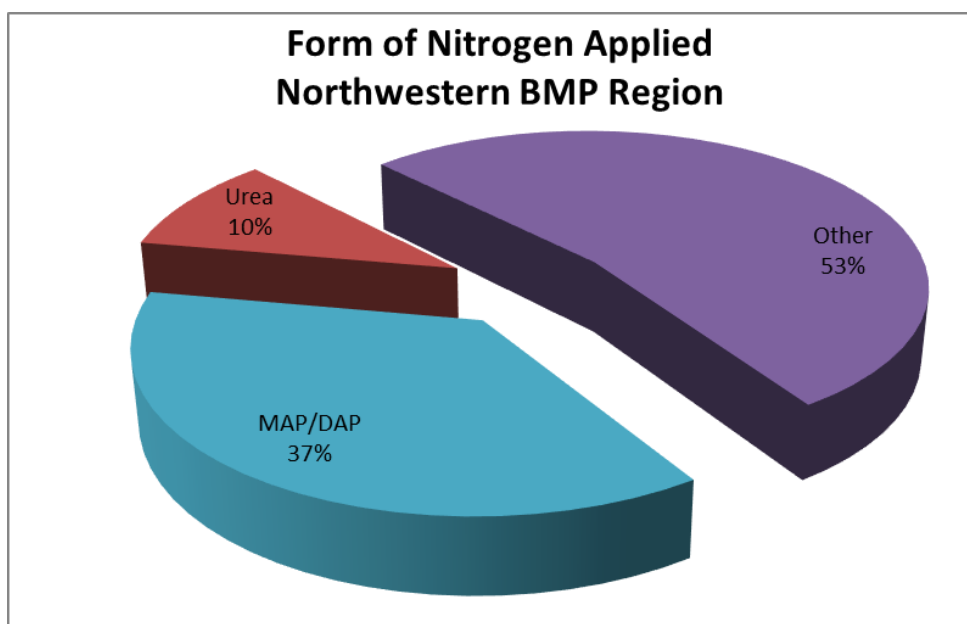


Figure 44. The form of the nitrogen applied to soybean acres in the NW BMP region for the 2016 survey for all fields applied with nitrogen fertilizer.

Figure 45 details the form of nitrogen that was applied to soybean acres in the IRR BMP region based (SFQ-FERT TABLE).

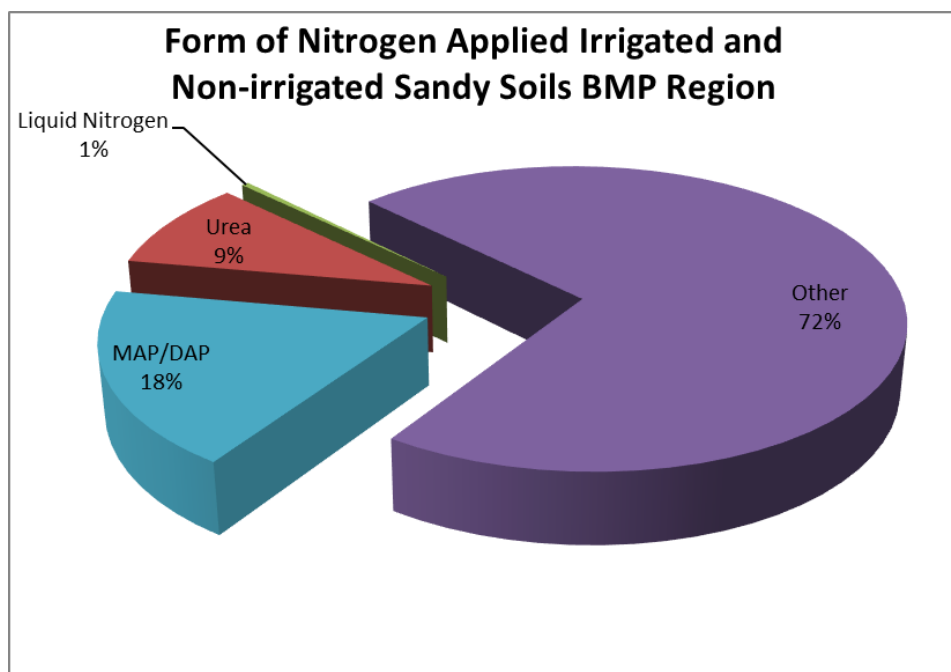


Figure 45. The form of the nitrogen applied to soybean acres in the IRR BMP region for the 2016 survey for all fields applied with nitrogen fertilizer.

Figure 46 details the application timing of urea on soybean acres in Minnesota for the largest field by pounds of nitrogen applied (SFQ-FERT TABLE).

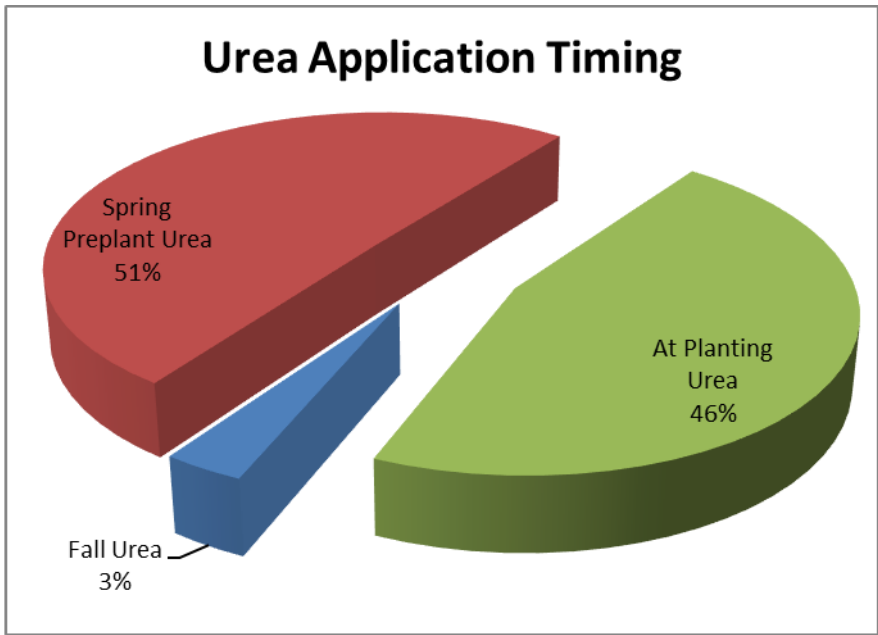


Figure 46. The application timing of urea to soybean acres in Minnesota by pounds of nitrogen applied in the 2016 survey.

Figure 47 details the application timing of liquid nitrogen on soybean acres in Minnesota for the largest field by pounds of nitrogen applied (SFQ-FERT TABLE).

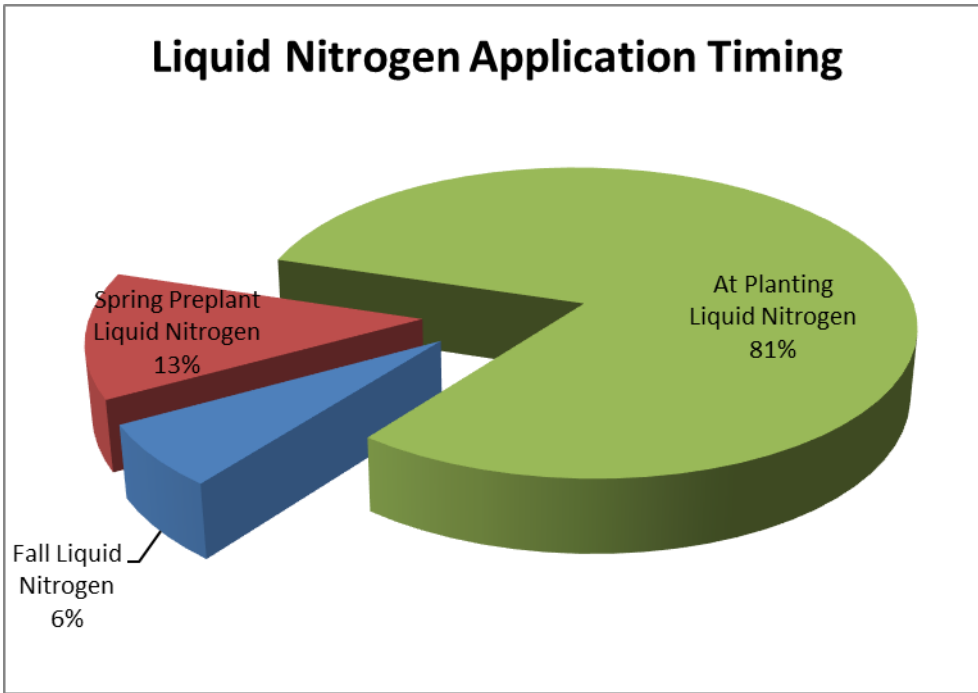


Figure 47. The application timing of liquid nitrogen to soybean acres in Minnesota by pounds of nitrogen applied in the 2016 survey.

Figure 48 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).

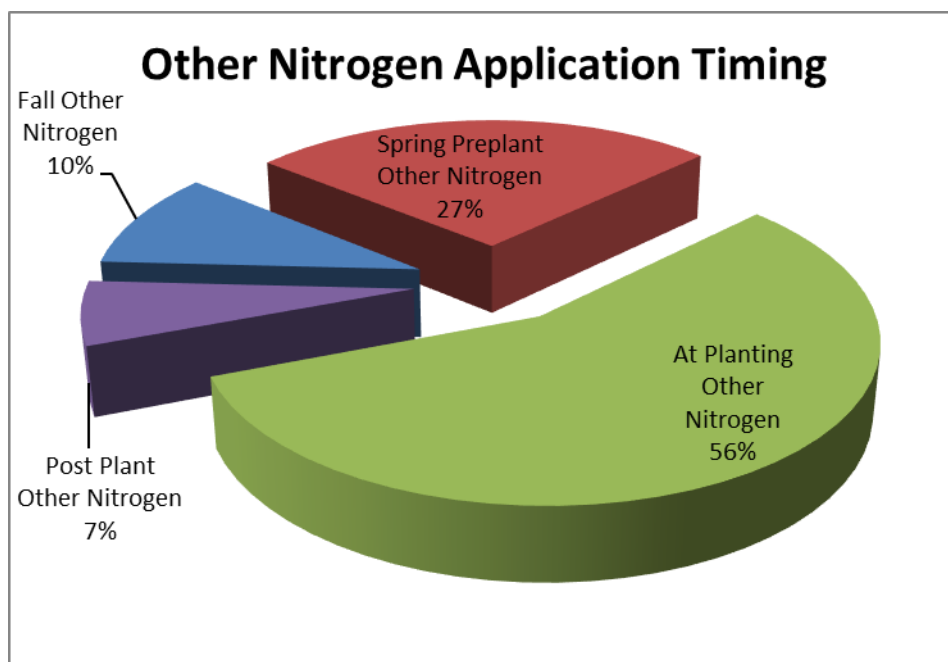


Figure 48. The application timing of other nitrogen sources to soybean acres in Minnesota by pounds of nitrogen applied in the 2016 survey.

Figure 49 details the application timing of phosphorus on soybean acres in Minnesota for the largest field by pounds of phosphorus applied (SFQ-FERT TABLE).

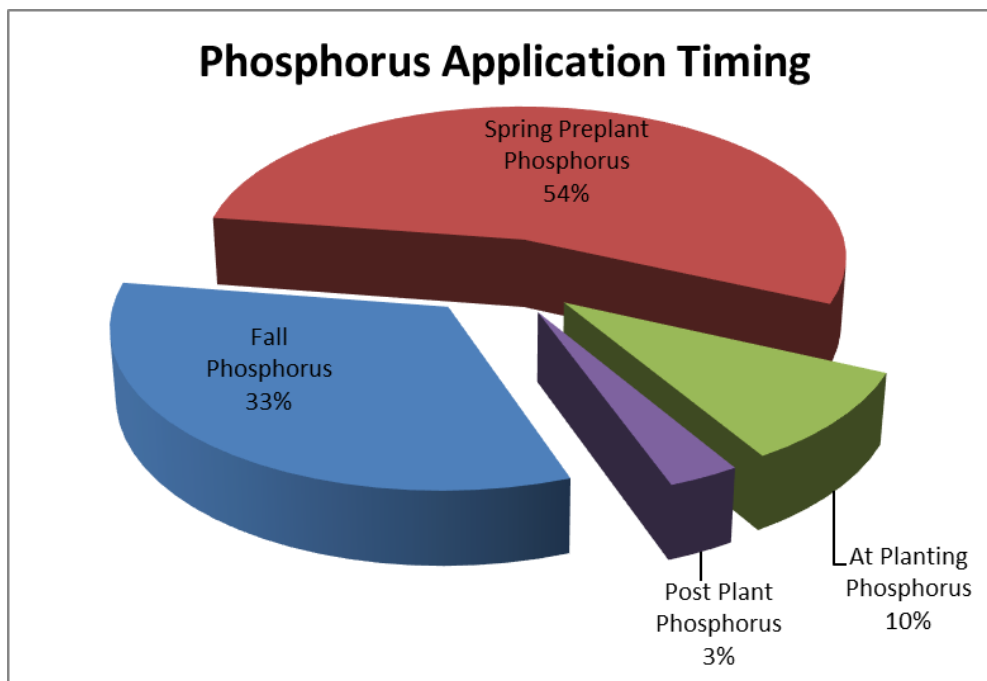


Figure 49. The application timing of phosphorus to soybean acres in Minnesota by pounds of phosphorus applied in the 2016 survey.

Figure 50 details the application timing of potassium on soybean acres in Minnesota for the largest field by pounds of potassium applied (SFQ-FERT TABLE).

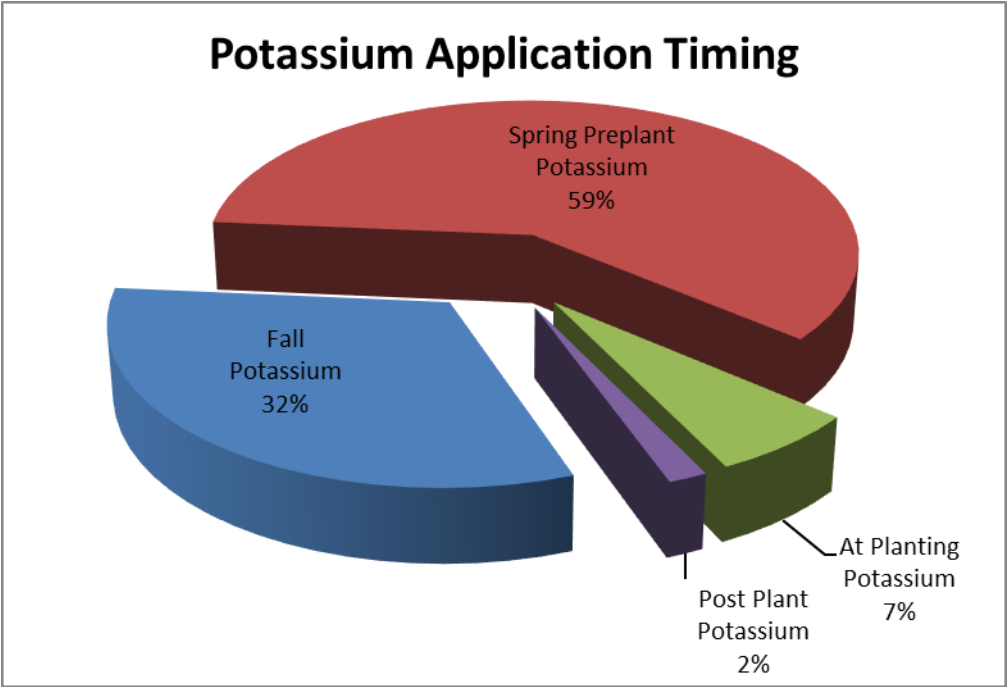


Figure 50. The application timing of potassium to soybean acres in Minnesota by pounds of potassium applied in the 2016 survey.

Figure 51 details the application timing of sulfur on soybean acres in Minnesota for the largest field by pounds of sulfur applied (SFQ-FERT TABLE).

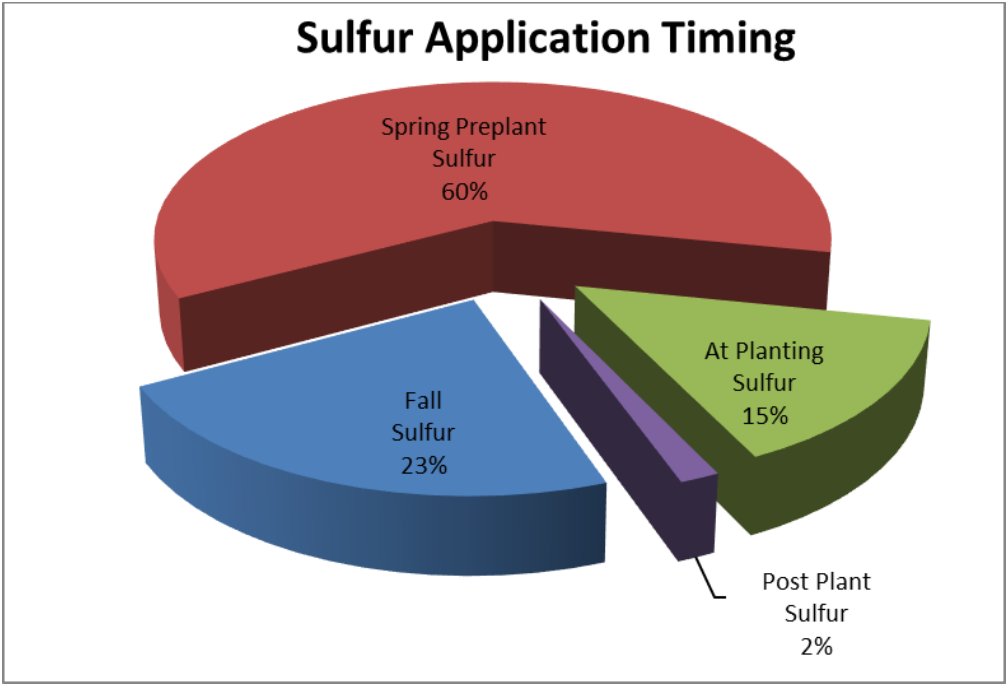


Figure 51. The application timing of sulfur to soybean acres in Minnesota by pounds of sulfur applied in the 2016 survey

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

Table 118 details the percent of respondents that used a nitrogen inhibitor or stabilizer in 2015 or 2016 for the 2016 soybean crop on the farmers largest field (SFQ-5 and SFQ-10).

Table 118. Nitrogen inhibitor or stabilizer use for the 2016 soybean crop.

BMP Region	Nitrogen Inhibitor or Stabilizer Use	Percent of Respondents	Average Soybean Yield Bushels per Acre
Northwestern	All	**	**
Northwestern	Some	**	**
Northwestern	None	99	38
Irrigated and Non-irrigated Sandy Soils	All	**	**
Irrigated and Non-irrigated Sandy Soils	Some	**	**
Irrigated and Non-irrigated Sandy Soils	None	97	44
South Western and West Central	All	**	**
South Western and West Central	Some	**	**
South Western and West Central	None	96	50
South Central	All	**	**
South Central	Some	**	**
South Central	None	96	55
Southeastern	All	**	**
Southeastern	Some	**	**
Southeastern	None	98	53
Statewide	All	2	51
Statewide	Some	**	**
Statewide	None	97	47

** Less than five responses

The following tables and figures in the remaining soybean section represent the 580 respondents that reported on their largest soybean 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: Soybeans Following Soybeans

Statewide, eleven percent of the fields reported were soybeans following soybeans. Figure 52 details the BMP regions where farmers reported on fields with soybeans following soybeans. There were 66 fields surveyed in Minnesota.⁴⁰

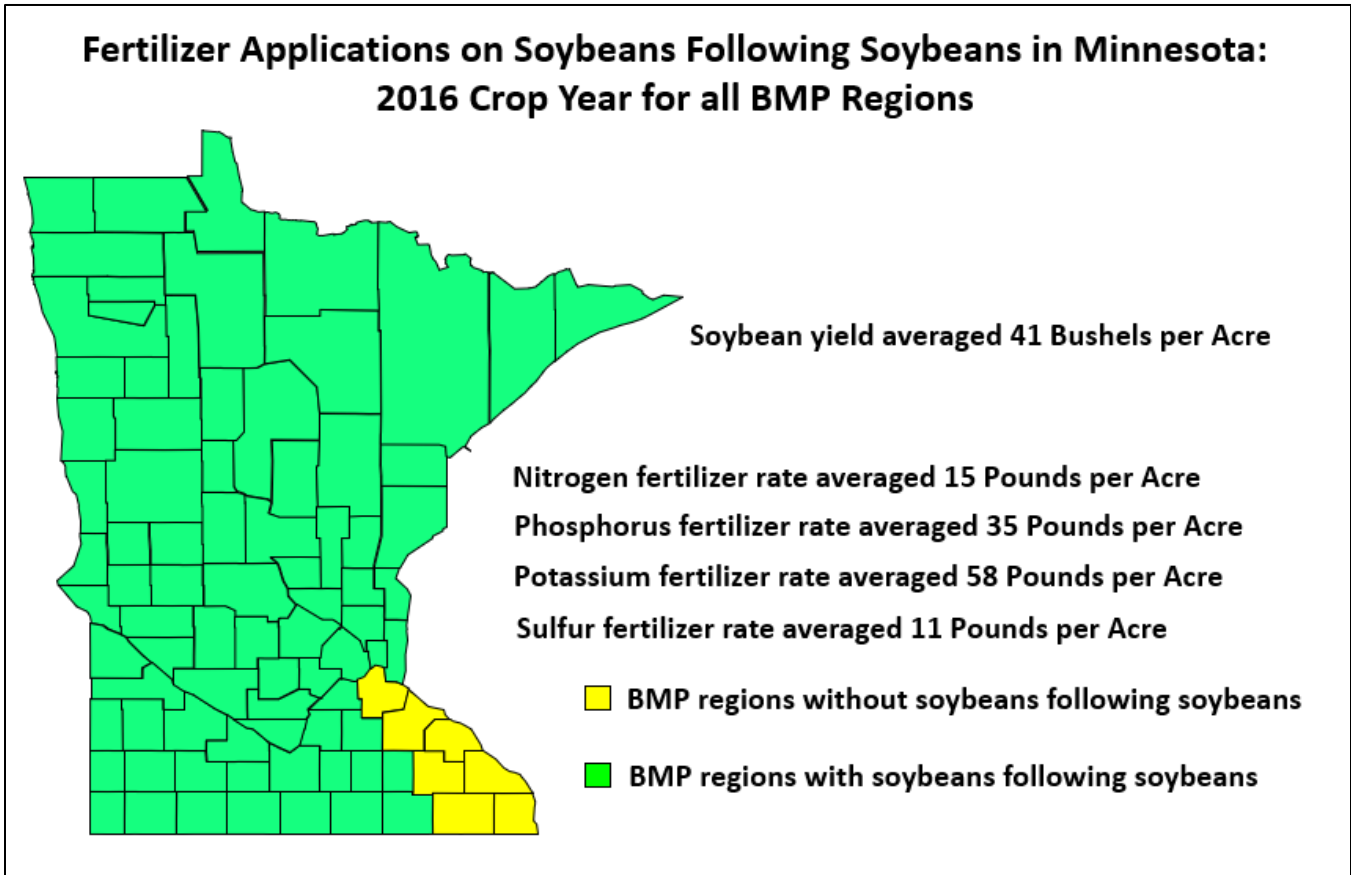


Figure 52. The average soybean yield and average fertilizer rate for soybeans following soybeans in Minnesota.

⁴⁰ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 73% applied nitrogen, 65% applied phosphorus, 86% applied potassium, and 20% applied sulfur on fields with soybeans following soybeans.

Figure 53 provides the distribution of average nitrogen fertilizer rate in Minnesota for soybeans following soybeans; the corresponding soybean yield is detailed in red⁴¹. Nitrogen rates are only from commercial fertilizer.

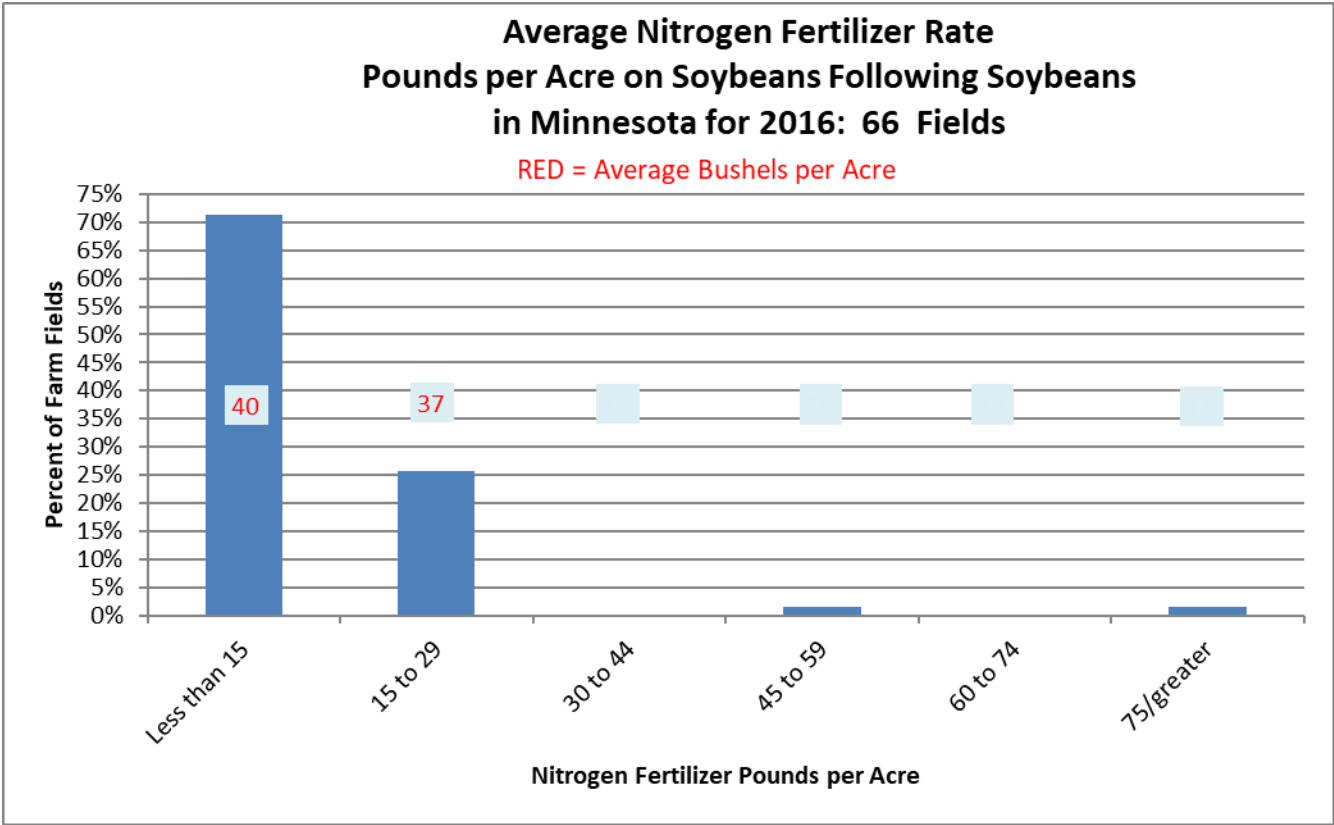


Figure 53. Average nitrogen fertilizer rate and yield on soybeans following soybeans in Minnesota for 2016: 66 fields.

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; corresponding yield; and the average nutrient rate across all fertilized fields on soybeans following soybeans in Table 119.

Table 119. Average fertilizer rate and soybean yield 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	73	15	38	11
Phosphorus	65	35	38	23
Potassium	86	58	39	50
Sulfur	20	11	42	2

⁴¹ Yields are not published if there are less than five responses.

Southeastern BMP Region: Soybeans Following Soybeans

The SE BMP region had no 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 12 fields that were included in the SW BMP region for soybeans following soybeans analysis. Figure 54 details the location, average rate of nitrogen, phosphorus, potassium, sulfur fertilizer and average yield for soybeans following soybeans in the SW BMP region.⁴²

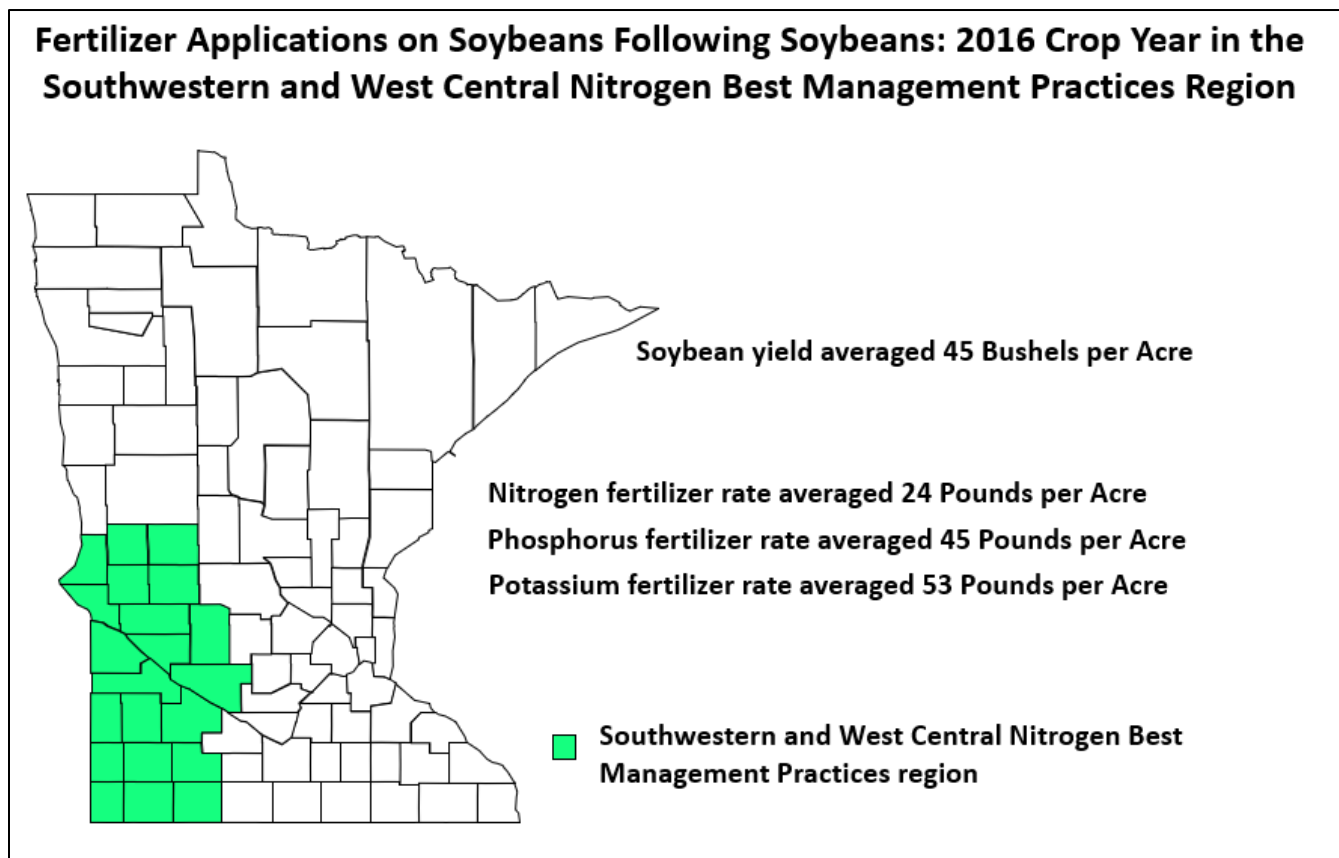


Figure 54. The average soybean yield and average fertilizer rate for soybeans following soybeans in the SW BMP region.

⁴² The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 75% applied nitrogen, 75% applied phosphorus, and 83% applied potassium on fields with soybeans following soybeans. Less than five respondents reported applying sulfur.

Figure 55 provides the distribution of average nitrogen fertilizer rate in the SW BMP region for soybeans following soybeans; the corresponding soybean yield is detailed in red⁴³. Nitrogen rates are only from commercial fertilizer.

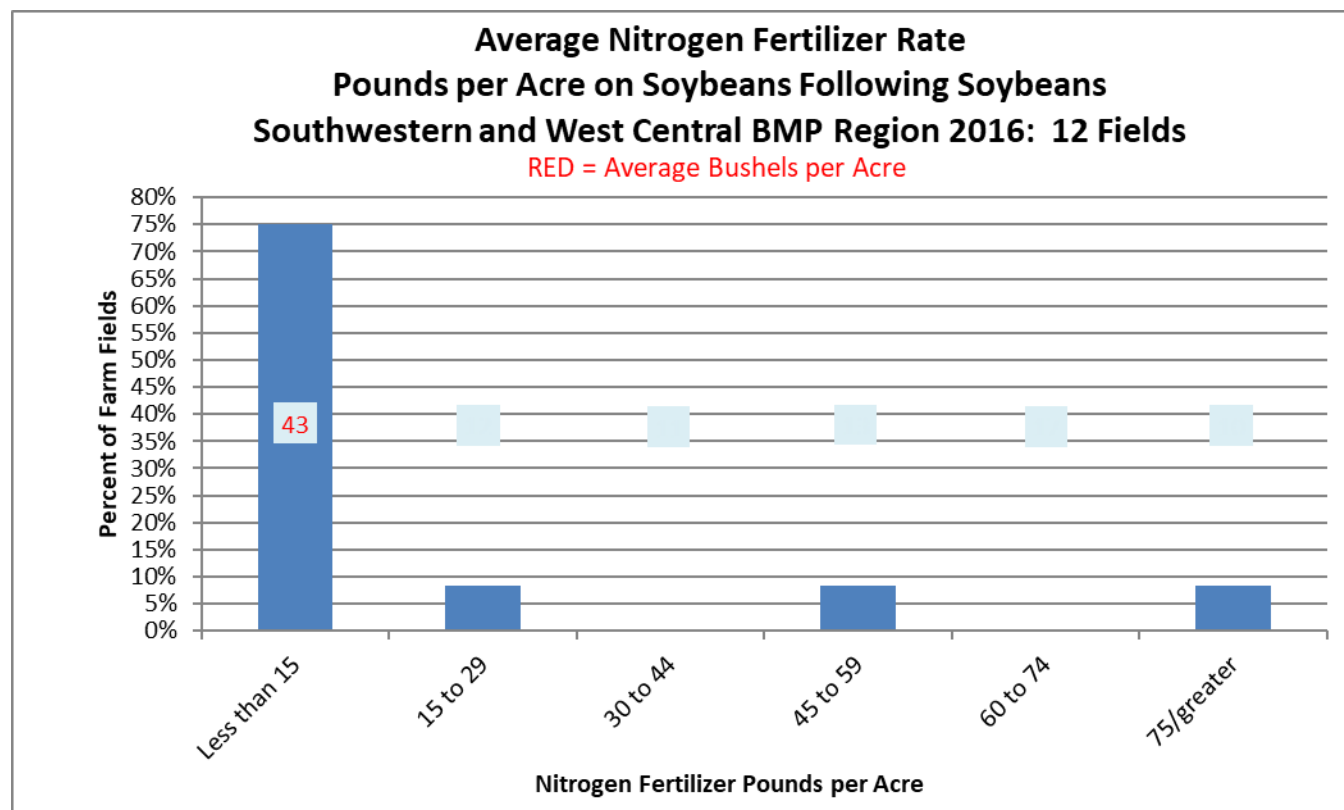


Figure 55. Average nitrogen fertilizer rate and yield on soybeans following soybeans in the SW BMP region for 2016: 12 fields.

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 on soybeans following soybeans in Table 120.

Table 120. 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	75	24	45	18
Phosphorus	75	45	45	34
Potassium	83	53	44	44
Sulfur	**	**	**	**

** Less than five responses

⁴³ Yields are not published if there are less than five responses.

Northwest BMP Region: Soybeans Following Soybeans

There were 19 fields that were included in the NW BMP region for soybeans following soybeans analysis. Figure 56 details the location, average rate of nitrogen, phosphorus, potassium, sulfur fertilizer and average yield for soybeans following soybeans in the NW BMP region.⁴⁴

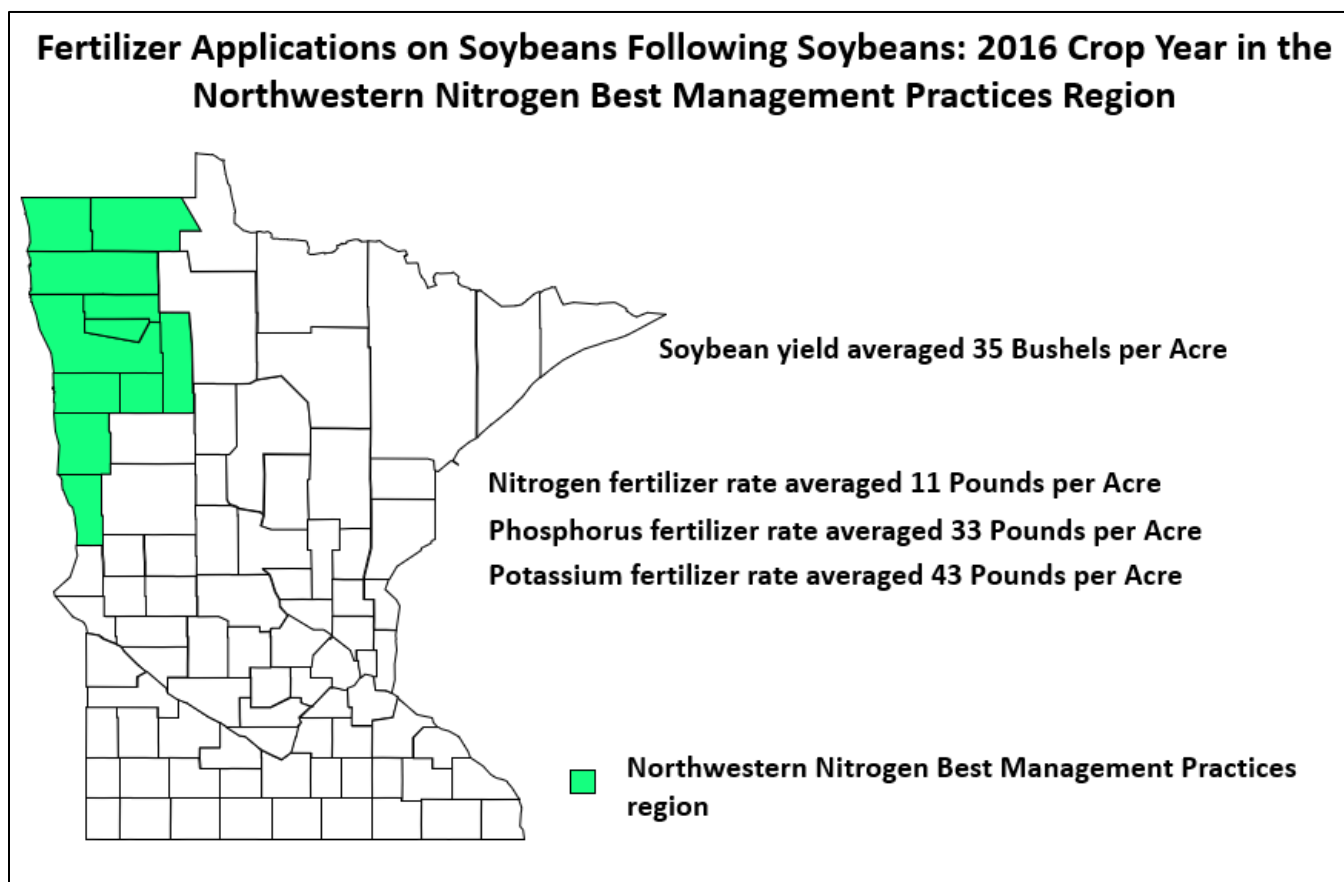


Figure 56. The average soybean yield and average fertilizer rate for soybeans following soybeans in the NW BMP region.

⁴⁴ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 89% applied nitrogen, 89% applied phosphorus, and 79% applied potassium on fields with soybeans following soybeans. Less than five respondents reported applying sulfur.

Figure 57 provides the distribution of average nitrogen fertilizer rate in the NW BMP region for soybeans following soybeans; the corresponding soybean yield is detailed in red. Nitrogen rates are only from commercial fertilizer.

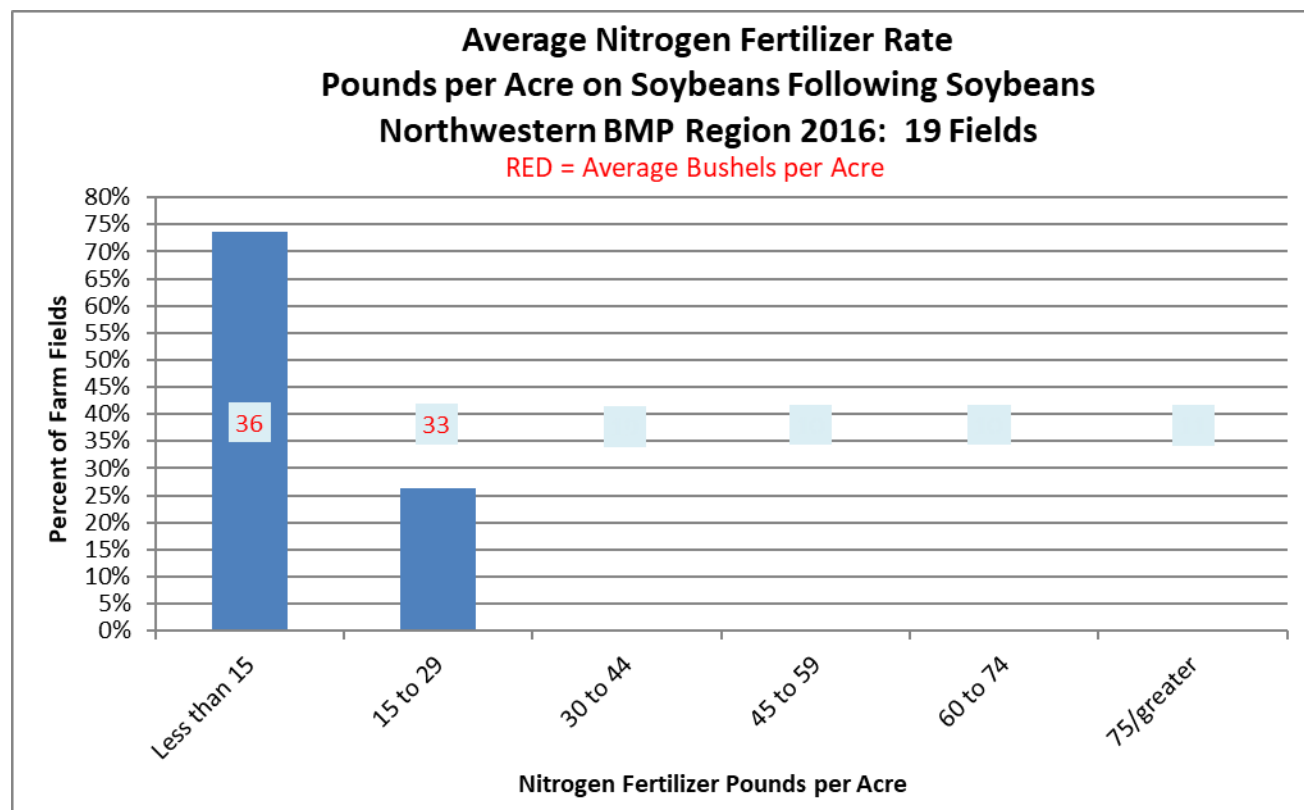


Figure 57. Average nitrogen fertilizer rate and yield on soybeans following soybeans in the NW BMP region for 2016: 19 fields.

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 on soybeans following soybeans in Table 121.

Table 121. Average fertilizer rate and soybean 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	89	11	34	10
Phosphorus	89	33	34	29
Potassium	79	43	35	34
Sulfur	**	**	**	**

** Less than five responses

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

There were 32 fields that were included in the IRR BMP region for soybeans following soybeans analysis. Figure 58 details the location, average rate of nitrogen, phosphorus, potassium, sulfur fertilizer and average yield for soybeans following soybeans in the IRR BMP region.⁴⁵

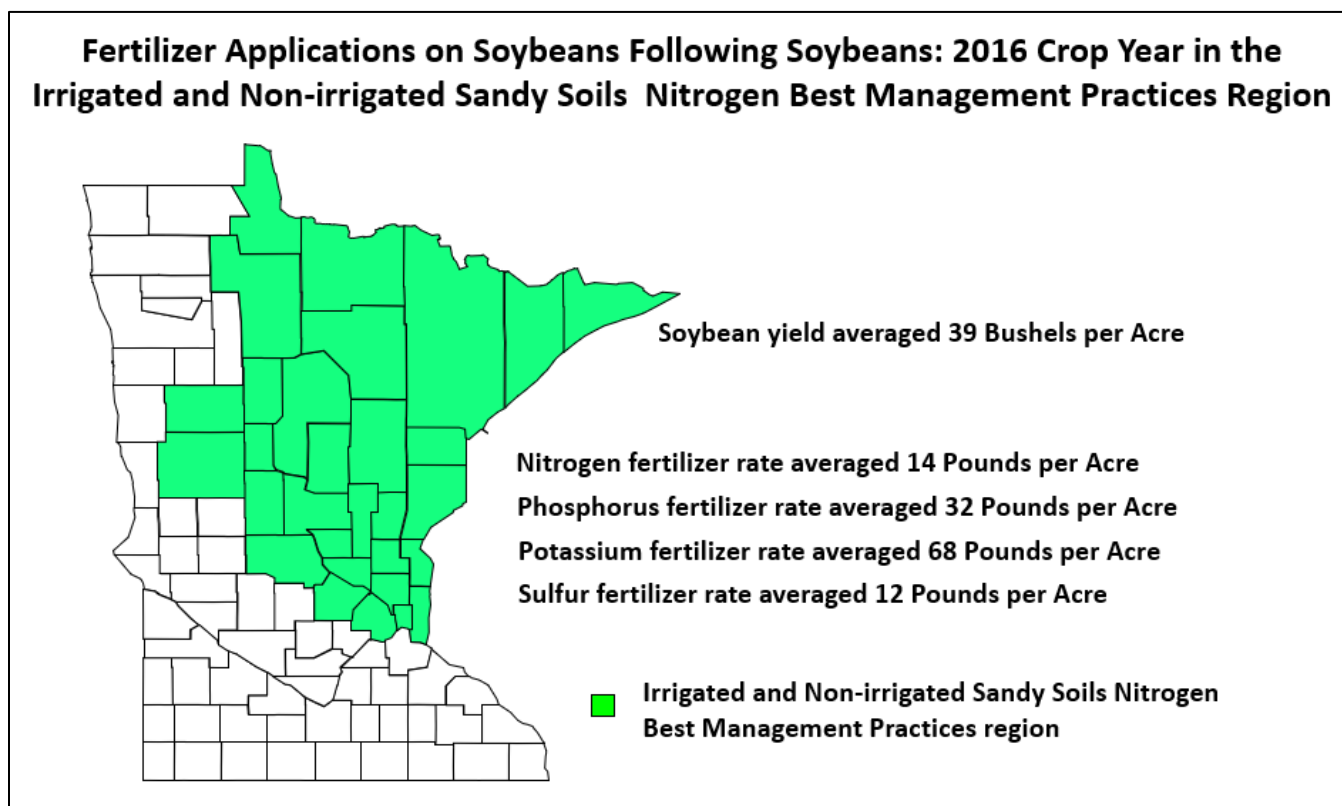


Figure 58. The average soybean yield and average fertilizer rate for soybeans following soybeans in the IRR BMP region.

⁴⁵ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 63% applied nitrogen, 47% applied phosphorus, 91% applied potassium, and 25% applied sulfur on fields with soybeans following soybeans.

Figure 59 provides the distribution of average nitrogen fertilizer rate in the IRR BMP region for soybeans following soybeans; the corresponding soybean yield is detailed in red.⁴⁶ Nitrogen rates are only from commercial fertilizer.

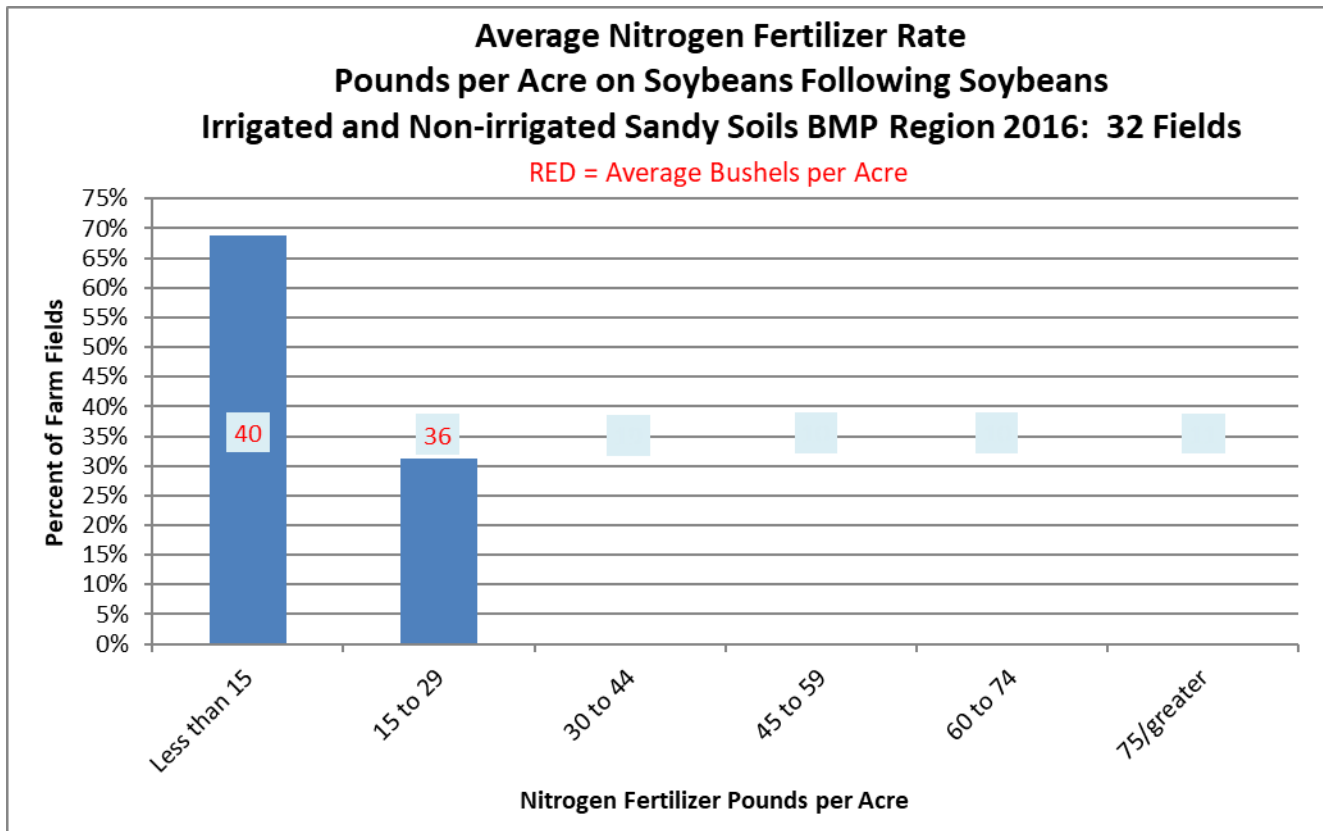


Figure 59. Average nitrogen fertilizer rate and yield on soybeans following soybeans in the IRR BMP region for 2016: 32 fields.

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 on soybeans following soybeans are shown in Table 122.

Table 122. Average fertilizer rate and soybean 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	63	14	38	9
Phosphorus	47	32	37	15
Potassium	91	68	38	62
Sulfur	25	12	42	3

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

Statewide: Soybeans Following Corn

Statewide, seventy percent of the fields reported were soybeans following corn. Figure 60 details the BMP regions where farmers reported on fields with soybeans following corn. There were 404 fields surveyed in Minnesota.⁴⁷

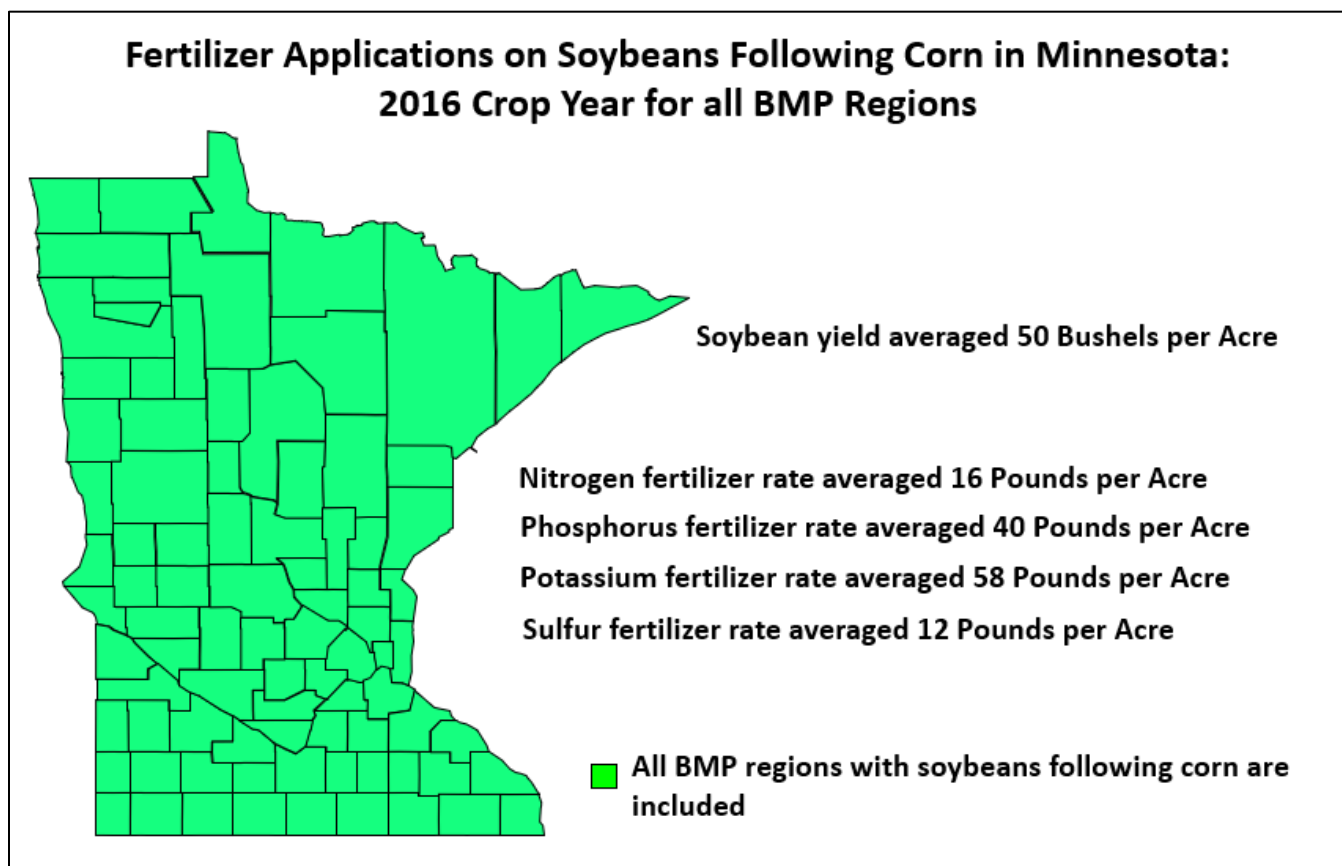


Figure 60. The average soybean yield and average fertilizer rate for soybeans following corn in Minnesota.

⁴⁷ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 73% applied nitrogen, 67% applied phosphorus, 83% applied potassium, and 15% applied sulfur on fields with soybeans following corn.

Figure 61 provides the distribution of average nitrogen fertilizer rate in Minnesota for soybeans following corn; the corresponding soybean yield is detailed in red.⁴⁸ Nitrogen rates are only from commercial fertilizer.

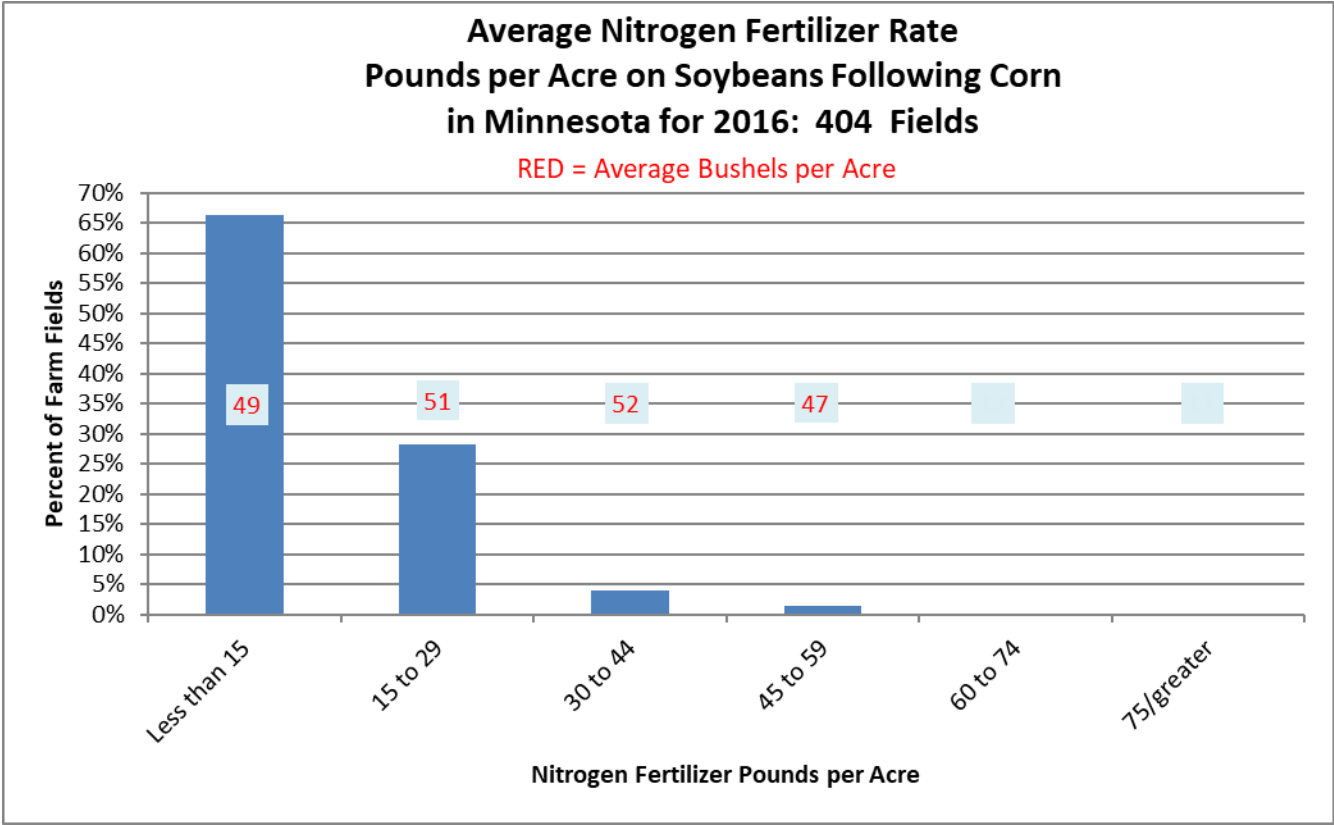


Figure 61. Average nitrogen fertilizer rate and yield on soybeans following corn in Minnesota for 2016: 404 fields.

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, corresponding yield, and the average nutrient rate across all fertilized on fields of soybeans following corn are shown in Table 123.

Table 123. Average fertilizer rate and soybean yield 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	73	16	50	12
Phosphorus	67	40	50	27
Potassium	83	58	49	49
Sulfur	15	12	50	2

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

Southeastern BMP Region: Soybeans Following Corn

There were 63 fields that were included in the SE BMP region for soybeans following corn analysis. Figure 62 details the location, average rate of nitrogen, phosphorus, potassium, sulfur fertilizer and average yield for soybeans following corn in the SE BMP region.⁴⁹

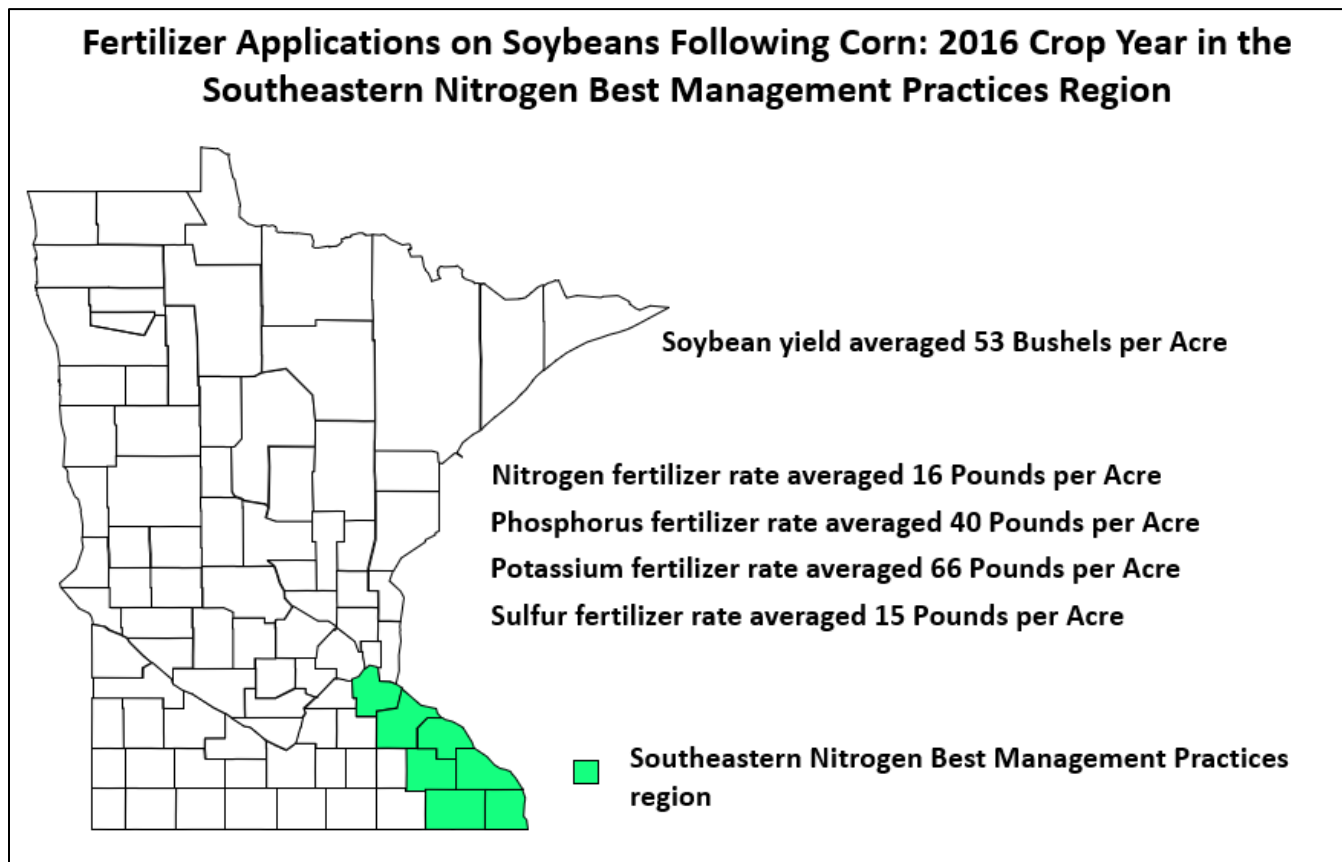


Figure 62. The average soybean yield and average fertilizer rate for soybeans following corn in the SE BMP region.

⁴⁹ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 59% applied nitrogen, 54% applied phosphorus, 90% applied potassium, and 16% applied sulfur on fields with soybeans following corn.

Figure 63 provides the distribution of average nitrogen fertilizer rate in the SE BMP region for soybeans following corn; the corresponding soybean yield is detailed in red.⁵⁰ Nitrogen rates are only from commercial fertilizer.

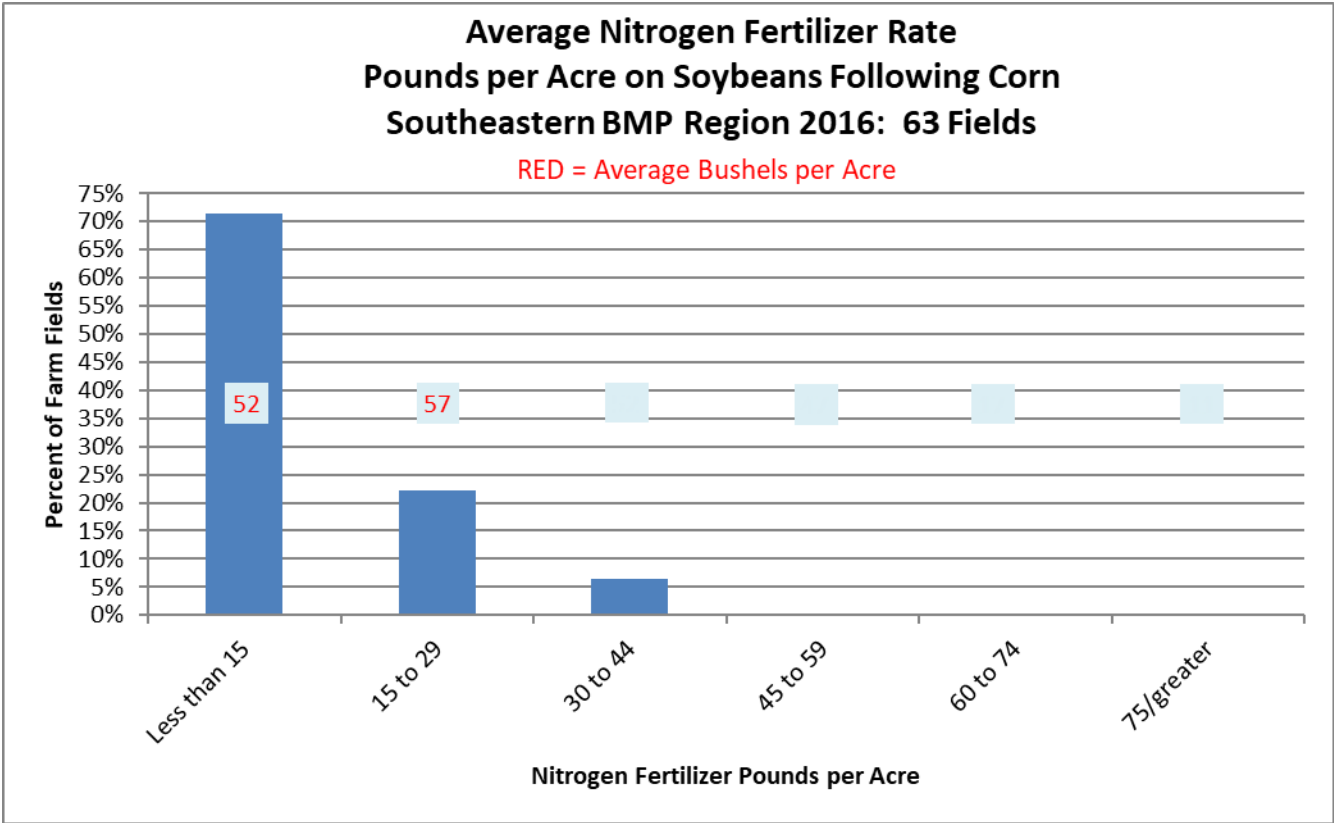


Figure 63. Average nitrogen fertilizer rate and yield on soybeans following corn in the SE BMP region for 2016: 63 fields.

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 124.

Table 124. Average fertilizer rate and soybean 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	59	16	55	9
Phosphorus	54	40	55	22
Potassium	90	66	53	60
Sulfur	16	15	55	2

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

South Central BMP Region: Soybeans Following Corn

There were 81 fields that were included in the SC BMP region for soybeans following corn analysis. Figure 64 details the location, average rate of nitrogen, phosphorus, potassium, sulfur fertilizer and average yield for soybeans following corn in the SC BMP region.⁵¹

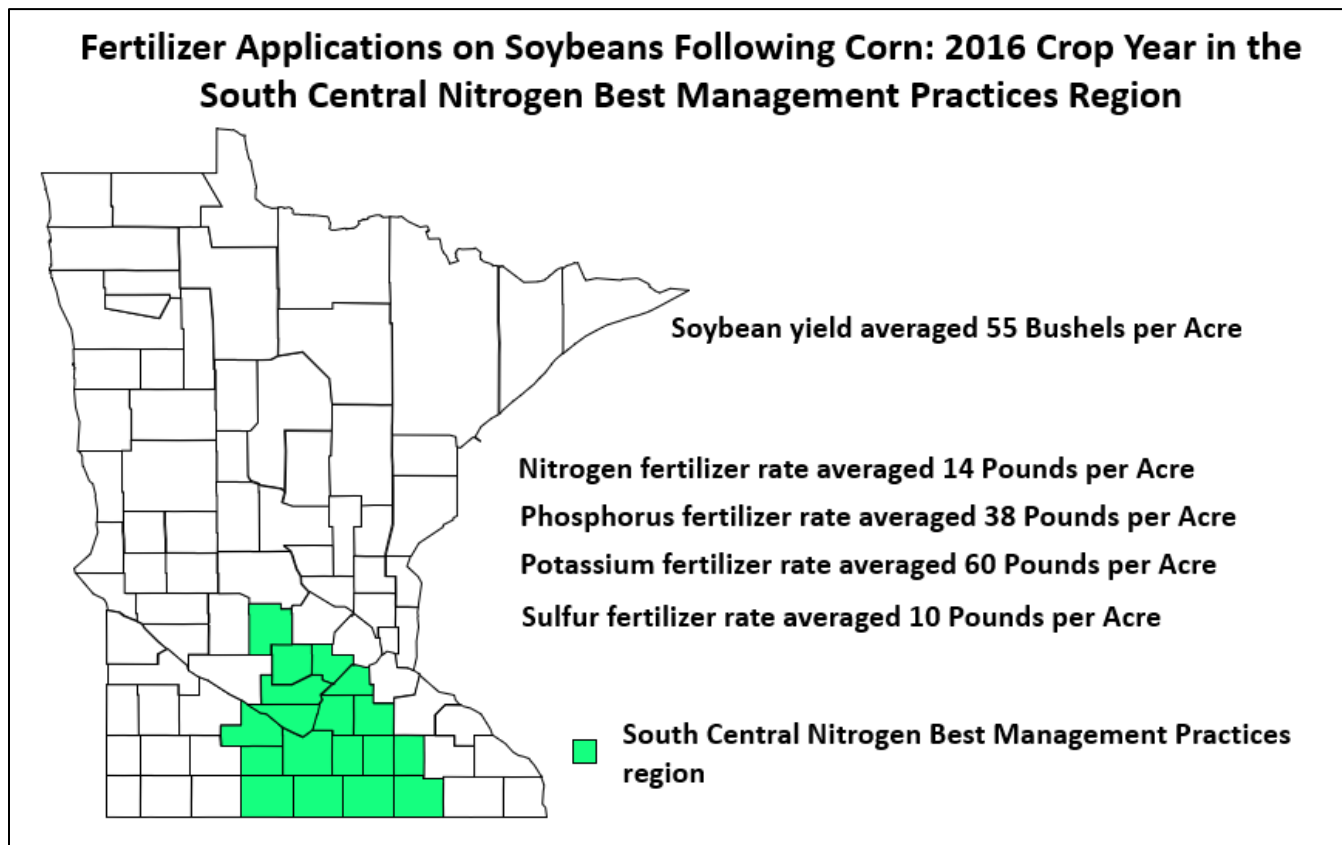


Figure 64. The average soybean yield and average fertilizer rate for soybeans following corn in the SC BMP region.

⁵¹ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 67% applied nitrogen, 65% applied phosphorus, 86% applied potassium, and 11% applied sulfur on fields with soybeans following corn.

Figure 65 provides the distribution of average nitrogen fertilizer rate in the SC BMP region for soybeans following corn; the corresponding soybean yield is detailed in red.⁵² Nitrogen rates are only from commercial fertilizer.

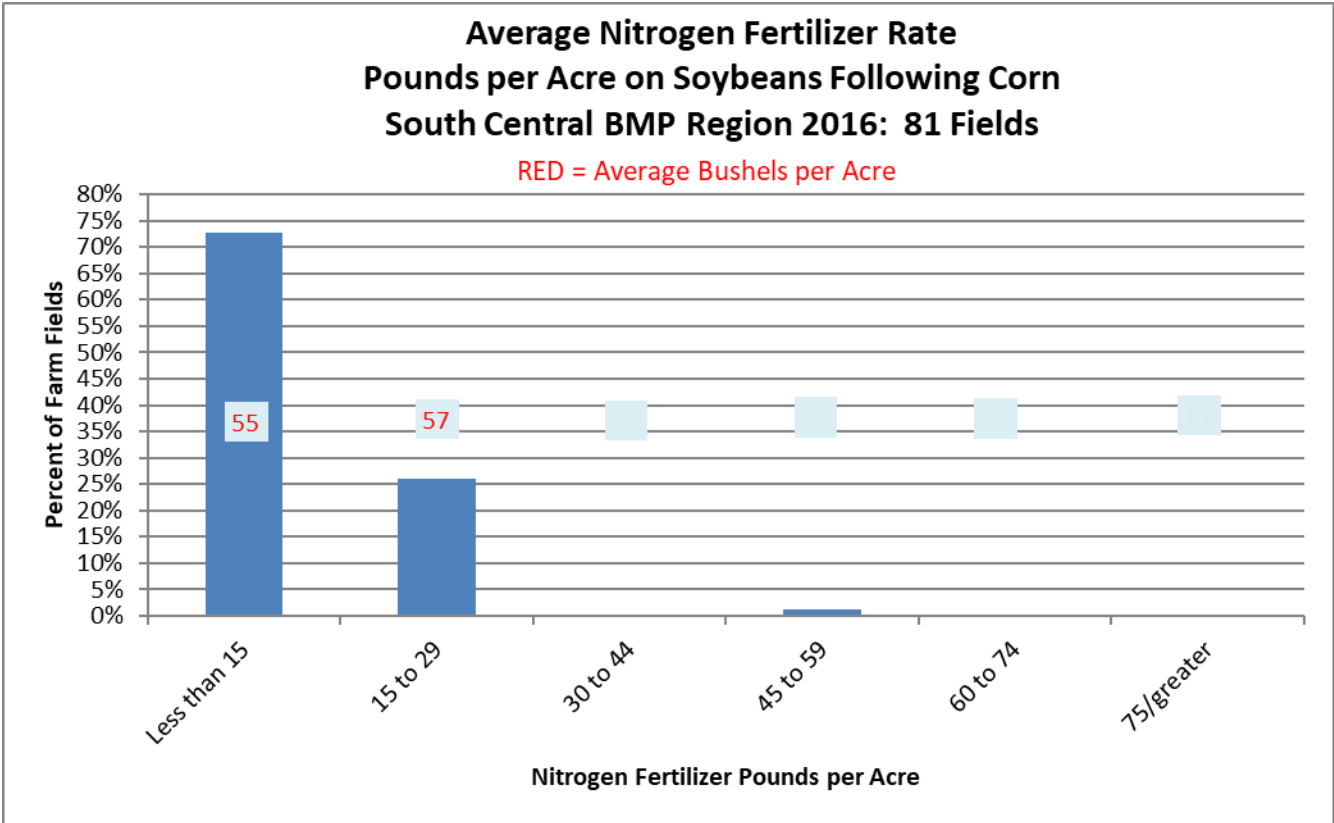


Figure 65. Average nitrogen fertilizer rate and yield on soybeans following corn in the SC BMP region for 2016: 81 fields.

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 125.

Table 125. Average fertilizer rate and soybean 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	67	14	56	9
Phosphorus	65	38	56	25
Potassium	86	60	55	52
Sulfur	11	10	56	1

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

Southwestern and West Central BMP Region: Soybeans Following Corn

There were 111 fields that were included in the SW BMP region for soybeans following corn analysis. Figure 66 details the location, average rate of nitrogen, phosphorus, potassium, sulfur fertilizer and average yield for soybeans following corn in the SW BMP region.⁵³

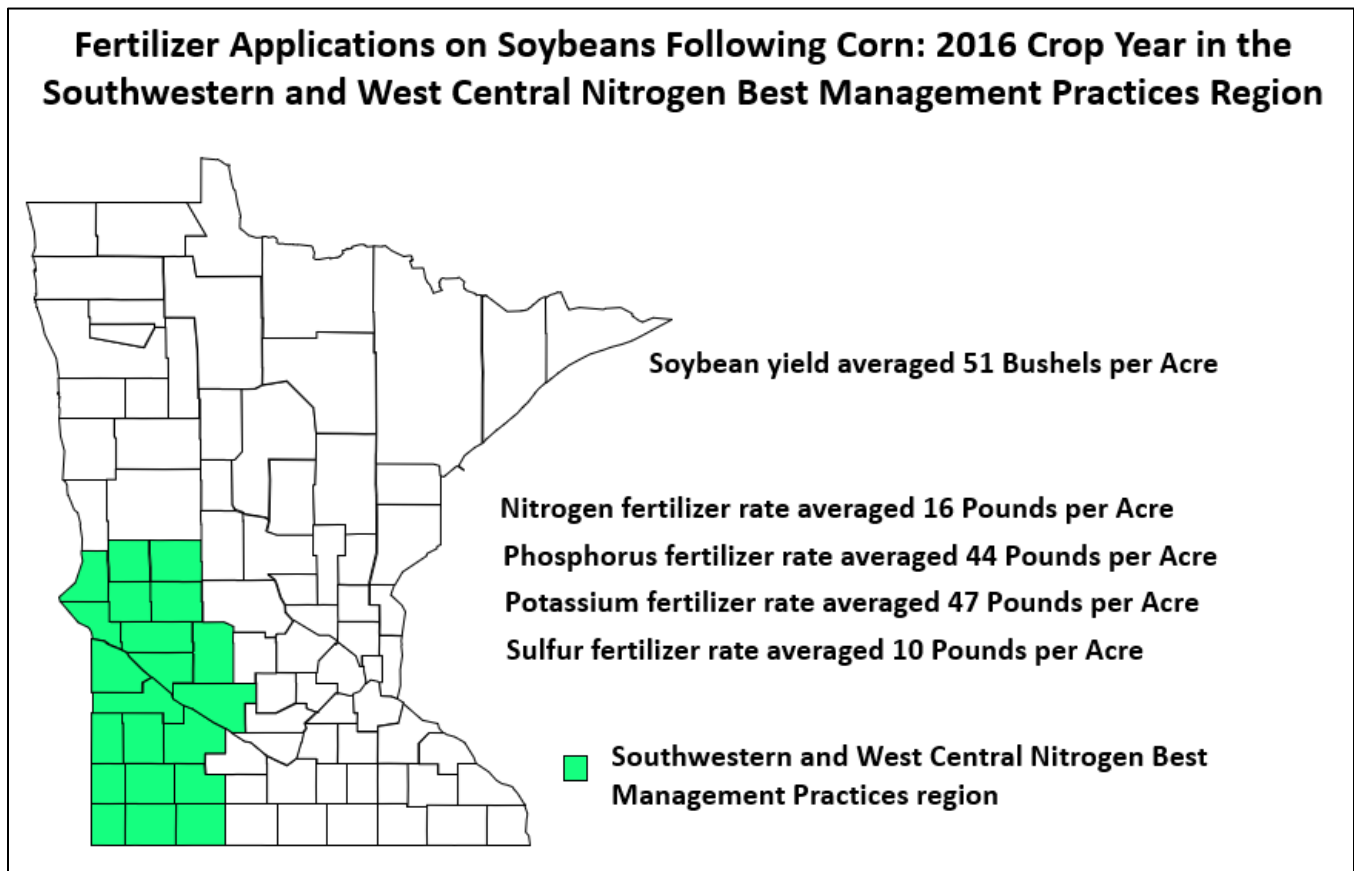


Figure 66. The average soybean yield and average fertilizer rate for soybeans following corn in the SW BMP region.

⁵³ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 90% applied nitrogen, 87% applied phosphorus, 75% applied potassium, and 10% applied sulfur on fields with soybeans following corn.

Figure 67 provides the distribution of average nitrogen fertilizer rate in the SW BMP region for soybeans following corn; the corresponding soybean yield is detailed in red.⁵⁴ Nitrogen rates are only from commercial fertilizer.

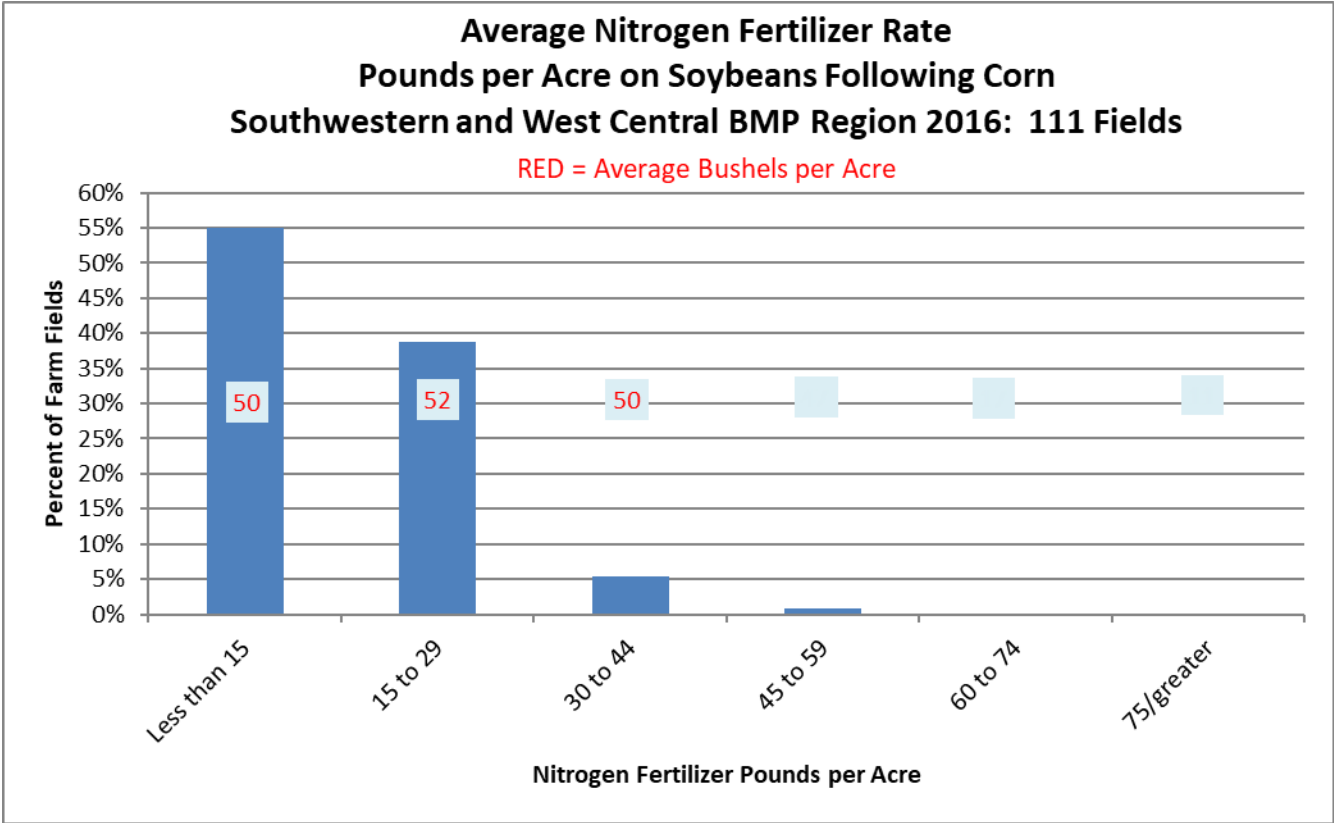


Figure 67. Average nitrogen fertilizer rate and yield on soybeans following corn in the SW BMP region for 2016: 111 fields.

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 126.

Table 126. Average fertilizer rate and soybean 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	90	16	51	14
Phosphorus	87	44	51	39
Potassium	75	47	50	35
Sulfur	10	10	53	1

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

Northwestern BMP Region: Soybeans Following Corn

There were 25 fields that were included in the NW BMP region for soybeans following corn analysis. Figure 68 details the location, average rate of nitrogen, phosphorus, potassium, sulfur fertilizer and average yield for soybeans following corn in the NW BMP region.⁵⁵

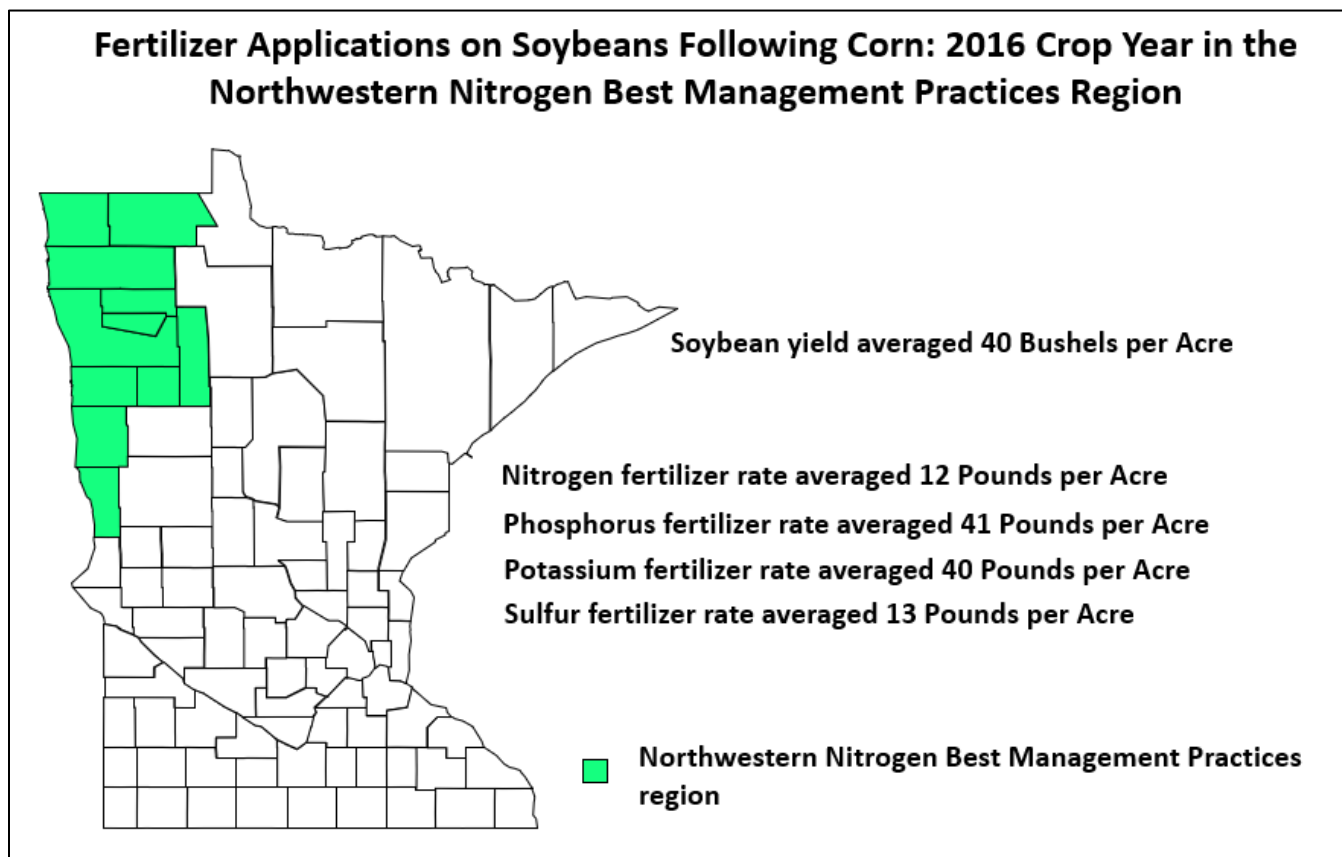


Figure 68. The average soybean yield and average fertilizer rate for soybeans following corn in the NW BMP region.

⁵⁵ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 96% applied nitrogen, 92% applied phosphorus, 60% applied potassium, and 20% applied sulfur on fields with soybeans following corn.

Figure 69 provides the distribution of average nitrogen fertilizer rate in the NW BMP region for soybeans following corn; the corresponding soybean yield is detailed in red.⁵⁶ Nitrogen rates are only from commercial fertilizer.

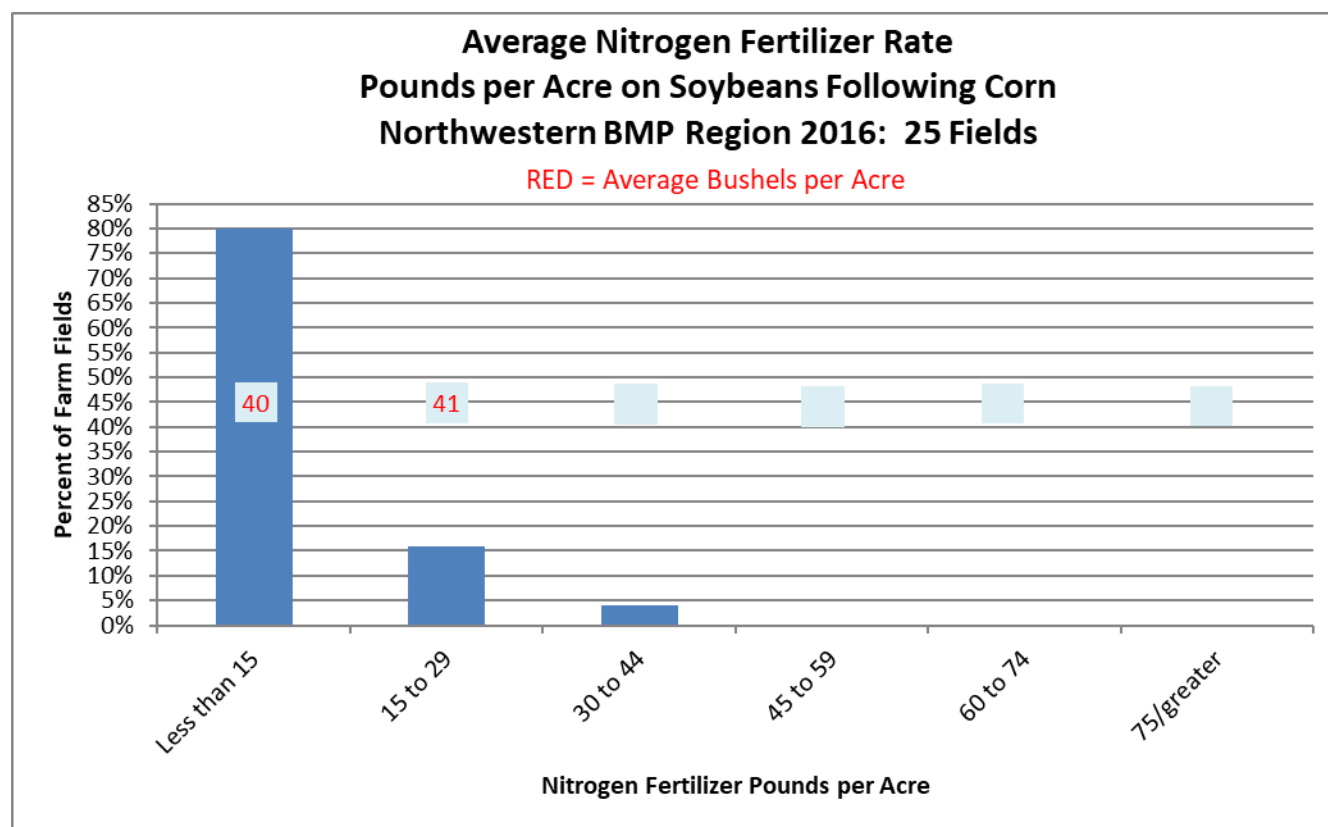


Figure 69. Average nitrogen fertilizer rate and yield on soybeans following corn in the NW BMP region for 2016: 25 fields.

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 127.

Table 127. Average fertilizer rate and soybean 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	96	12	40	11
Phosphorus	92	41	40	37
Potassium	60	40	40	24
Sulfur	20	13	39	3

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

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

There were 124 fields that were included in the IRR BMP region for soybeans following corn analysis. Figure 70 details the location, average rate of nitrogen, phosphorus, potassium, sulfur fertilizer and average yield for soybeans following corn in the IRR BMP region.⁵⁷

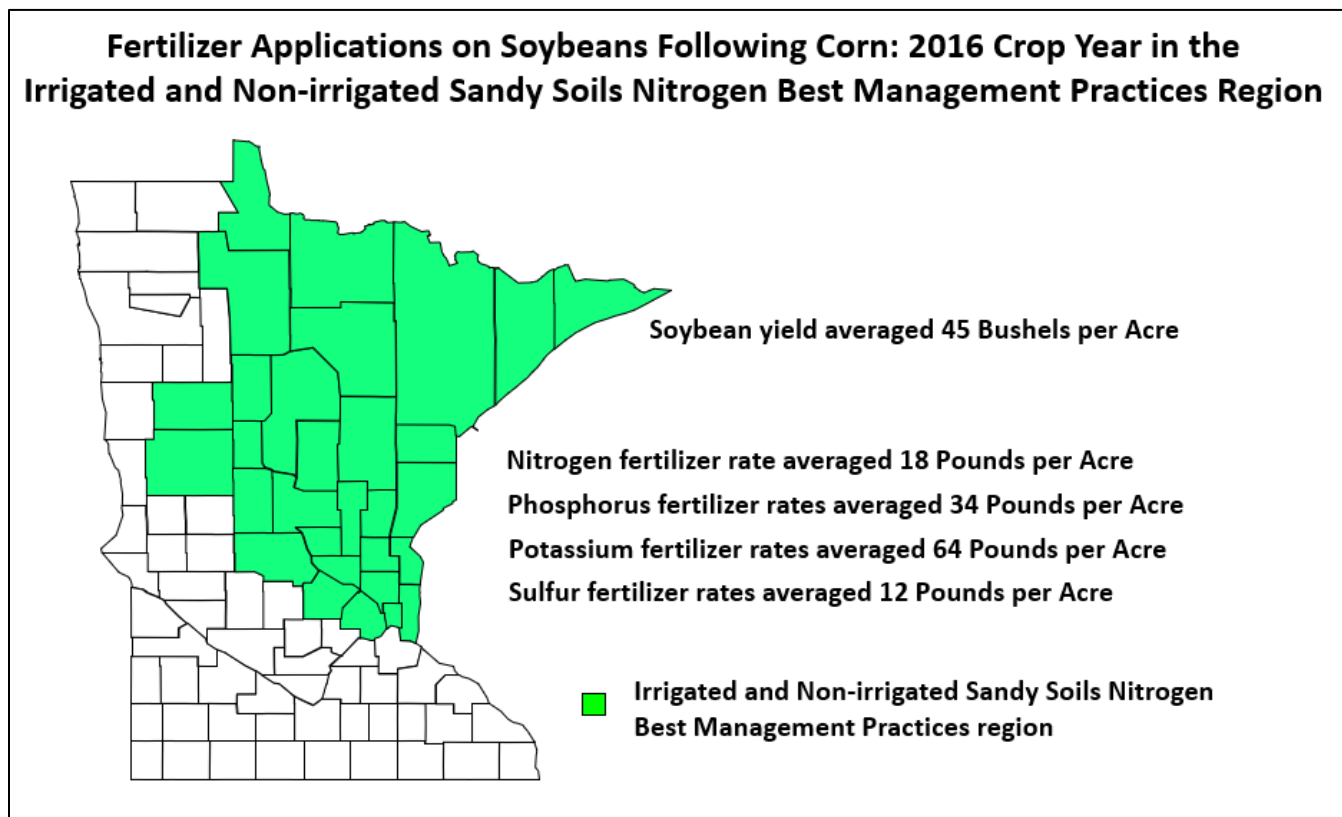


Figure 70. The average soybean yield and average fertilizer rate for soybeans following corn in the IRR BMP region.

⁵⁷ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 63% applied nitrogen, 50% applied phosphorus, 90% applied potassium, and 22% applied sulfur on fields with soybeans following corn.

Figure 71 provides the distribution of average nitrogen fertilizer rate in the IRR BMP region for soybeans following corn; the corresponding soybean yield is detailed in red.⁵⁸ Nitrogen rates are only from commercial fertilizer.

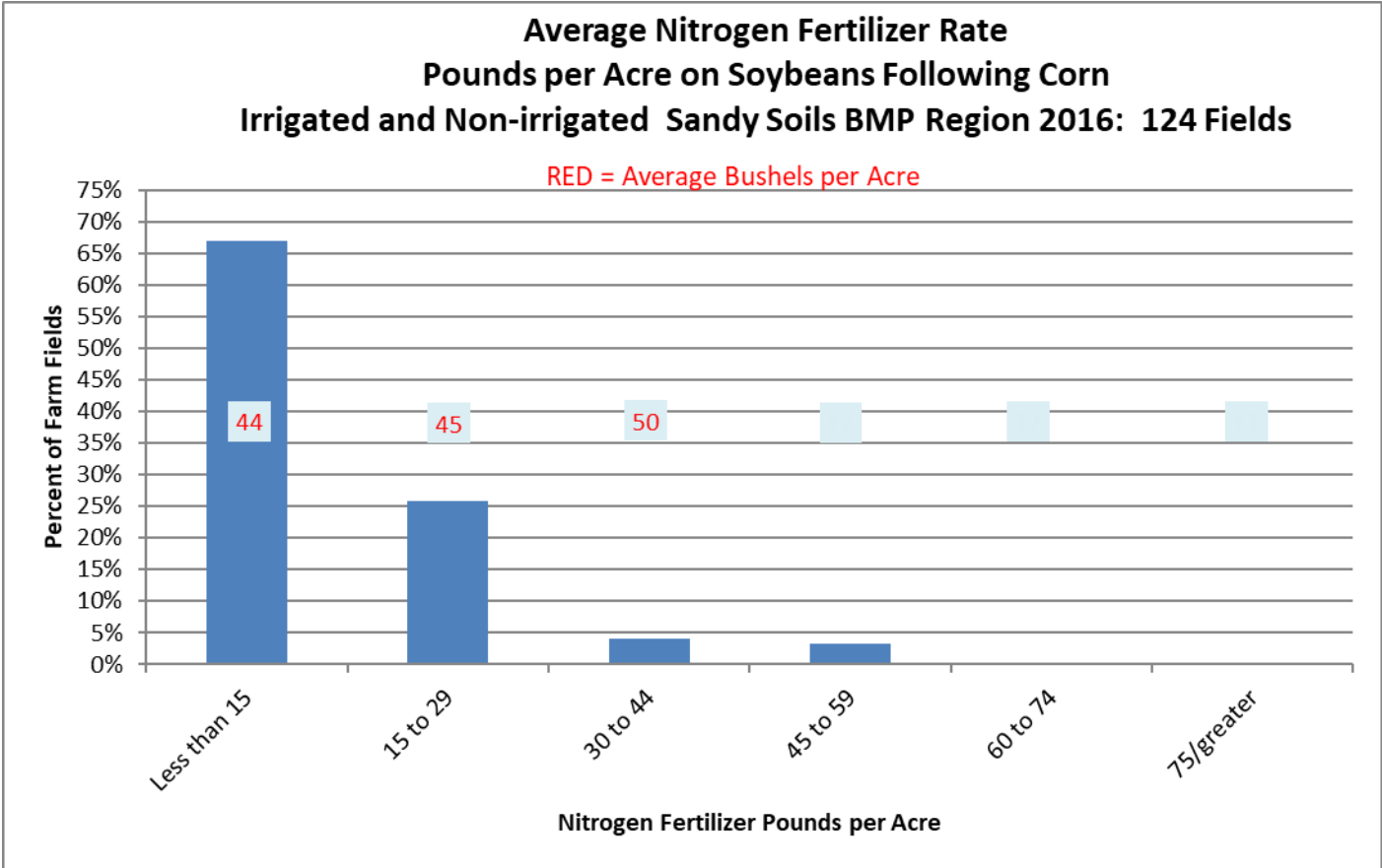


Figure 71. Average nitrogen fertilizer rate and yield on soybeans following corn in the IRR BMP region for 2016: 124 fields.

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 128.

Table 128. Average fertilizer rate and soybean 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	63	18	45	11
Phosphorus	50	34	45	17
Potassium	90	64	45	58
Sulfur	22	12	48	3

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

Statewide: Soybeans Following Corn Following Alfalfa

Statewide, one percent of the fields reported were soybeans following corn following alfalfa. Figure 72 details the BMP regions where farmers reported on fields with soybeans following corn following alfalfa. There were 7 fields surveyed in Minnesota.⁵⁹

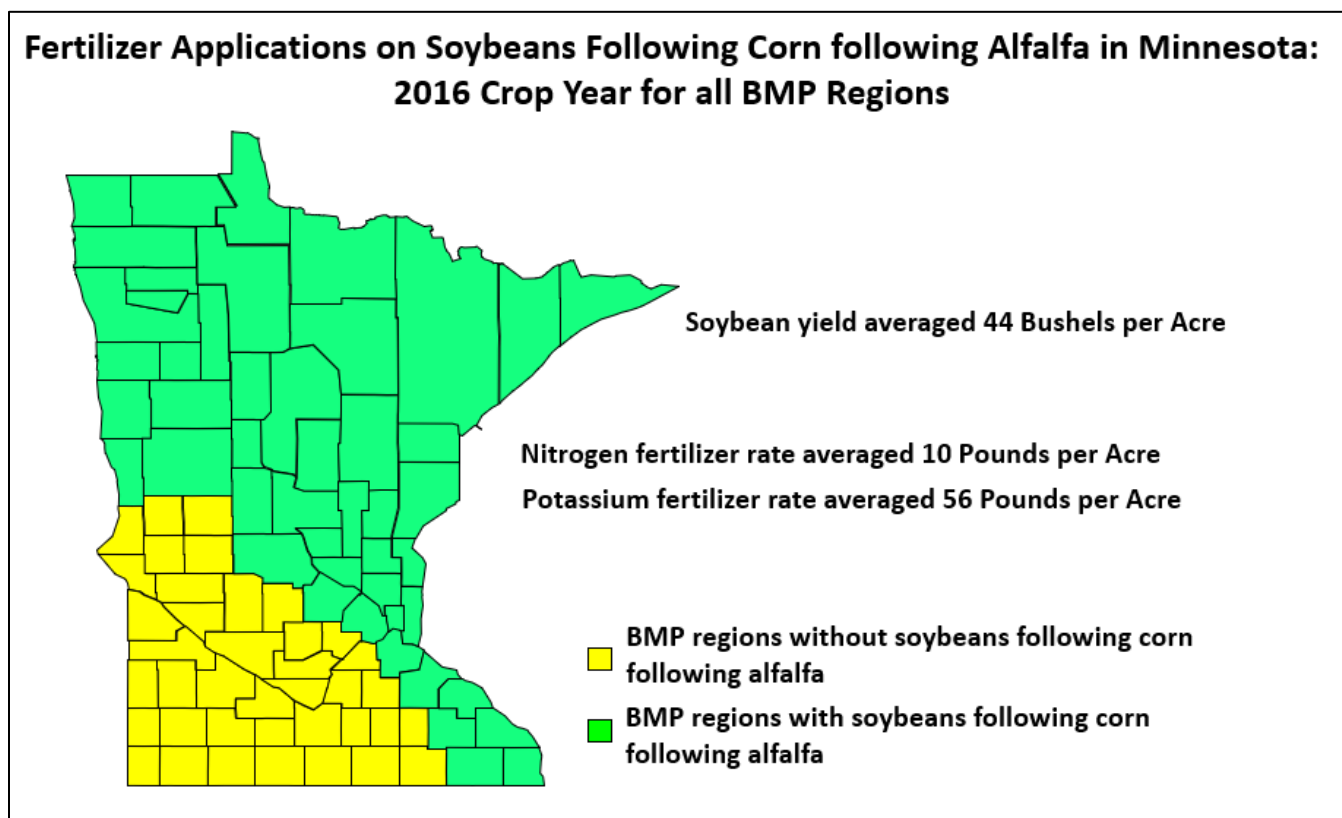


Figure 72. The average soybean yield and average fertilizer rate for soybeans following corn following alfalfa in Minnesota.

⁵⁹ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 86% applied nitrogen and 86% applied potassium on fields with soybeans following corn following alfalfa. Less than five respondents reported applying phosphorus or sulfur.

Figure 73 provides the distribution of average nitrogen fertilizer rate in Minnesota for soybeans following corn following alfalfa; the corresponding soybean yield is detailed in red.⁶⁰ Nitrogen rates are only from commercial fertilizer.

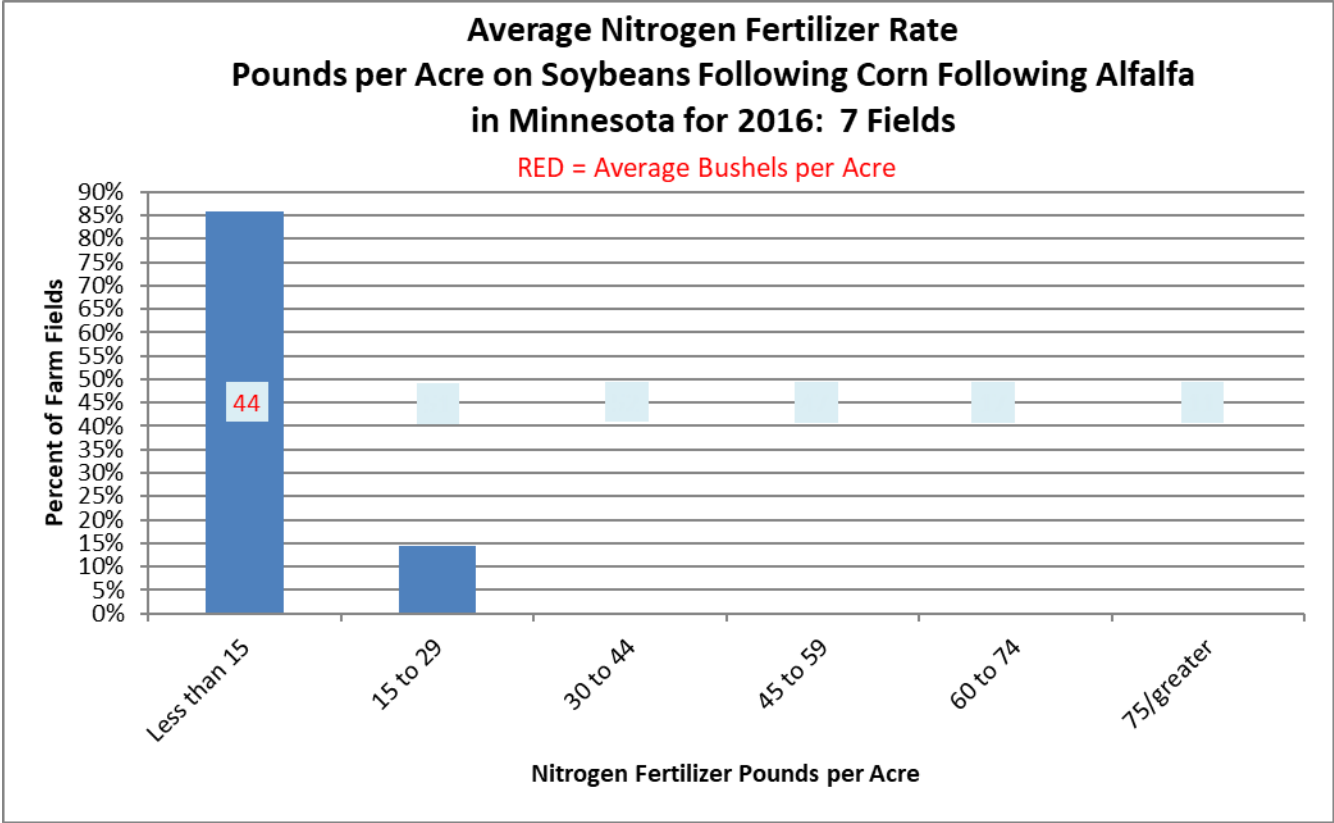


Figure 73. Average nitrogen fertilizer rate and yield on soybeans following corn following alfalfa in Minnesota for 2016: 7 fields.

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; corresponding yield; and the average nutrient rate across all fertilized fields of soybeans following corn following alfalfa are shown in Table 129.

Table 129. Average fertilizer rate and soybean yield in Minnesota for soybeans following corn following alfalfa.

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	86	10	43	9
Phosphorus	**	**	**	**
Potassium	86	56	43	48
Sulfur	**	**	**	**

** Less than five responses

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

Southeastern BMP Region: Soybeans Following Corn Following Alfalfa

The SE BMP region had less than five responses for soybeans following corn following alfalfa.

South Central BMP Region: Soybeans Following Corn Following Alfalfa

The SC BMP had no responses for soybeans following corn following alfalfa.

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

The SW BMP region had no responses for soybeans following corn following alfalfa.

Northwestern BMP Region: Soybeans Following Corn Following Alfalfa

The NW BMP region had less than five responses for soybeans following corn following alfalfa.

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

There were 5 fields that were included in the IRR BMP region for soybeans following corn following alfalfa analysis. Figure 74 details the location, average rate of nitrogen, phosphorus, potassium, sulfur fertilizer and average yield for soybeans following corn following alfalfa in the IRR BMP region.⁶¹

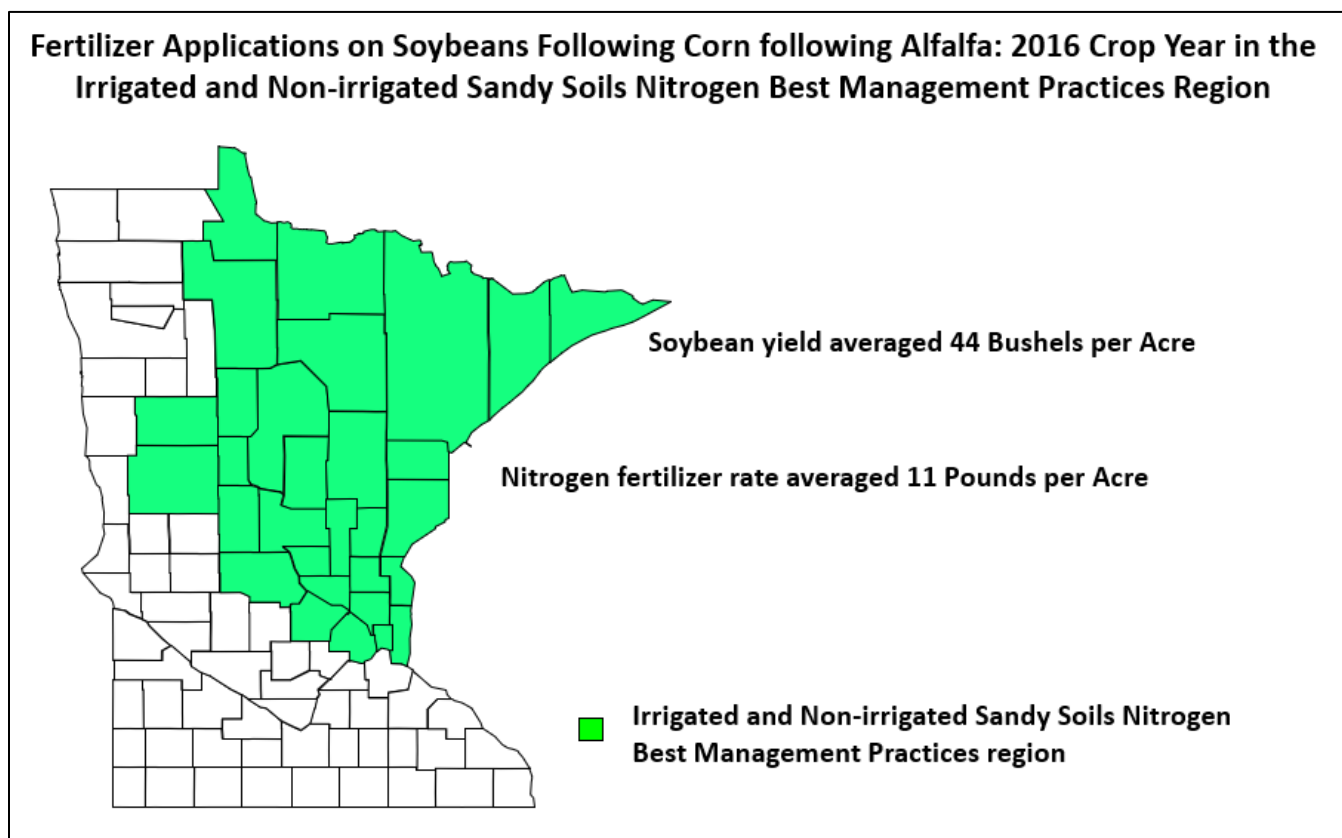


Figure 74. The average soybean yield and average fertilizer rate for soybeans following corn following alfalfa in the IRR BMP region.

⁶¹ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen on fields with soybeans following corn following alfalfa. Less than five respondents reported applying phosphorus, potassium, or sulfur.

Figure 75 provides the distribution of average nitrogen fertilizer rate in the IRR BMP region for soybeans following corn following alfalfa; the corresponding soybean yield is detailed in red.⁶² Nitrogen rates are only from commercial fertilizer.

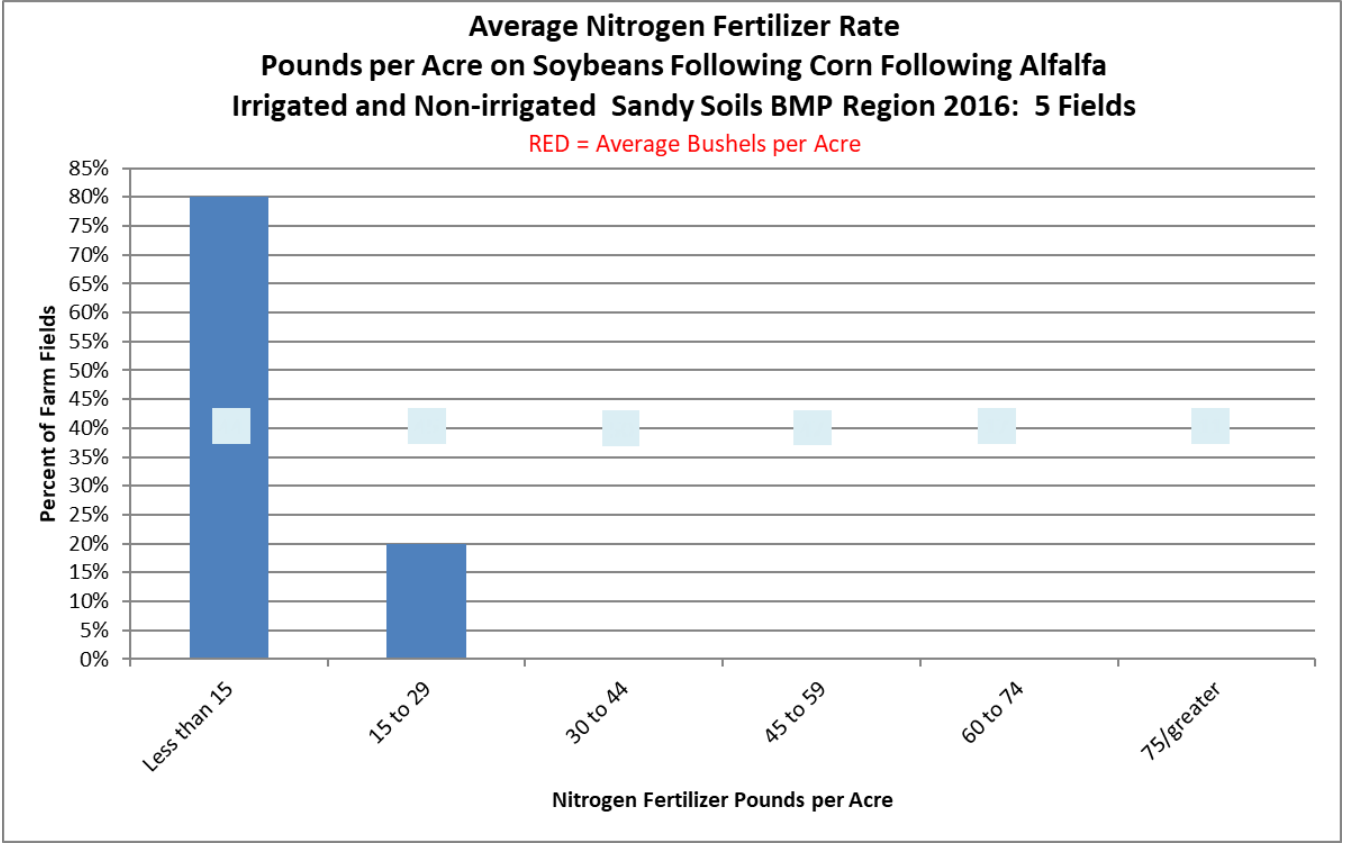


Figure 75. Average nitrogen fertilizer rate and yield on soybeans following corn following alfalfa in the IRR BMP region for 2016: 5 fields.

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 following alfalfa are shown in Table 130.

Table 130. Average fertilizer rate and yield in the IRR BMP region for soybeans following corn following alfalfa.

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	11	44	11
Phosphorus	**	**	**	**

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

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
Potassium	**	**	**	**
Sulfur	**	**	**	**

** 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, thirteen percent of the fields reported were soybeans following small grains. Figure 76 details the BMP regions where farmers reported on fields with soybeans following small grains. There were 75 fields surveyed in Minnesota.⁶³

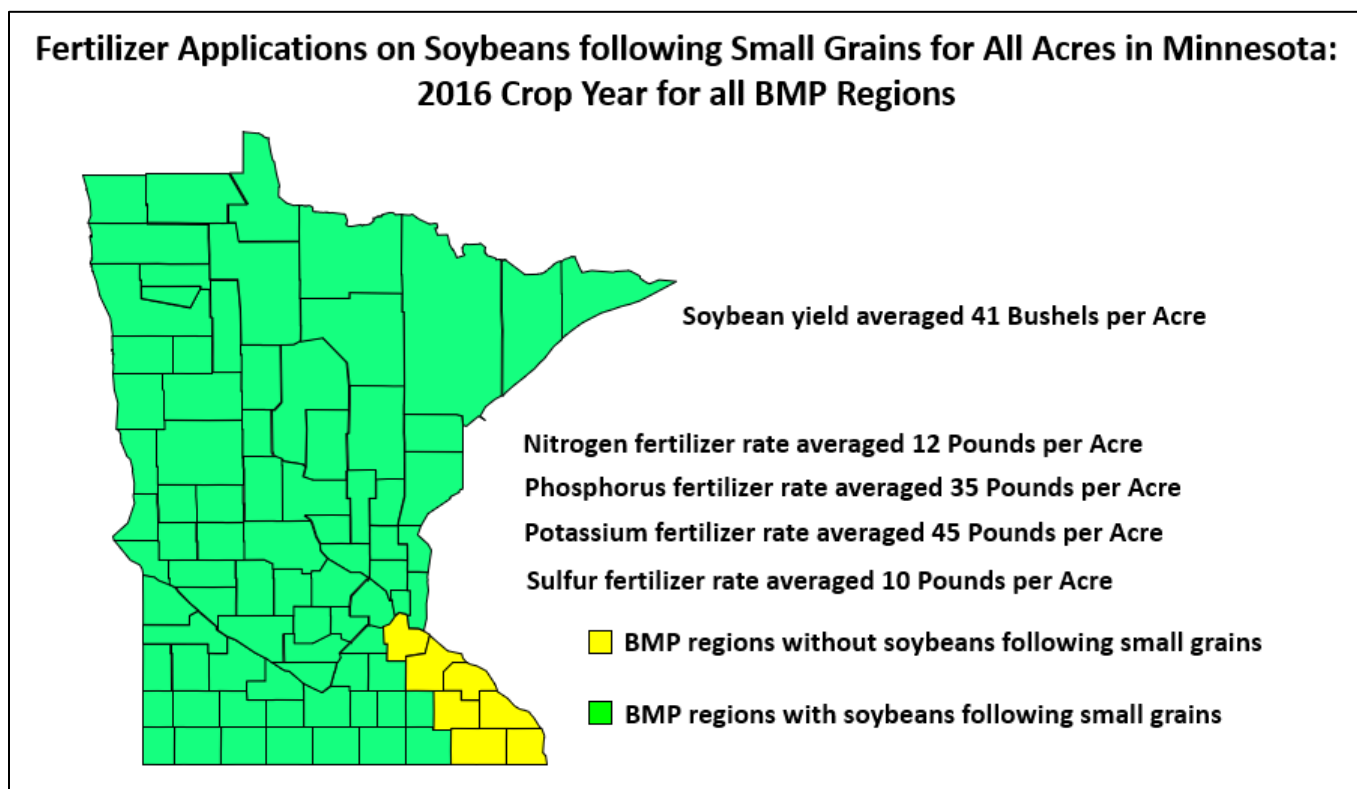


Figure 76. The average soybean yield and average fertilizer rate for soybeans following small grains in Minnesota.

⁶³ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 93% applied nitrogen, 88% applied phosphorus, 72% applied potassium, and 13% applied sulfur on fields with soybeans following small grains.

Figure 77 provides the distribution of average nitrogen fertilizer rate in Minnesota for soybeans following small grains; the corresponding soybean yield is detailed in red.⁶⁴ Nitrogen rates are only from commercial fertilizer.

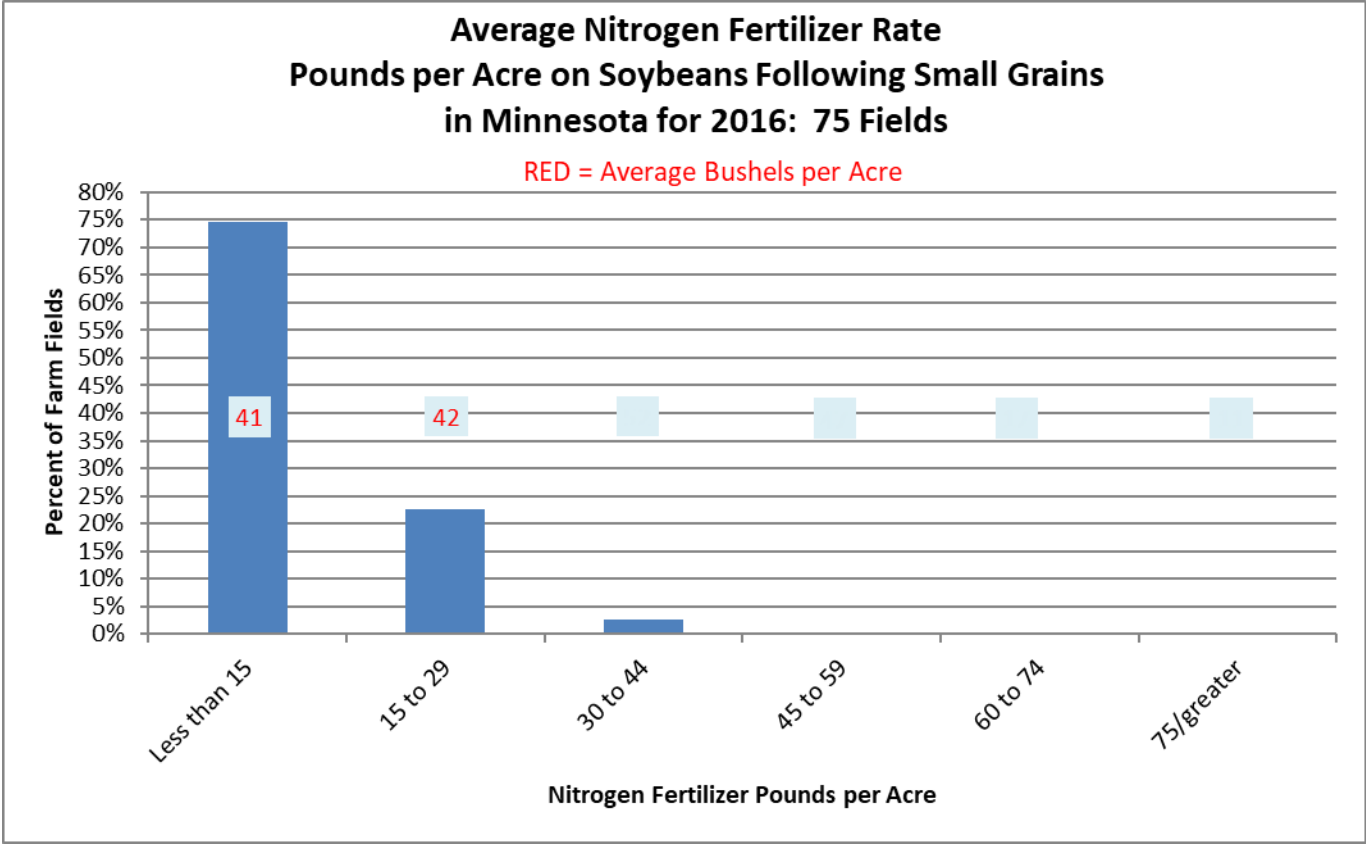


Figure 77. Average nitrogen fertilizer rate and yield on soybeans following small grains in Minnesota for 2016: 75 fields.

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; corresponding yield; and the average nutrient rate across all fertilized fields of soybeans following small grains are shown in Table 131.

Table 131. Average fertilizer rate and soybean yield 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	93	12	41	11
Phosphorus	88	35	41	30
Potassium	72	45	41	32
Sulfur	13	10	44	1

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

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 had less than five responses for soybeans following small grains.

Southwestern and West Central BMP Region: Soybeans Following Small Grains

There were 7 fields that were included in the SW BMP region for soybeans following small grains analysis. Figure 78 details the location, average rate of nitrogen, phosphorus, potassium, sulfur fertilizer and average yield for soybeans following small grains in the SW BMP region.⁶⁵

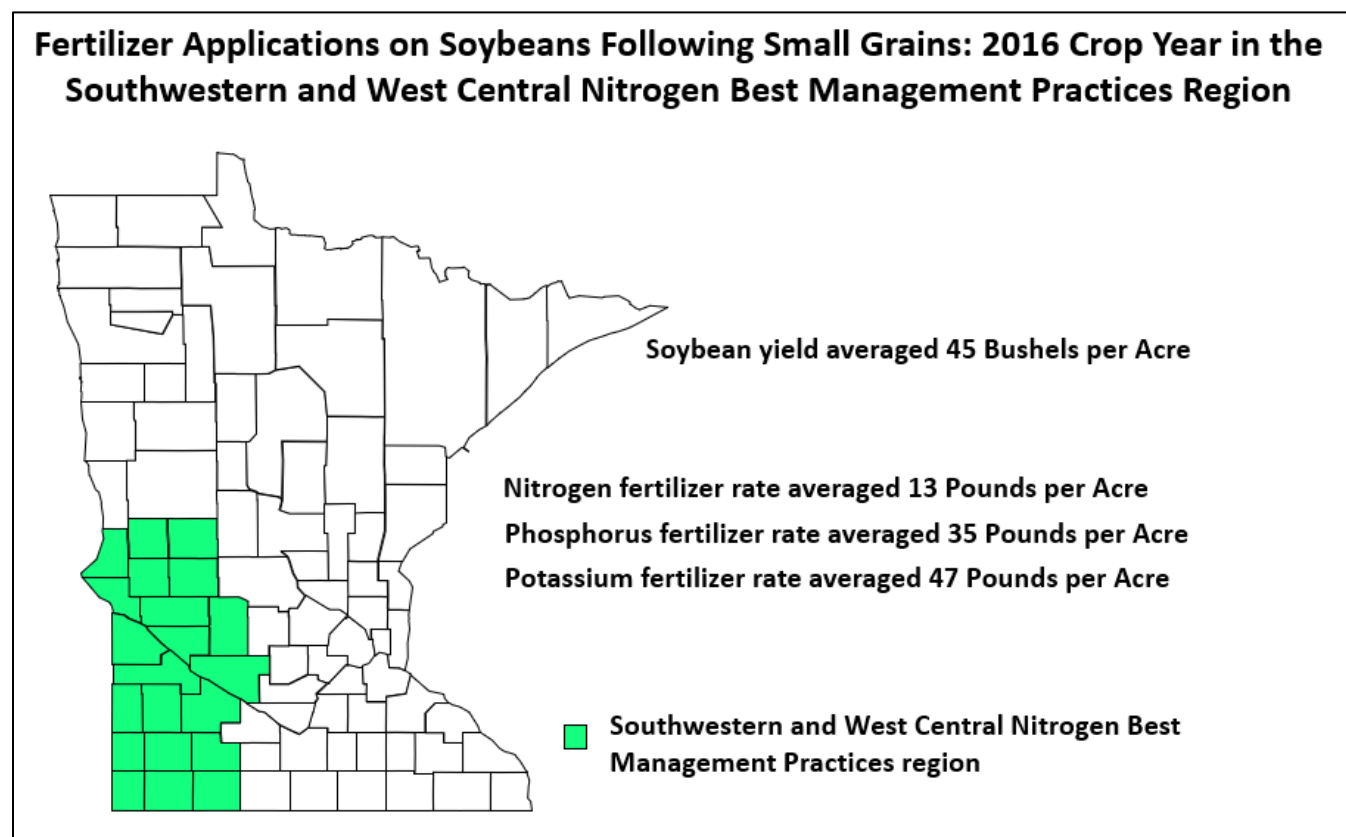


Figure 78. The average soybean yield and average fertilizer rate for soybeans following small grains in the SW BMP region.

⁶⁵ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 86% applied nitrogen, 86% applied phosphorus, and 86% applied potassium on fields with soybeans following small grains. Less than five respondents reported applying sulfur.

Figure 79 provides the distribution of average nitrogen fertilizer rate in the SW BMP region for soybeans following small grains; the corresponding soybean yield is detailed in red.⁶⁶ Nitrogen rates are only from commercial fertilizer.

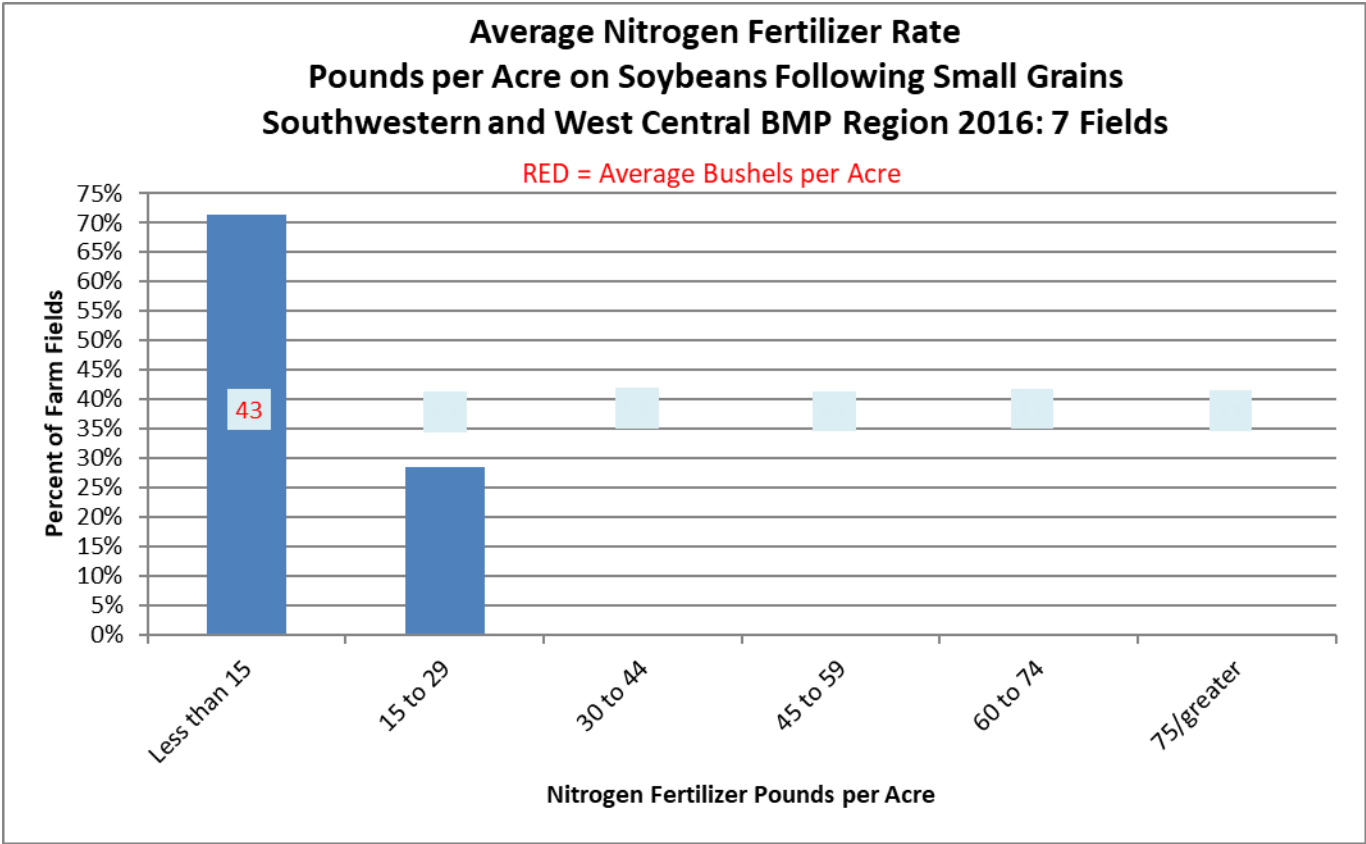


Figure 79. Average nitrogen fertilizer rate and yield on soybeans following small grains in the SW BMP region for 2016: 7 fields.

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 small grains are shown in Table 132.

Table 132. Average fertilizer rate and soybean yield in the SW 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	86	13	46	11
Phosphorus	86	35	46	30
Potassium	86	47	45	40
Sulfur	**	**	**	**

** Less than five responses

⁶⁶ Yields are not published if there are less than five responses.

Northwestern BMP Region: Soybeans Following Small Grains

There were 48 fields that were included in the NW BMP region for soybeans following small grains analysis. Figure 80 details the location, average rate of nitrogen, phosphorus, potassium, sulfur fertilizer and average yield for soybeans following small grains in the NW BMP region.⁶⁷

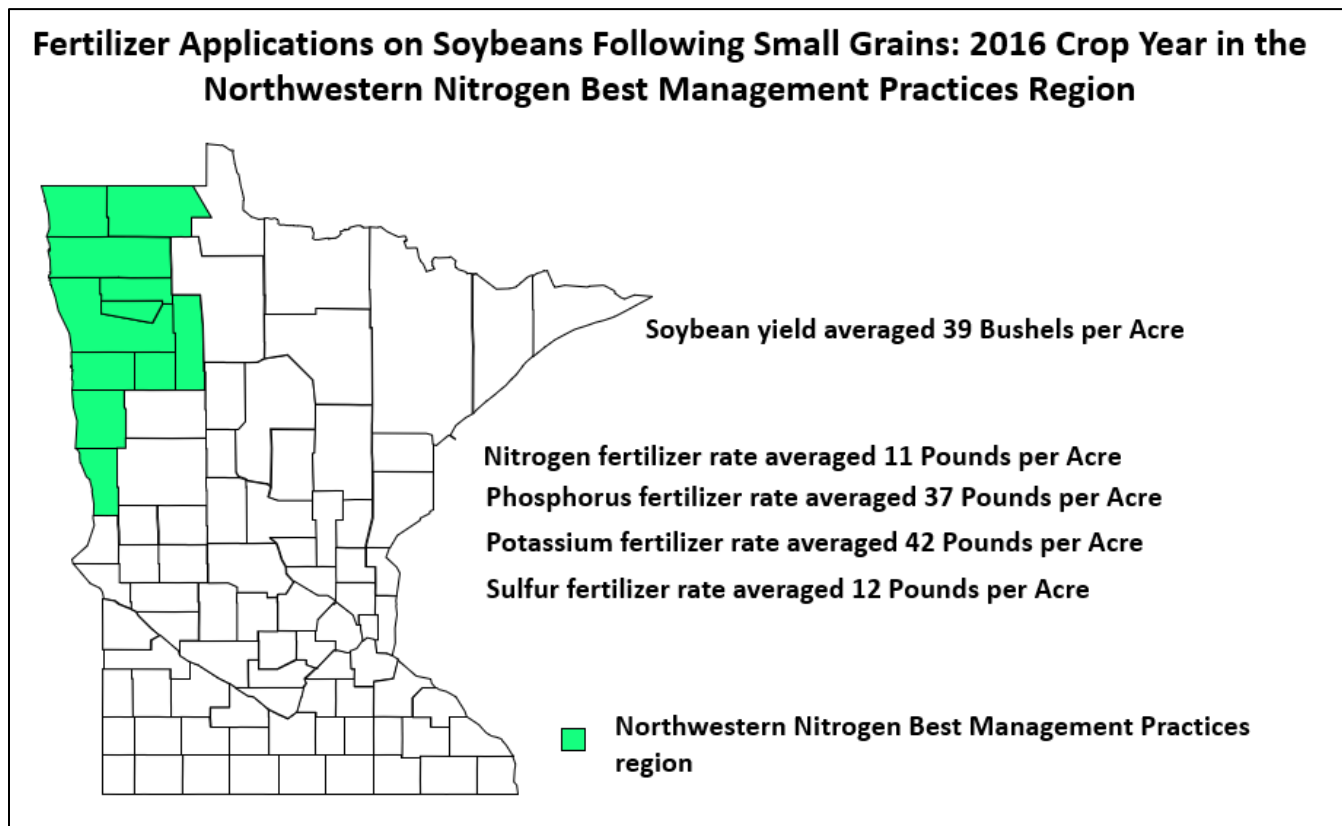


Figure 80. The average soybean yield and average fertilizer rate for soybeans following small grains in the NW BMP region.

⁶⁷ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 98% applied nitrogen, 90% applied phosphorus, 58% applied potassium, and 15% applied sulfur on fields with soybeans following small grains.

Figure 81 provides the distribution of average nitrogen fertilizer rate in the NW BMP region for soybeans following small grains; the corresponding soybean yield is detailed in red.⁶⁸ Nitrogen rates are only from commercial fertilizer.

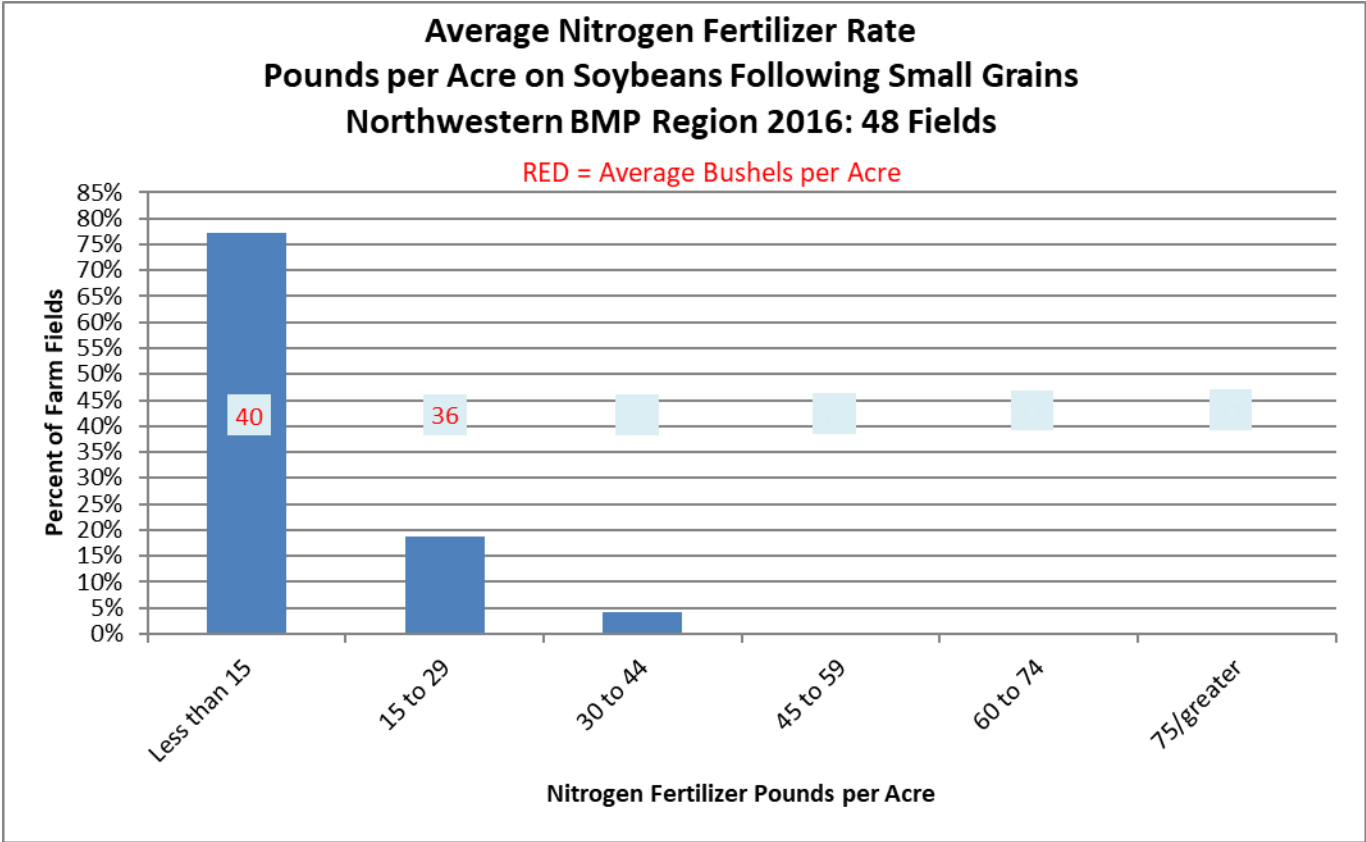


Figure 81. Average nitrogen fertilizer rate and yield on soybeans following small grains in the NW BMP region for 2016: 48 fields.

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 small grains are shown in Table 133.

Table 133. Average fertilizer rate and soybean yield 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	98	11	39	11
Phosphorus	90	37	39	33
Potassium	58	42	39	24
Sulfur	15	12	41	2

⁶⁸ Yields are not published if there are less than five responses.

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

There were 19 fields that were included in the IRR BMP region for soybeans following small grains analysis. Figure 82 details the location, average rate of nitrogen, phosphorus, potassium, sulfur fertilizer and average yield for soybeans following small grains in the IRR BMP region.⁶⁹

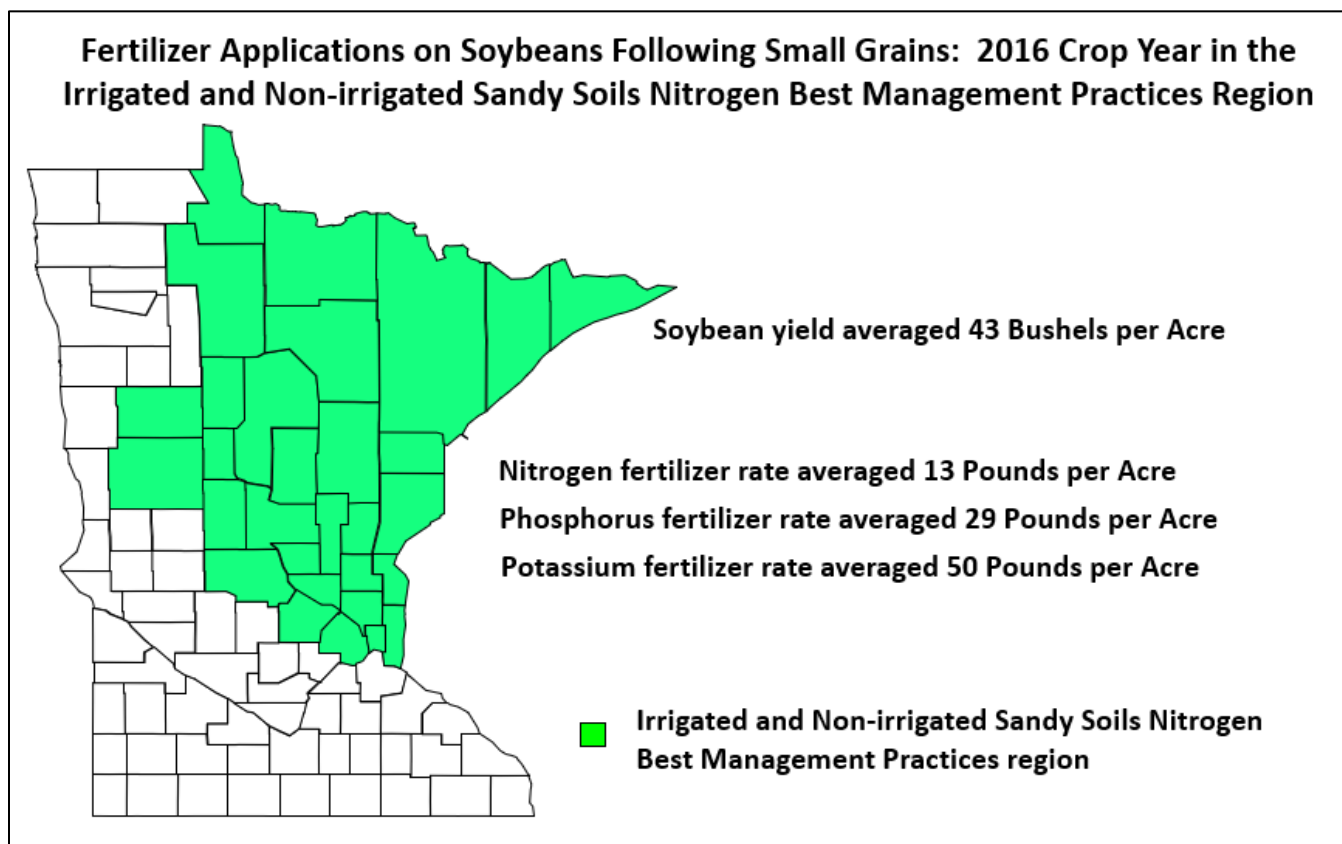


Figure 82. The average soybean yield and average fertilizer rate for soybeans following small grains in the IRR BMP region.

⁶⁹ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 84% applied nitrogen, 84% applied phosphorus, and 100% applied potassium on fields with soybeans following small grains. Less than five respondents reported applying sulfur.

Figure 83 provides the distribution of average nitrogen fertilizer rate in the IRR BMP region for soybeans following small grains; the corresponding soybean yield is detailed in red.⁷⁰ Nitrogen rates are only from commercial fertilizer.

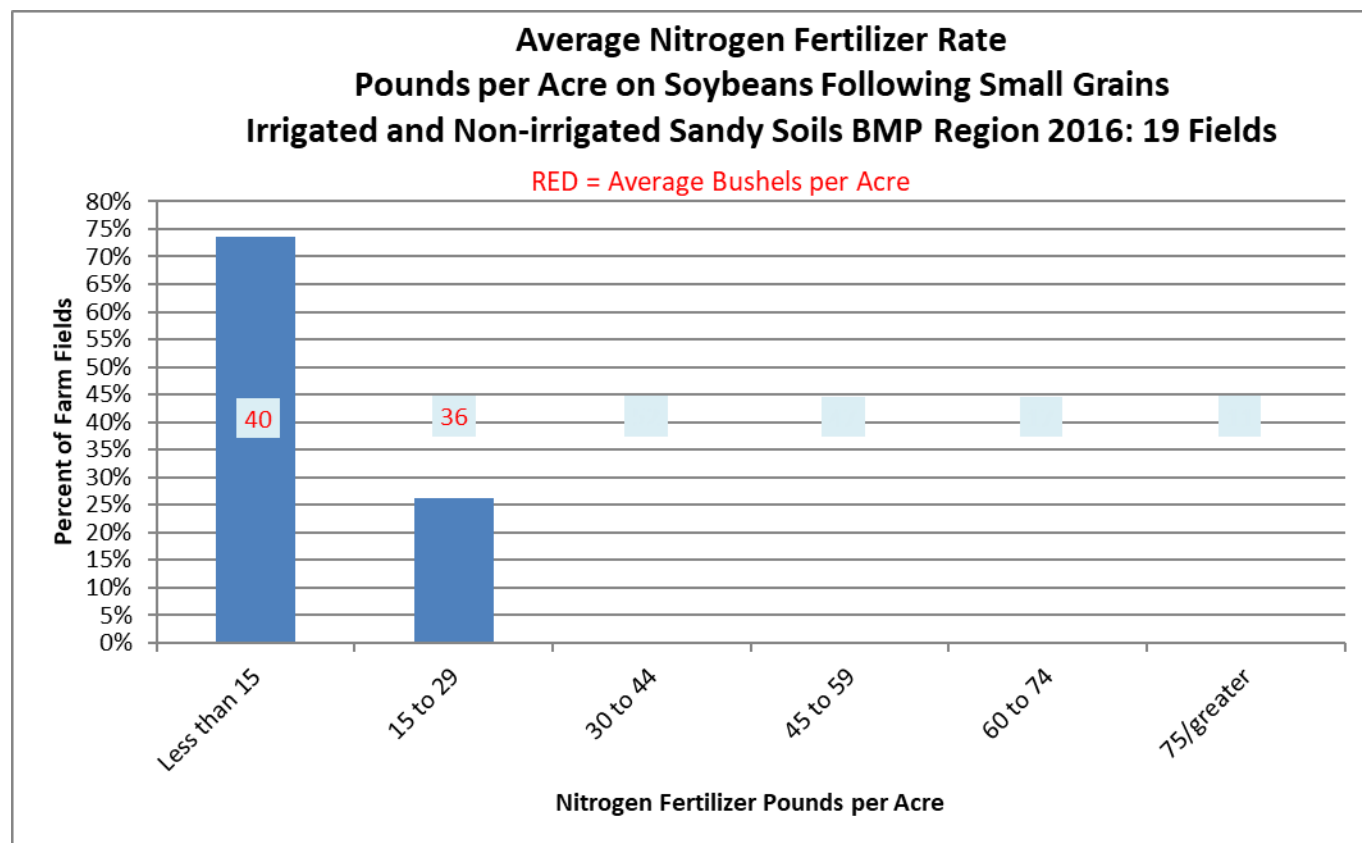


Figure 83. Average nitrogen fertilizer rate and yield on soybeans following small grains in the IRR BMP region for 2016: 19 fields.

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 small grains are shown in Table 134.

Table 134. Average fertilizer rate and soybean yield 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	84	13	43	11
Phosphorus	84	29	43	24
Potassium	100	50	43	50
Sulfur	**	**	**	**

** Less than five responses

⁷⁰ Yields are not published if there are less than five responses.

Statewide: Soybeans Following Other Crops

Statewide, five percent of the fields reported were soybeans following other crops. Figure 84 details the BMP regions where farmers reported on fields with soybeans following other crops. There were 27 fields surveyed in Minnesota.⁷¹

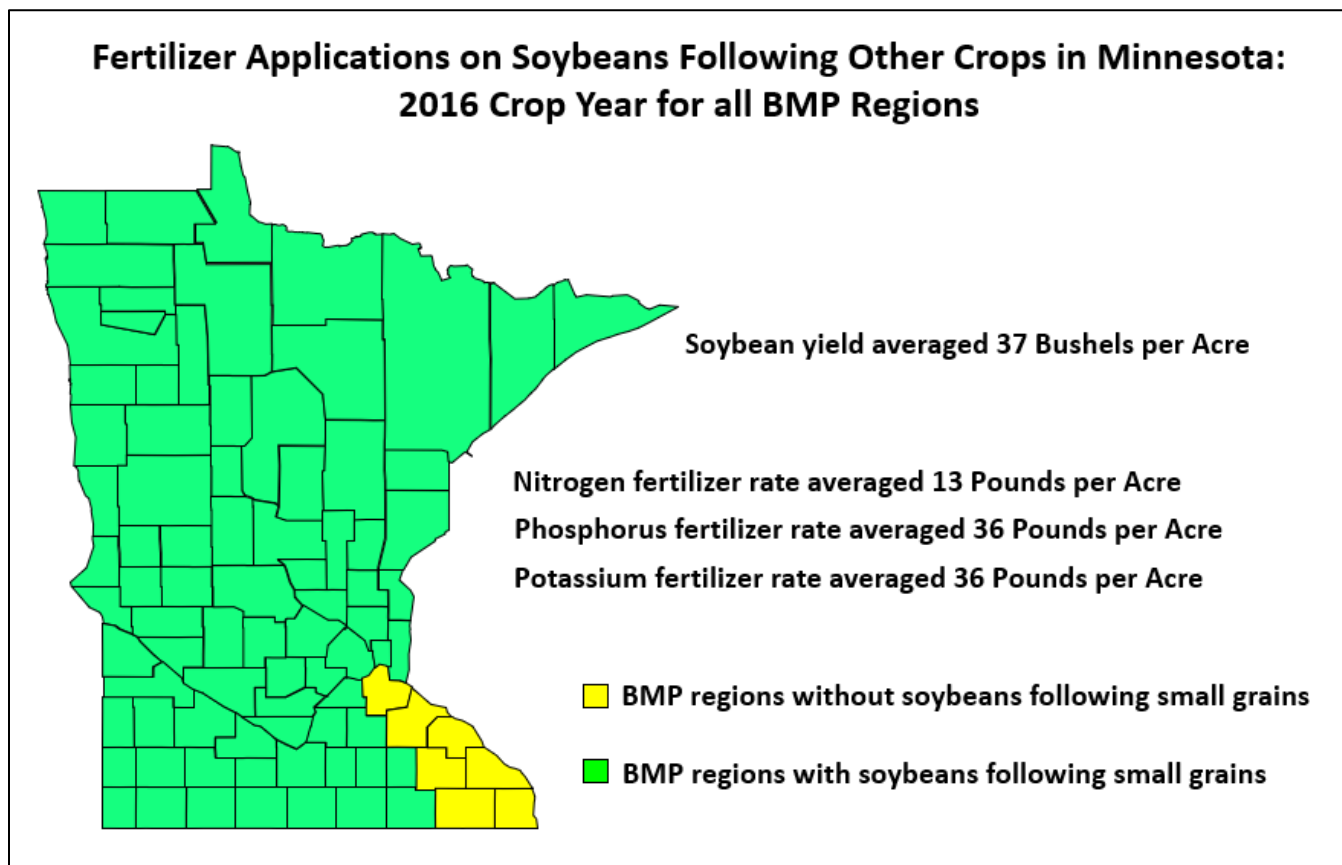


Figure 84. The average soybean yield and average fertilizer rate for soybeans following other crops in Minnesota.

⁷¹ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 96% applied nitrogen, 81% applied phosphorus, and 74% applied potassium on fields with soybeans following other crops. Less than five respondents reported applying sulfur.

Figure 85 provides the distribution of average nitrogen fertilizer rate in Minnesota for soybeans following other crops; the corresponding soybean yield is detailed in red.⁷² Nitrogen rates are only from commercial fertilizer.

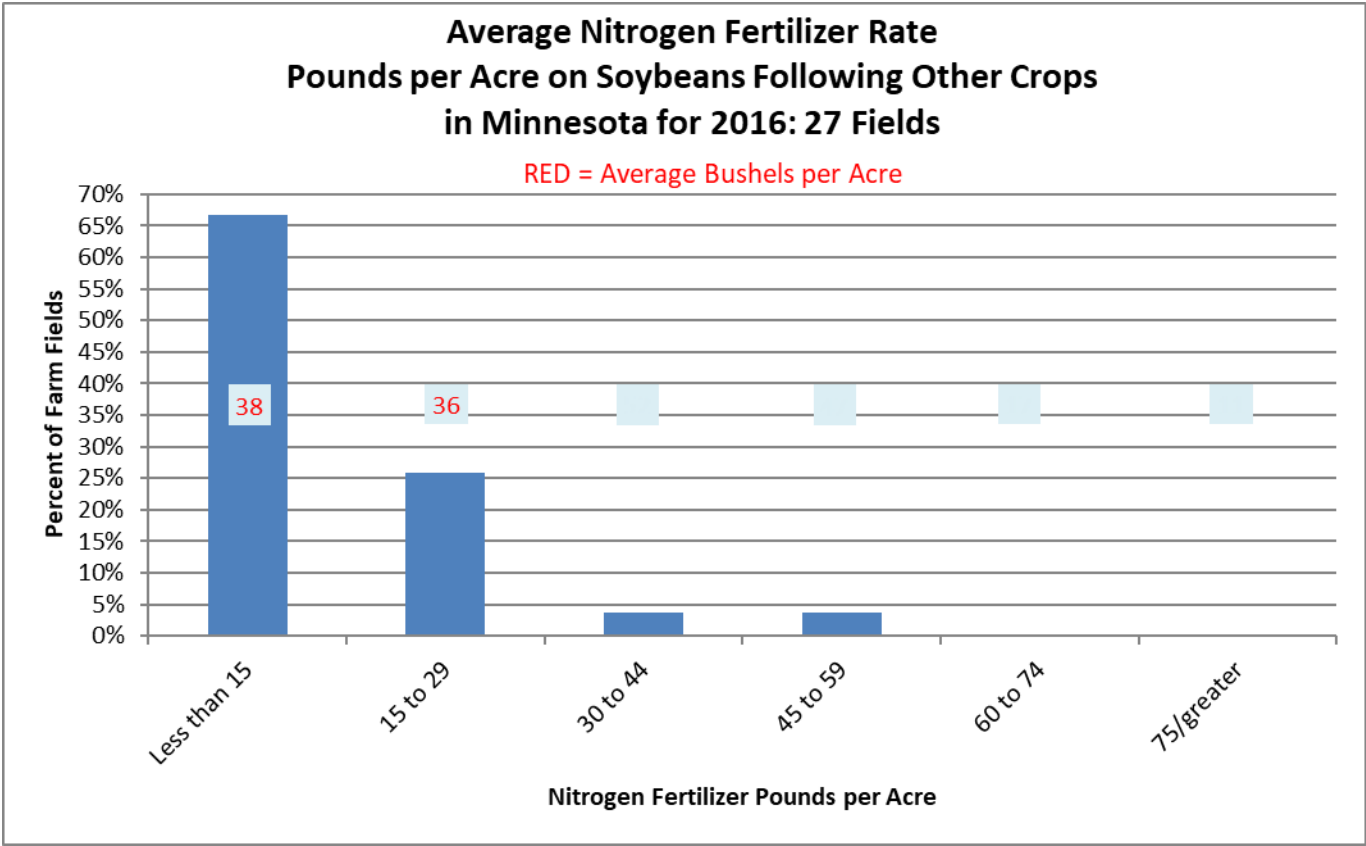


Figure 85. Average nitrogen fertilizer rate and yield on soybeans following other crops in Minnesota for 2016: 27 fields.

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; corresponding yield; and the average nutrient rate across all fertilized fields of soybeans following other crops are shown in Table 135.

Table 135. Average fertilizer rate and soybean yield in Minnesota for soybeans following other crops.

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	96	13	37	13
Phosphorus	81	36	37	29
Potassium	74	36	38	27
Sulfur	**	**	**	**

** Less than five responses

⁷² Yields are not published if there are less than five responses.

Southeastern BMP Region: Soybeans Following Other Crops

The SE BMP region had no responses for soybeans following other crops.

South Central BMP Region: Soybeans Following Other Crops

The SC BMP had less than five responses for soybeans following other crops.

Southwestern and West Central BMP Region: Soybeans Following Other Crops

The SW BMP had less than five responses for soybeans following other crops.

Northwestern BMP Region: Soybeans Following Other Crops

There were 19 fields that were included in the NW BMP region for soybeans following other crops analysis. Figure 86 details the location, average rate of nitrogen, phosphorus, potassium, sulfur fertilizer and average yield for soybeans following small grains in the NW BMP region.⁷³

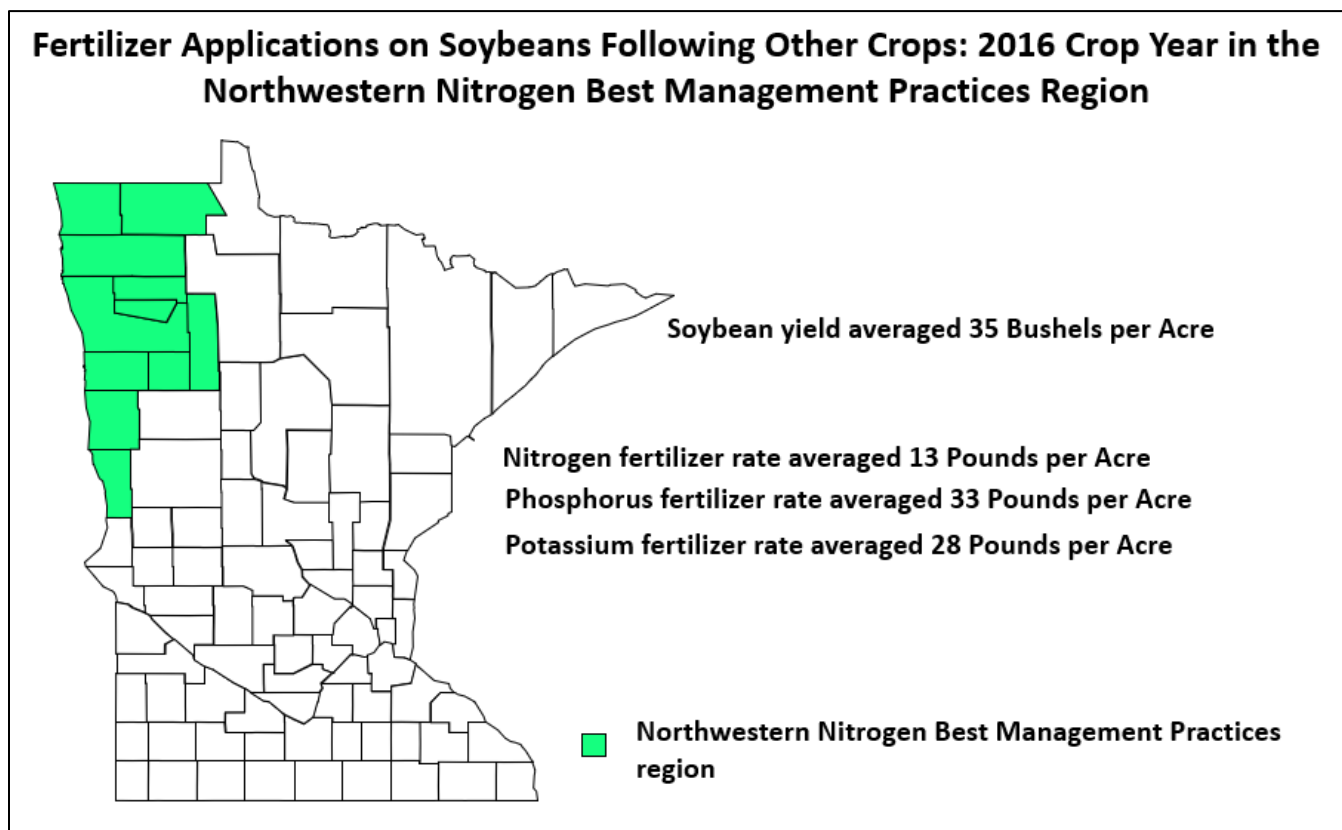


Figure 86. The average soybean yield and average fertilizer rate for soybeans following other crops in the NW BMP region.

⁷³ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 100% applied nitrogen, 84% applied phosphorus, and 63% applied potassium on fields with soybeans following other crops. Less than five respondents reported applying sulfur.

Figure 87 provides the distribution of average nitrogen fertilizer rate in the NW BMP region for soybeans following other crops; the corresponding soybean yield is detailed in red.⁷⁴ Nitrogen rates are only from commercial fertilizer.

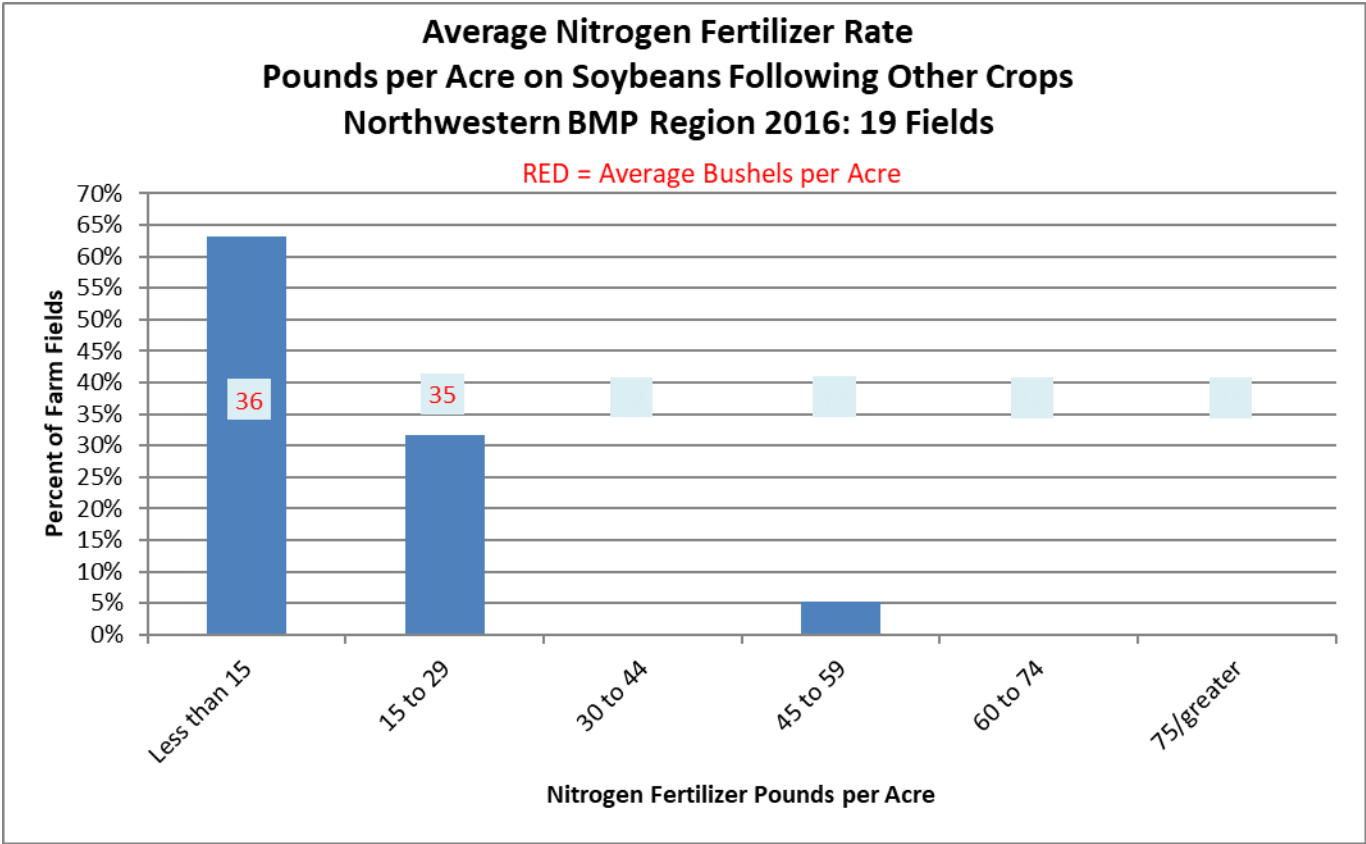


Figure 87. Average nitrogen fertilizer rate and yield on soybeans following other crops in the NW BMP region for 2016: 19 fields.

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 other crops are shown in Table 136.

Table 136. Average fertilizer rate and soybean yield in the NW BMP region for soybeans following other crops.

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	13	35	13
Phosphorus	84	33	35	28
Potassium	63	28	35	17
Sulfur	**	**	**	**

** Less than five responses

⁷⁴ Yields are not published if there are less than five responses.

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

There were 5 fields that were included in the IRR BMP region for soybeans following other crops analysis. Figure 88 details the location, average rate of nitrogen, phosphorus, potassium, sulfur fertilizer and average yield for soybeans following other crops in the IRR BMP region.⁷⁵

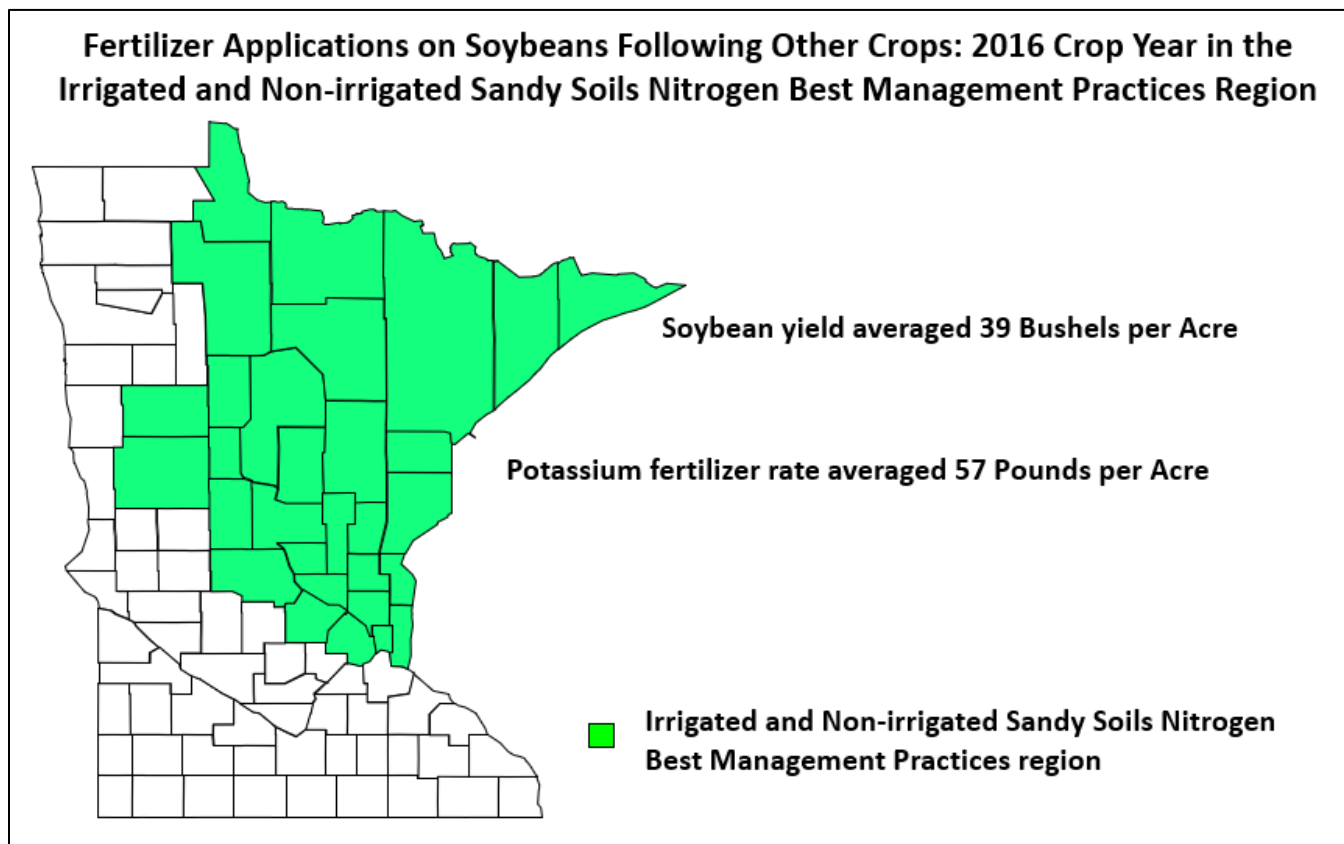


Figure 88. The average soybean yield and average fertilizer rate for soybeans following other crops in the IRR BMP region.

⁷⁵ The published averages are for respondents that applied commercial fertilizer on soybean fields without manure to the 2016 soybean crop. Of the respondents that applied commercial fertilizer, 100% applied potassium on fields with soybeans following other crops. Less than five respondents reported applying nitrogen, phosphorus, or sulfur.

Figure 89 provides the distribution of average nitrogen fertilizer rate in the IRR BMP region for soybeans following other crops; the corresponding soybean yield is detailed in red.⁷⁶ Nitrogen rates are only from commercial fertilizer.

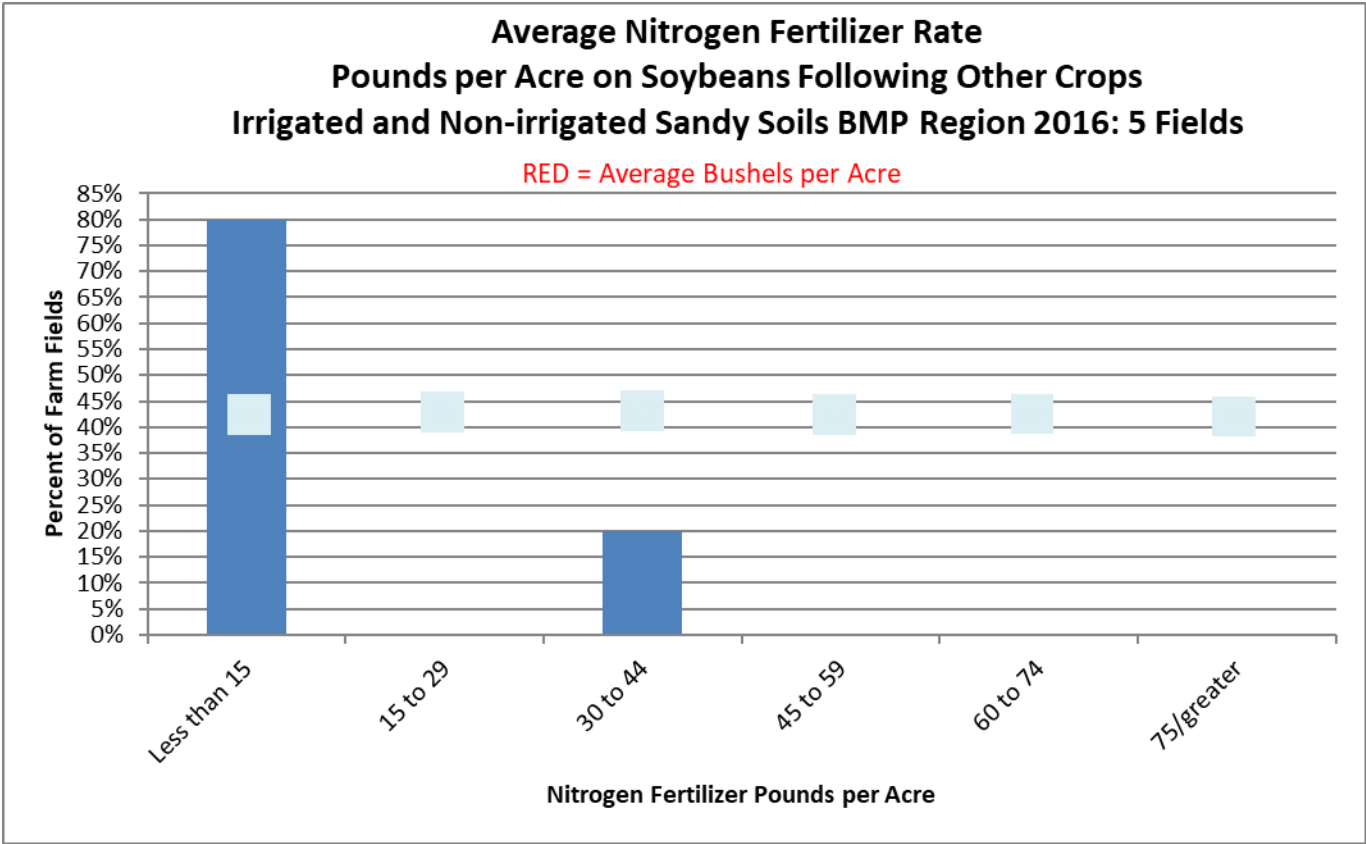


Figure 89. Average nitrogen fertilizer rate and yield on soybeans following other crops in the IRR BMP region for 2016: 5 fields.

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 other crops are shown in Table 137.

Table 137. Average fertilizer rate and soybean yield in the IRR BMP region for soybeans following other crops.

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	57	39	57
Sulfur	**	**	**	**

** Less than five responses

⁷⁶ Yields are not published if there are less than five responses.

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 2016 Crop Season

FIELDS MP102 Part 1 (Wheat Field 1)

Wheat All Question 1 Total Crop Acres How many acres of wheat did you plant?

Wheat Fertilizer Question 1 Wheat Acre Do you have a wheat field without manure? Yes No

Setup Statement Verify Acres I will now ask you about your fertilizer inputs on wheat your acres. First on a wheat field with no manure. Think about your largest wheat field that you planted in 2016 without any manure.

Wheat Fertilizer Question 2 Wheat Irrigated Was this field irrigated? Yes No

Wheat Fertilizer Question 3 Wheat Prev Crop What was the crop grown on this field in 2015 before the 2016 wheat crop? (Not including cover crop)?

Prev Crop =

Soybeans (1) "Soybeans",

Corn (2) "Corn",

Alfalfa (3) "Alfalfa",

Small Grains (4) "Small Grains",

Other (99) "Other"

Wheat Fertilizer Question 3b If Corn Planted Was alfalfa planted in 2014? Yes, no, DK, RF

Wheat Fertilizer Question 4 No Manure How many acres were in your largest field in 2016? Yes No

Wheat Fertilizer Question 5 Ave Yield What was the average yield of this field over the last 3 wheat crops? Bushels per Acre, DK, RF

Wheat Fertilizer Question 6 Fert Applied Was any commercial nitrogen fertilizer applied to this corn field in 2016? Please include fall applications in 2015 for the 2016 crop year. Yes No

Wheat 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

Wheat Fertilizer Question 8 Total N What was the total amount of nitrogen applied PER ACRE on this field? Pounds per Acre, DK, RF

Wheat Fertilizer Question 9 Fert Type What type of fertilizer was used to supply the majority of the nitrogen applied to this field?

Wheat 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 2016 crop year, again including any 2015 fall applications of commercial fertilizer. This will include all fall applications in 2015 and all 2016 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?

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?

Wheat Fertilizer Question Table Fert Rate

Line		Type of Fertilizer or Nutrient	What Quantity was applied per acre?	Enter Unit	When was this applied?	Report Actual Nutrients Applied for Other Dry Mix [19] or Other Types [13]				
		[Enter Code]	[Quantity]	[Unit Code]	[Enter Code]	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 soybean did you plant?

Soybean Fertilizer Question 1 Soybean Acre Do you have a soybean field without manure? Yes No

Setup Statement Verify Acres I will now ask you about your fertilizer inputs on soybean your acres. First on a soybean field with no manure. Think about your largest soybean field that you planted in 2016 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 2015 before the 2016 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 3b If Corn Planted Was alfalfa planted in 2014? Yes, no, DK, RF

Soybean Fertilizer Question 4 No Manure How many acres were in your largest field in 2016? Yes No

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 corn field in 2016? Please include fall applications in 2015 for the 2016 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 9 Fert Type What type of fertilizer was used to supply the majority of the nitrogen applied to this field?

Soybean 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 2016 crop year, again including any 2015 fall applications of commercial fertilizer. This will include all fall applications in

2015 and all 2016 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?

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	What Quantity was applied per acre?	Enter Unit	When was this applied?	Report Actual Nutrients Applied for Other Dry Mix [19] or Other Types [13]				
		[Enter Code]	[Quantity]	[Unit Code]	[Enter Code]	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 Anhydrous 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								

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 pilot⁷⁷ 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 pilot⁷⁸ 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.

⁷⁷ "Expanded Minnesota Agricultural Statistics Pesticide Use Data", 2003, by NASS and MDA.

⁷⁸ Unpublished data. From the September 20, 2003 EPA Report.