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Agricultural Chemical Usage - Field Crop Methodology and Quality Measures

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Agricultural Resource Management Survey: Methodology and Chemical Usage Statistics

Scope and Purpose: The National Agricultural Statistics Service (NASS) collects data about chemical use as well as pest management practices for selected field crops. These field crop data have been collected annually since the 1990 crop year. Two to six target field crops are typically selected each year, chosen on a rotational basis. The states involved (referred to as "program states") are selected based on NASS acres planted estimates. NASS aims to cover at a minimum 80 percent of acres planted to each target commodity. The data are collected as Phase II of the Agricultural Resource Management Survey (ARMS II). The ARMS is a cooperative agreement between USDA's NASS and Economic Research Service (ERS).

One or both ARMS II components may be conducted each year: the Production Practices Report Survey (PPR) and the Production Practices and Costs Report Survey (PPCR). The PPR is conducted in support of NASS's chemical usage program exclusively. The PPCR is conducted in cooperation with ERS as part of the ARMS costs of production program.

The ARMS is conducted in three phases. The initial screening phase identifies in-business, in-scope operations, multiple operating arrangements, and operations having commodities of interest for Phases II and III. The ARMS II PPR collects data on chemical use and pest management practices. The ARMS II PPCR collects data on agricultural production practices, chemical and other resource use, and variable costs of production for each crop for which an ARMS Phase III cost of production survey is conducted. ERS is responsible for estimating cost of production for major commodities and determines the PPCR commodity rotation.

Survey Timeline: Data collection may begin on September 1 and continue through mid-December. NASS Regional Field Offices (RFOs) along with NASS Headquarters (HQ) spend the next several months reviewing reported data for reasonableness and conduct producer follow-ups, as necessary. The estimates are released to the NASS Quick Stats 2.0 system during the second or third week in May.

Sample Size, Sampling Frames, and Methods: The ARMS II is selected as a follow-on survey to the ARMS Phase 1 (ARMS I) Screening Survey. The ARMS I sample is selected from the NASS list frame using Sequential Interval Poisson Sampling to minimize overlap between the current year's ARMS I sample, last year's ARMS I sample, and other NASS surveys. Each eligible operation in the list frame is given a positive probability of selection. A given operation's probability of selection is calculated based on farm value of sales (FVS) strata membership and acreage levels of the ARMS II commodities. After the screening phase, operations which report positive acreage for ARMS II target commodities are subsampled for the ARMS II. Multiple operating arrangements are further subsampled so that only one suboperation is included in the ARMS II sample. The sampling weights are adjusted upwards to account for this subsampling.

Data Collection and Editing: All federal data collections require approval by the Office of Management and Budget (OMB). NASS must document the public need for the data, show the design applies sound statistical practice, ensure the data do not already exist elsewhere, and show that the public is not excessively burdened. The ARMS II questionnaires must display an active OMB number that gives NASS the authority to conduct the survey, a statement of the survey purpose and the use of the collected data, a response burden statement that estimates the time required to complete the form, a confidentiality statement that the respondent's information will be protected from disclosure, and a statement that response to the survey is voluntary and not required by law. Using these questionnaires, chemical use and pest

management data are collected only by personal visit from an enumerator. Postcards are mailed to producers prior to field contact stating the importance of cooperation and that contact will be made in the coming weeks. Once contact is made by the field enumerator, an appointment is made to collect data. Data is collected for one field randomly chosen from all the operation's fields planted to the ARMS II field crop. The field enumerator returns the questionnaires to the NASS RFO for editing and data entry. Questionnaire responses are captured and edited for consistency using automated systems, and a report of questionnaires with errors is generated. NASS statisticians will correct the errors on the report or comment to their validity if the data are deemed to be correct.

Analysis Tools: Chemical use data are processed through an interactive data analysis tool which displays data for all reports by product or commodity. This application tool provides various scatter plots, graphs, tables, charts, and listing tools that allow the analyst to compare an individual record to other similar records within a program state. Outliers and unusual data relationships are investigated by RFO and HQ statisticians to determine validity. Suspect data found to be in error are corrected.

Nonsampling Errors: Nonsampling errors are present in any survey process. These errors include reporting, recording, editing, and imputation errors. Steps are taken to minimize the impact of these errors, such as comprehensive interviewer training, validation and verification of processing systems, detailed computer edits, and the analysis tool. Re-contact with respondents is conducted on an as needed basis.

Nonresponse Adjustment: Response to the ARMS II is voluntary. Some producers refuse to participate in the survey, others cannot be located during the data collection period, and some submit incomplete reports. These nonrespondents must be accounted for to make accurate estimates of total chemical usage. For ARMS II, item level nonresponse is accounted for by imputing data where there are missing values. Imputed rates of application for chemicals are calculated through an automated imputation system that calculates an unweighted mean for an imputation group based on commodity, program state, and product. When a group lacks other responses, groups are collapsed by program state to preserve as much of the homogeneity as possible.

Calibration: Calibration is a weighting technique used in survey sampling to adjust the survey weights for sampled elements so that the weighted sum of a set of benchmark variables equals a pre-determined set of values for the population. The input to the calibration algorithm is the weights generated from the sampling procedures. Sampling weights are calculated based on selection probability so that the samples are representative of the entire population of farms at the program state level for the target field crop(s) in that program state. Due to survey nonresponse, weights are adjusted through a calibration algorithm. Calibration adjusts the sampling weights so the expanded data will match planted acreage totals from the January Crop Production report [http://usda.mannlib.cornell.edu/usda/current/CropProdSu/CropProdSu-01-12-2018.pdf]. This ensures that the chemical use and pest management data collected will accurately represent the chemical usage for all target field crops for the entire target population.

Estimators: The ARMS II utilizes direct expansions and/or ratio expansions for all survey indications. Direct expansions are calculated by summing the reported or imputed chemical data values by the calibrated weights. Similarly, ratios are calculated by applying calibrated weights and nonresponse adjustments to data when both the numerator and denominator are reported. Variance estimates are computed for all expansions.

Outliers: NASS conducts a review of outliers found in the chemical use data by reviewing application rates for all records for the same product and commodity combinations. The RFO and HQ statisticians work together to ensure the data are as accurate as possible. The RFO statisticians review outliers within their program states, and the HQ statistician examines outliers across all program states for the published categories. A determination is made as to whether an adjustment to the application data is required. Most outliers trace back to unique situations that do not exist in the target population as much as the survey weight would indicate.

Estimation: HQ statisticians execute a summary that generates program state level and national level indications. RFO statisticians are responsible for performing a detailed review of their survey results and providing comments that justify their survey results. HQ statisticians conduct a final review of survey results from all program states. Any irregularities

revealed by the summary must be investigated and, if necessary, resolved. After final review, program state level summary results are adopted as official national estimates.

There are three main types of data that NASS estimates for these surveys - fertilizer application, pesticide application, and pest management data. For the application data, NASS collects information about the commercial fertilizers and pesticides applied during the crop year. For fertilizer, these applications are collected as either actual pounds or percent analysis of Nitrogen (N), Phosphate (P_2O_5), Potash (K_2O), and Sulfur (S). Fertilizer data are then published in actual pounds of nutrient used. For pesticides, these applications are collected at the product level, generally per application. These product level data are converted to pounds of active ingredient (or the acid or metallic equivalent, where applicable), summarized, and published. If there are not a sufficient number of reports, the data is suppressed from publication, along with any needed complementary suppression.

For both fertilizer and pesticide application data, NASS estimates area applied (percent of planted acres treated), number of applications, rate per application (pounds of active ingredient or acid equivalent per acre), rate per crop year (number of applications multiplied by rate per application), and total amount applied.

The standard deviation for each active ingredient is calculated to determine data distribution for each crop. Chemical distribution rates are given by active ingredient for the percent of acres treated, number of applications, rate per application, and rate per crop year. Rate distribution tables include the median, the 10^{th} and 90^{th} percentiles, the mean, and the coefficient of variation (CV) for an active ingredient when a sufficient number of farm operators report applying it on the specified crop.

The pest management data are generally a series of yes/no questions pertaining to specific pest management practices. Pest management data are collected for the randomly chosen field. From these data, NASS releases the percent of operations using the practice as well as the percent of acreage. The percent of acreage assumes that the operation treats all fields of a particular commodity in the same way.

Selected Terms and Definitions

Active Ingredient: The specific pesticide ingredient which kills or controls the target pest(s) or other target material(s), or otherwise results in the pesticide effect(s). All pesticide-use estimates in the report are published per active ingredient (rather than per product); one or more active ingredients are present in known amounts in the pesticide products reported in the survey.

Rate and *Total Applied* estimates were reported in a single unit of equivalence, per active ingredient. For salt, ester, or amine active ingredients, estimates were published in the parent acid equivalents. For example, the acid derivatives glyphosate isopropylamine salt and 2,4-D, 2-EHE were published in the glyphosate and 2,4-D equivalents, respectively. For copper compounds, estimates were published in the metallic copper equivalent.

Active Ingredient Code: A unique code assigned to each active ingredient upon registration with the Environmental Protection Agency's Office of Pesticide Programs, to facilitate pesticide regulation.

Area Applied, Percent: Percent of total planted acres which received one or more applications of a specific fertilizer, nutrient, or pesticide active ingredient. (*In Quick Stats: Treated, Measured as Percent of Area Planted*)

Avoidance: A strategy in which the detrimental effects of pests on crops are mitigated or eliminated solely through various cultural practices. Avoidance is one of four classes of pest-management practices for which data are included in the report.

Beneficial Insects: Insects (small invertebrate animals, mostly of arthropod classes Insecta and Arachnida), which are collected and introduced onto crop acres because of their value in biological control as predators on harmful insects and parasites.

Chemigation: Application of agricultural chemicals, including pesticide products, by injection into irrigation water.

Crop Year: The period starting immediately after harvest of the previous year's crop and ending at harvest of the current year's crop.

Farm: Any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold during the year. Government payments are included in sales.

Fertilizer: A soil-enriching agricultural input which contains one or more plant nutrients. Data for three primary macronutrients, nitrogen (N), phosphate (P_2O_5), and potash (K_20), and the secondary macronutrient sulfur (S) are included in the report.

Fungi: Various organisms of the kingdom Fungi, which obtain nutrients by decomposing plant or other organic life. This pest group includes mushrooms, molds, mildews, smuts, rusts, and yeasts. Fungal infestations have the potential to reduce crop production and/or lower the grade quality of the host crop.

Mechanism of Action (MOA): The method or biological pathway by which the pesticide or active ingredient kills or controls the target pest(s) or other target material(s).

Minimum or Reduced Tillage: Tillage practices prior to planting which result in a minimum of 30 percent or more of crop residue being retained on the surface following planting.

Monitoring: A strategy involving the observance or detection of pests through systematic sampling, counting, or other forms of scouting. Monitoring may include prediction of pest population levels through the observance of environmental factors such as weather or soil and crop quality. Monitoring is one of four classes of pest-management practices for which data are included in the report.

Nematodes: Unsegmented, parasitic worms of the phylum Nematoda. Prominent animal pest of field crops with the potential to be highly destructive, lowering crop production and grade quality significantly.

Number of Applications: The average number of times a treated acre received a specific fertilizer nutrient or pesticide active ingredient. (*In Quick Stats: Applications, Measured in Number)*

Pesticide: Defined by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) as "(1) any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest, (2) any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant, and (3) any nitrogen stabilizer…" (*Title 7, U.S. Code, 136)*. Under FIFRA, pesticides are registered and regulated through the Environmental Protection Agency's Office of Pesticide Programs. Four classes of pesticides are included in the report: (1) herbicides targeting weeds, (2) insecticides targeting insects (3) fungicides targeting fungi, and (4) other chemicals targeting all other pests or other materials (including extraneous crop foliage).

Pheromone: A chemical substance produced by an insect which serves as a stimulus to other individuals of the same species for one or more behavioral responses.

Prevention: A strategy in which a pest population is kept from infesting a crop or field by taking various preceding actions. Prevention is one of four classes of pest-management practices for which data are included in the report.

Rate per Application: Ratio indicating pounds (lbs) of a fertilizer primary nutrient or pesticide active ingredient (or associated acid or metallic equivalent) applied, counting all applications per crop year, per planted acre. (*In Quick Stats: Applications, Measured in Lb/Acre/Year)*

Suppression: A strategy which involves the control or reduction of existing pest populations in order to mitigate crop damage. May include physical or biological controls, or management of resistance build-up through pesticide rotation. Suppression is one of four classes of pest-management practices for which data are included in the report.

Quality Metrics for Agricultural Chemical Usage

Purpose and Definitions: Under the guidance of the Statistical Policy Office of the Office of Management and Budget (OMB), NASS provides data users with quality metrics for its published data series. The metrics tables below describe the performance data for the survey contributing to the publication. The accuracy of data products may be evaluated through sampling and non-sampling error. The measurement of error due to sampling in the current period is evaluated by the coefficient of variation for each estimated item. Non-sampling error is evaluated by response rates and the percent of the estimate from respondents.

Sample Size is the number of observations selected from the population that are used to be representative of the entire population.

Response rates measure the proportion of the sample that is represented by the responding units in the survey.

Coefficient of Variation provides a measure of the size for the standard error relative to the point estimate and is used to measure the precision of the results of a survey estimator.

Cotton Chemical Usage: Sample Size and Response Rate – Program States: 2017

State	Sample size	Response rate
	(number)	(percent)
Alabama	200	75.7
Arkansas	150	78.4
Georgia	300	73.3
Mississippi	200	83.0
Missouri	150	82.0
North Carolina	200	78.5
Oklahoma	150	60.0
Tennessee	150	72.2
Texas	400	58.6
Program States	1,900	72.0

Soybean Chemical Usage: Sample Size and Response Rate – Program States: 2017

State	Sample size	Response rate
	(number)	(percent)
Arkansas	200	83.0
Illinois	300	72.0
Indiana	250	69.7
Iowa	300	69.6
Kansas	250	71.1
Kentucky	200	80.0
Michigan	250	72.8
Minnesota	300	76.3
Mississippi	150	91.3
Missouri	250	64.0
Nebraska	250	65.3
North Carolina	200	82.0
North Dakota	200	81.5
Ohio	250	77.2
South Dakota	250	62.8
Wisconsin	250	72.8
Program States	3,850	73.6

Winter Wheat Chemical Usage: Sample Size and Response Rate – Program States: 2017

State	Sample size	Response rate
	(number)	(percent)
Colorado	150	44.3
Idaho	75	62.7
Illinois	150	74.7
Kansas	200	42.5
Michigan	100	56.0
Missouri	150	52.7
Montana	150	70.7
Nebraska	150	56.3
North Dakota	75	24.7
Ohio	150	52.0
Oklahoma	150	48.7
Oregon	75	71.1
South Dakota	100	30.0
Texas	150	52.6
Washington	100	52.5
Program States	1,925	53.0

Spring Wheat Chemical Usage: Sample Size and Response Rate – Program States: 2017

State	Sample size	Response rate
	(number)	(percent)
Idaho	125	46.5
Minnesota	150	50.0
Montana	150	74.0
North Dakota	250	54.2
Oregon	100	62.7
South Dakota	150	43.3
Washington	150	55.7
Program States	1,075	54.9

Durum Wheat Chemical Usage: Sample Size and Response Rate – Program States: 2017

State	Sample size	Response rate
	(number)	(percent)
Arizona	50	56.0
California	100	46.1
Idaho	35	37.0
Montana	100	80.0
North Dakota	225	54.3
Program States	510	57.9

Cotton Pesticide Usage Coefficient of Variation – Program States: 2017

Active ingredient	Planted acres treated	Number of applications	Rate per application	Rate per crop year
	(percent)	(percent)	(percent)	(percent)
Herbicides				
2;4-D; dimethylamine salt	12.4	8.4	6.3	6.3
Acetochlor	8.8	3.9	4.6	7.6
Carfentrazone-ethyl	22.0	2.0	9.4	9.8
Clethodim	26.5	2.9	11.1	12.6
Dicamba; BAPMA	14.9	6.8	1.7	7.1
Dicamba; diglycolamine salt	13.9	7.9	8.7	11.8
Dicamba; dimethylamine salt	20.6	10.1	9.6	11.4
Dicamba; sodium salt	11.8	5.2	10.2	12.0
Dimethenamid-P	23.8	8.4	3.5	7.9
Diuron	7.3	3.1	8.6	7.8
Flumioxazin	9.8	2.9	7.2	7.7
Fluometuron	9.2	1.2	5.3	5.6
Fomesafen sodium	9.8	1.2	4.8	4.8
Glufosinate-ammonium	7.4	4.0	3.8	4.1
Glyphosate	25.1	5.7	9.2	9.9
Glyphosate isopropylamine salt	3.0	3.1	2.8	4.4
Glyphosate potassium salt	8.0	5.2	2.8	5.6
MSMA	25.8	0.0	4.9	4.9
Paraquat	9.6	3.3	3.8	4.9
Pendimethalin	13.4	2.0	8.1	8.6
Prometryn	17.4	0.3	11.4	11.4
Pyraflufen-ethyl	26.6	14.4	15.1	20.0
Pyrithiobac-sodium	19.6	5.3	7.2	7.8
Rimsulfuron	21.5	1.3	11.9	12.5
S-Metolachlor	8.5	3.9	7.7	7.9
Thifensulfuron	24.5	6.5	9.5	9.1
Trifluralin	6.7	2.1	7.9	7.7
Insecticides				
Abamectin	15.2	6.4	6.3	9.7
Acephate	6.1	4.5	5.7	5.7
Bifenthrin	5.9	4.5	3.3	5.4
Chlorantraniliprole	12.4	7.9	2.5	8.3
Cyfluthrin	28.3	6.4	15.3	15.1
Cypermethrin	21.7	6.4	9.9	25.3
Dicrotophos	12.5	6.4	13.1	17.5
Imidacloprid	10.6	8.6	11.7	12.2
Lambda-cyhalothrin	10.8	7.3	10.7	10.7
Novaluron	9.4	13.8	9.7	16.0
Pyriproxyfen	11.8	6.6	5.4	5.6
Sulfoxaflor	14.4	6.6	12.9	16.1
Thiamethoxam	12.6	6.8	16.3	19.2
Other				
Cyclanilide	10.6	3.7	9.0	9.3
Ethephon	3.4	1.9	3.7	3.9
Mepiquat chloride	3.4	3.6	7.8	8.5
Mepiquat pentaborate	27.5	10.4	10.1	15.1
Thidiazuron	4.3	2.9	8.9	9.0
Tribufos	3.8	2.0	4.4	4.4

Soybean Pesticide Usage Coefficient of Variation – Program States: 2017

Active ingredient	Planted acres treated	Number of applications	Rate per application	Rate per crop year
	(percent)	(percent)	(percent)	(percent)
Herbicides				
2;4-D; 2-EHE	5.2	3.9	3.8	4.8
2;4-D; dimethylamine salt	8.4	3.7	4.0	4.9
Acetochlor	13.5	5.1	7.6	7.4
Acifluorfen; sodium	17.0	2.4	5.0	6.6
Chlorimuron-ethyl	6.2	0.9	4.8	4.8
Clethodim	6.4	0.7	5.6	5.6
Cloransulam-methyl	7.5	0.5	8.0	8.0
Dicamba; BAPMA	11.1	3.7	1.9	3.7
Dicamba; diglycolamine salt	8.2	3.5	6.4	6.2
Dicamba; dimethylamine salt	16.5	4.8	13.6	17.1
Dimethenamid-P	10.8	3.2	6.1	6.4
Fluazifop-P-butyl	14.5	4.1	17.2	16.2
Flumioxazin	5.5	0.8	4.4	4.4
Fluthiacet-methyl	13.4	3.7	11.5	12.7
Fomesafen	22.0	0.0	6.3	6.3
Fomesafen sodium	4.3	0.8	2.8	2.8
Glufosinate-ammonium	5.6	7.1	2.7	5.7
Glyphosate	9.0	2.3	3.9	4.1
Glyphosate dimethylamine salt	21.1	8.3	2.4	9.2
Glyphosate isopropylamine salt	2.0	1.7	1.4	2.3
Glyphosate potassium salt	3.0	1.8	1.4	2.2
Imazethapyr	7.1	1.5	3.3	3.4
Lactofen	16.1	1.1	5.5	5.6
Metolachlor	15.7	1.7	4.0	3.8
Metribuzin	4.5	0.5	4.4	4.5
Paraquat	10.0	4.4	4.0	6.1
Pendimethalin	22.6	0.2	6.4	6.4
Pyroxasulfone	7.3	1.6	7.7	7.8
S-Metolachlor	4.9	1.7	2.3	2.6
Saflufenacil	7.9	0.4	7.1	7.2
Sulfentrazone	4.1	0.6	2.5	2.6
Thifensulfuron	11.8	3.8	7.5	9.4
Trifluralin	18.9	0.0	4.7	4.7
Insecticides				
Acephate	22.4	6.0	6.3	8.6
Bifenthrin	10.3	2.3	6.3	6.6
Chlorantraniliprole	18.2	0.6	24.5	24.5
Chlorpyrifos	12.3	2.0	7.5	7.6
Imidacloprid	23.0	2.3	14.5	15.3
Lambda-cyhalothrin	7.7	1.2	5.7	5.7
Zeta-cypermethrin	20.8	4.8	8.4	9.9
Fungicides				
Azoxystrobin	13.7	2.2	4.4	5.2
Cyproconazole	25.4	3.3	7.6	10.6
Difenoconazole	17.5	0.5	5.5	5.6
Fluxapyroxad	12.1	2.0	7.2	7.3
Picoxystrobin	20.7	3.8	8.0	10.0
Propiconazole	17.4	3.2	6.4	7.0
Prothioconazole	21.7	1.3	18.3	18.3
Pyraclostrobin	10.5	1.9	6.3	6.4
Trifloxystrobin	17.5	0.9	16.0	16.1
Other				
Cytokinins	19.7	6.6	10.1	11.6
Indolebutyric acid	19.7	6.6	9.8	14.6

Winter Wheat Pesticide Usage Coefficient of Variation – Program States: 2017

Active ingredient	Planted acres treated	Number of applications	Rate per application	Rate per crop Year
	(percent)	(percent)	(percent)	(percent)
Herbicides				
2;4-D; 2-EHE	8.7	10.4	4.4	8.8
2;4-D; dimethylamine salt	13.7	8.2	11.9	12.8
Bromoxynil heptanoate.	15.3	0.1	22.7	22.7
Bromoxynil octanoate	10.4	8.5	8.7	12.3
Chlorsulfuron	12.9	4.9	13.5	13.9
Dicamba; dimethylamine salt	13.5	8.7	14.1	16.2
Fluroxypyr 1-MHE	13.0	15.7	7.8	15.1
Glyphosate isopropylamine salt	8.2	5.9	2.7	6.7
Glyphosate potassium salt	14.9	11.7	4.2	10.1
Imazamox	19.7	7.8	16.7	15.7
Kantor	25.4	2.3	20.3	21.3
MCPA; 2-ethylhexyl	12.2	12.4	9.0	11.8
Metsulfuron-methyl	11.3	7.1	15.8	16.7
Pyrasulfotole technical	17.5	0.2	6.5	6.5
Pyroxsulam	16.0	1.7	18.8	18.8
Thifensulfuron	11.0	11.3	9.9	13.0
Tribenuron-methyl	11.1	11.4	10.3	11.4
Insecticides				
Lambda-cyhalothrin	24.3	12.2	15.0	16.4
Fungicides				
Azoxystrobin	24.5	5.0	8.8	10.6
Fluxapyroxad	21.7	27.1	5.3	27.4
Propiconazole	11.5	5.2	10.5	9.4
Prothioconazole	10.7	3.9	4.4	2.7
Pyraclostrobin	15.4	19.3	10.5	12.1
Tebuconazole	13.4	1.3	6.6	6.6

Spring Wheat Pesticide Usage Coefficient of Variation – Program States: 2017

Active ingredient	Planted acres treated	Number of applications	Rate per application	Rate per crop Year
	(percent)	(percent)	(percent)	(percent)
Herbicides				
2;4-D; 2-EHE	10.6	5.5	10.5	10.1
2;4-D; dimethylamine salt	18.0	6.1	19.4	19.3
Bromoxynil heptanoate	13.4	0.3	6.5	6.5
Bromoxynil octanoate	6.4	4.8	7.0	5.2
Clopyralid monoethanolamine salt	7.0	0.4	5.1	5.1
Dicamba; dimethylamine salt	20.8	8.3	14.7	19.0
Flucarbazone-sodium	21.9	0.0	8.3	8.3
Fluroxypyr 1-MHE	4.4	0.3	4.8	4.8
Glyphosate isopropylamine salt	5.2	4.5	2.8	4.9
Glyphosate potassium salt	11.8	8.7	3.2	8.4
Kantor	15.0	0.4	7.3	7.3
MCPA; 2-ethylhexyl	7.6	5.7	8.2	4.8
Pinoxaden	15.3	0.9	7.9	8.0
Pyrasulfotole technical	12.1	0.0	3.7	3.7
Pyroxsulam	17.6	0.0	2.5	2.5
Thiencarbazone-methyl	18.0	0.0	2.9	2.9
Thifensulfuron	10.6	2.8	13.8	13.5
Tribenuron-methyl	9.8	2.7	46.9	46.6
Insecticides				
Lambda-cyhalothrin	15.0	0.0	6.9	6.9
Fungicides				
Azoxystrobin	20.6	4.6	9.7	12.9
Propiconazole	5.4	2.1	6.4	6.7
Prothioconazole	11.8	2.0	6.5	5.9
Pyraclostrobin	24.6	1.0	6.6	6.9
Tebuconazole	7.7	1.7	4.3	4.0

Durum Wheat Pesticide Usage Coefficient of Variation – Program States: 2017

Active ingredient	Planted acres treated	Number of applications	Rate per application	Rate per crop Year
	(percent)	(percent)	(percent)	(percent)
Herbicides				
2;4-D; 2-EHE	9.8	6.0	7.4	9.9
2;4-D; dimethylamine salt	18.2	0.0	14.2	14.2
Bromoxynil octanoate	8.0	0.1	4.8	4.8
Clopyralid monoethanolamine salt	20.2	0.0	3.7	3.7
Dicamba; dimethylamine salt	15.3	5.8	13.3	18.3
Fluroxypyr 1-MHE	7.7	1.3	9.3	10.4
Glyphosate isopropylamine salt	5.9	5.9	3.3	6.2
Glyphosate potassium salt	15.1	9.7	4.5	10.0
MCPA; 2-ethylhexyl	14.9	2.6	5.1	4.1
Pyrasulfotole technical	16.7	0.0	4.1	4.1
Thiencarbazone-methyl	18.2	0.6	5.7	5.8
Thifensulfuron	18.2	4.8	18.1	16.0
Tribenuron-methyl	16.4	4.9	13.9	14.2
Fungicides				
Propiconazole	8.1	0.9	4.8	4.8

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- All reports are available electronically, at no cost, on the NASS web site: http://www.nass.usda.gov
- Both national and state specific reports are available via a free e-mail subscription. To set-up this free subscription, visit http://www.nass.usda.gov and in the "Follow NASS" box under "Receive reports by Email," click on "National" or "State" to select the reports you would like to receive.

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