Agricultural Chemical Usage – Vegetable Methodology and Quality Measures

ISSN: 2168-177X

Released July 24, 2019, by the National Agricultural Statistics Service (NASS), Agricultural Statistics Board, United States Department of Agriculture (USDA).

Vegetable Chemical Usage Survey: Methodology and Chemical Usage Statistics

Scope and Purpose: The National Agricultural Statistics Service (NASS) Vegetable Chemical Use Survey (VCUS) collects entire farm level chemical use data from growers of select vegetables in program states. The fruit and vegetable chemical surveys have been conducted in alternating years since 1990 with data collected on fruits in odd numbered years and vegetables in even numbered years. The states involved and the commodities surveyed are selected based on NASS acres planted and evaluated each cycle to ensure maximum coverage.

The states involved (referred to as "program states") and the commodities surveyed are selected based on NASS acres planted and evaluated each cycle to ensure maximum coverage. NASS aims to cover at a minimum 80 percent of targeted vegetable crop acres in the United States. Farm level data are combined during summary and, pending compliance with disclosure rules, published at state and national levels. Data are published for 23 targeted vegetable crops in 18 states.

Survey Timeline: Data collection begins on September 1 and lasts until mid-January of the following year to ensure completion of the crop year. 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 fourth week in July.

Sampling: The target population for the VCUS is all agricultural establishments with more than $1,000 in agricultural sales (or potential sales). NASS uses a dual frame approach, consisting of list frame and area frame components, to provide complete coverage of this target population.

NASS maintains a list of farm and ranch operators. NASS is constantly seeking new operations from outside list sources confirmed to be qualifying farms before being added to the list. A profile, known as control data, of each operation is maintained which indicates what the farm has historically produced and a general indication of size. This information allows NASS to define sampling populations that are specific to each survey and employ advanced and more efficient sample designs.

The VCUS list sample is selected based on a calculated Farm Value of Sales (FVS). All farms on the list frame with an estimated FVS of $1,000 or more are eligible. The value of sales control data need not be exact as it is used to stratify similar list operations into homogeneous groups.

Sampling Frames and Methods: The sample for the Vegetable Chemical Use Survey (VCUS) is selected from the NASS List Sampling Frame. List incompleteness is addressed through the estimators. The sample design for VCUS is Multivariate Probability Proportional to Size (MPPS). In MPPS, the maximum of the probabilities of selection over all of the target crops that an operation grows is used in combination with the desired sample sizes for each crop to draw the sample. The larger the operation's maximum probability is, the larger the operation's chance of being selected for the sample.

VCUS is a two-phase sample design. In Phase 1, the screening phase, list frame control data are used to determine the probabilities of selection. The operations selected in Phase 1 are interviewed in the Integrated Screening Survey to determine if they are growing any of the crops of interest and the number of acres planted. In Phase 2, the results from the Integrated Screening Survey are used to select the final sample for the survey. Both the Phase 1 and Phase 2 sample selections use MPPS designs. In Phase 2, operations with multiple operating arrangements are sub-sampled. Only the sub-sampled operations are contacted for data collection.

The sample size for the VCUS is 2,802.

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 vegetable chemical use 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 will be set up to collect data when the farm operator indicates no further chemical applications are remaining. 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, while data found to be correct are kept.

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 VCUS 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 if accurate estimates of total chemical usage are to be made. For this survey, 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, state, and product. When a group lacks sufficient responses, groups are collapsed 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 numerous factors so that the sample allocations are representative of the entire population of farms at the state level for the target vegetable crop(s) in that 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 March Vegetable Production report. This ensures that the chemical data collected will accurately represent the chemical usage for all target vegetable crops for the entire target population.

Estimators: The VCUS 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 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 states. Any irregularities revealed by the summary must be investigated and, if necessary, resolved. After final review, national level summary results are adopted as official national estimates except in cases where strong justification supports deviating from survey totals.

For this survey there are two main types of data that NASS estimates - pesticide application and pest management data. For the application data, NASS collects information about pesticides applied during the crop year. For pesticides, these applications are collected at the product level, generally per application. These product level data are converted to pounds of active ingredient, summarized, and published. If there are not a sufficient number of reports, the data are suppressed from publication, along with any needed complementary suppression.

For the pesticide application data, NASS estimates area applied (percent 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. In order to publish data for an active ingredient, there must be a minimum number of reports for the specific active ingredient at the summary level (by crop, by state, or all program states). If there are not a sufficient number of reports, the data is suppressed from publication, along with any needed complementary suppression

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. The distribution tables include the coefficient of variation (CV) for an active ingredient when at least 30 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 entire operation. 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, if the operation uses the practice on one acre, it is used on all acres. This also means that the pest management data are not crop specific; they are distributed across all vegetable acres.

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 Percent of 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 Percent of*)

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, Measure 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 Percent of 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.

Vegetable Chemical Usage, Sample Size and Response Rate – Program States: 2018

State	Sample size	Response rate
	(number)	(percent)
Arizona	23	87.0
California	384	88.8
Florida	130	37.7
Georgia	103	45.6
Illinois	101	49.5
Indiana	68	54.4
Michigan	265	66.0
Minnesota	279	77.8
New Jersey	94	59.6
New York	269	60.2
North Carolina	165	68.5
Ohio	191	77.0
Oregon	110	55.5
Pennsylvania	193	63.2
South Carolina	48	54.2
Texas	73	68.5
Washington	84	45.2
Wisconsin	222	71.2
Program States	2,802	66.7

Beans, Snap Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Herbicides				
Bentazon	75	7	39	46
EPTC	90	1	15	16
Fomesafen sodium	42	0	15	15
Halosulfuron-methyl	53	9	129	124
Imazamox	173	9	41	50
Imazethapyr ammonium	139	7	18	25
Metolachlor	266	2	151	150
Pendimethalin	54	2	14	14
S-Metolachlor	69	32	28	35
Trifluralin	116	2	8	8
Insecticides				
Bifenthrin	96	18	28	45
Lambda-cyhalothrin	57	13	11	18
Zeta-cypermethrin	42	27	31	57
Fungicides				
Copper hydroxide	248	42	148	110
Thiophanate-methyl	32	24	59	50

Broccoli Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Herbicides				
DCPA	105	89	24	93
Oxyfluorfen	55	18	25	41
Insecticides				
Chlorantraniliprole	34	7	9	14
Emamectin benzoate	57	47	12	58
Imidacloprid	31	13	50	41
Indoxacarb	98	9	1	9
Lambda-cyhalothrin	38	8	7	11
Spinetoram	36	9	6	11
Spirotetramat	49	66	2	65
Thiamethoxam	67	20	26	20
Zeta-cypermethrin	235	51	2	51

Carrots Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Herbicides				
Linuron	407	82	56	32
Pendimethalin	361	8	17	25
Fungicides				
Sulfur	125	271	154	314

Cauliflower Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Herbicides				
Oxyfluorfen	43	22	38	60
Insecticides				
Imidacloprid	63	34	15	26
Lambda-cyhalothrin	22	17	4	20
Spinetoram	93	9	8	11
Spirotetramat	66	13	4	14

Celery Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Herbicides				
Prometryn	87	37	8	38
Insecticides				
Abamectin	15	105	6	101
Acephate	73	82	5	87
Acetamiprid	49	27	3	30
Chlorantraniliprole	93	43	5	43
Methoxyfenozide	30	98	22	120
Permethrin	72	58	8	63
Spinetoram	89	22	5	25
Spirotetramat	77	42	2	41
Fungicides				
Chlorothalonil	29	31	9	25
Propiconazole	46	54	0	54

Corn, Sweet Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Herbicides				
Acetochlor	42	3	10	11
Atrazine	25	19	59	42
Dimethenamid-P	47	3	6	8
Glyphosate isopropylamine salt	66	1	14	15
Mesotrione	127	14	26	17
Pendimethalin	226	14	66	78
S-Metolachlor	116	3	53	55
Tembotrione	42	20	2	21
Topramezone	99	11	12	17
Insecticides				
Bifenthrin	71	9	13	19
Lambda-cyhalothrin	28	42	6	46
Fungicides				
Azoxystrobin	23	8	6	13
Propiconazole	19	5	4	8

Cucumbers Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Herbicides				
Ethalfluralin	134	7	79	79
Fungicides				
Chlorothalonil	135	23	19	18

Lettuce, Head Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per Application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Herbicides				
Pronamide	43	36	16	25
Insecticides				
Chlorantraniliprole	101	28	2	28
Flupyradifurone	180	5	7	10
Imidacloprid	38	58	44	59
Lambda-cyhalothrin	40	42	4	42
Methomyl	79	23	17	19
Permethrin	64	24	6	27
Spinetoram	59	28	5	29
Spirotetramat	53	79	3	76
Sulfoxaflor	133	107	1	108
Zeta-cypermethrin	69	18	2	16
Fungicides				
Ametoctradin	58	21	5	24
Dimethomorph	69	21	4	23
Fenamidone	30	26	6	23
Mancozeb	40	42	9	48
Mandipropamide technical	144	52	10	42
Mono-potassium salt	62	33	46	73
Pyraclostrobin	85	48	6	53

Lettuce, Other Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per Application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Herbicides				
Bensulide	98	13	11	15
Pronamide	71	35	23	17
Insecticides				
Chlorantraniliprole	119	21	10	27
Flonicamid	140	44	3	42
Flupyradifurone	125	11	5	12
Imidacloprid	48	63	81	27
Lambda-cyhalothrin	80	59	5	58
Methomyl	119	37	14	39
Permethrin	61	28	8	24
Spinetoram	72	16	5	18
Spinosad	54	4	5	6
Spirotetramat	59	47	6	43
Sulfoxaflor	96	61	1	61
Zeta-cypermethrin	152	22	3	24
Fungicides				
Ametoctradin	62	11	3	11
Boscalid	57	65	5	66
Cymoxanil	65	17	6	22
Dimethomorph.	63	22	2	22
Fenamidone	52	46	5	42
Mancozeb	43	41	6	44
Mandipropamide technical	132	52	7	45
Mono-potassium salt	67	42	26	64
Oxathiapiprolin.	213	47	19	33
Pyraclostrobin	97	26	8	33

Onions Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Herbicides				
Bromoxynil octanoate	27	13	9	25
Clethodim	37	10	8	12
Oxyfluorfen	31	21	12	17
Pendimethalin.	31	9	15	17
Insecticides				
Methomyl	41	26	6	30
Spinetoram	51	18	12	19
Fungicides				
Chlorothalonil	28	19	13	19
Copper hydroxide	77	33	28	32
Mancozeb	35	46	9	54
Mefenoxam	29	11	20	19
Pyraclostrobin	34	10	4	13

Peas, Green Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Herbicides				
Imazethapyr	56	17	11	26
Imazethapyr ammonium	21	0	13	13
Pendimethalin	16	2	7	7
Saflufenacil	34	12	8	19
Insecticides				
Bifenthrin	63	12	11	19

Peppers, Bell Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Insecticides				
Chlorantraniliprole	45	17	11	23
Zeta-cypermethrin	47	33	14	37
Fungicides				
Azoxystrobin	61	43	21	56
Chlorothalonil	196	50	46	95
Copper hydroxide	121	159	73	220
Difenoconazole	51	52	32	77
Mancozeb	100	86	85	92

Pumpkins Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per Application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Herbicides				
Clomazone	21	2	9	9
Ethalfluralin	44	3	14	15
Glyphosate isopropylamine salt	67	7	19	22
Halosulfuron-methyl	39	20	10	24
S-Metolachlor	35	3	6	8
Insecticides				
Acetamiprid	65	110	16	120
Bifenthrin	54	19	14	15
Carbaryl	121	79	20	67
Imidacloprid	95	42	39	27
Lambda-cyhalothrin	66	39	9	40
Permethrin	63	25	23	29
Zeta-cypermethrin	94	49	55	65
Fungicides				
Azoxystrobin	38	14	5	16
Chlorothalonil	18	14	6	16
Copper chloride hydroxide	41	18	5	19
Copper hydroxide	32	25	21	25
Cyazofamid	67	32	17	19
Cyflufenamid	64	18	3	18
Cymoxanil	122	14	14	14
Difenoconazole	81	28	14	29
Famoxadone	125	15	15	15
Mancozeb	70	26	73	86
Myclobutanil	131	40	45	35
Quinoline	39	23	7	19

Squash Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Herbicides				
Clomazone	57	2	38	36
Ethalfluralin	47	1	22	21
S-Metolachlor	71	7	9	13
Insecticides				
Carbaryl	92	43	27	23
Lambda-cyhalothrin	84	21	23	41
Fungicides				
Azoxystrobin	81	32	26	44
Chlorothalonil	41	24	18	25
Copper hydroxide	91	28	41	62

Strawberries Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Fungicides				
Captan….	32	44	12	50

Tomatoes Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per Application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Herbicides				
Glyphosate isopropylamine salt	28	19	18	31
Glyphosate potassium salt.....	54	24	23	35
Oxyfluorfen	71	8	13	20
Rimsulfuron……	83	11	14	18
S-Metolachlor…..……	24	22	9	30
Trifluralin…	15	17	3	17
Insecticides				
Abamectin	24	12	6	16
Bifenthrin…….....	22	13	5	8
Carbaryl.....	57	7	13	12
Chlorantraniliprole.....	35	26	3	24
Dimethoate	25	35	8	32
Imidacloprid	18	19	6	24
Lambda-cyhalothrin…..……	26	30	2	31
Methoxyfenozide.....	25	11	9	13
Thiamethoxam…..	42	22	8	28
Fungicides				
Azoxystrobin	24	12	1	13
Chlorothalonil…….……	30	36	8	34
Copper hydroxide……...	58	214	149	92
Difenoconazole.....	34	11	2	12
Mancozeb……..……..	21	49	35	18
Pyraclostrobin.....	60	33	3	31
Sulfur.....	23	27	4	28
Other Chemicals				
Ethephon…..……..…….……..	65	14	11	16

Watermelon Pesticide Usage Coefficient of Variation – Program States: 2018

Active ingredient	Percent of acres treated	Number of applications	Rate per application	Rate per crop Year
	(CV percent)	(CV percent)	(CV percent)	(CV percent)
Fungicides				
Azoxystrobin.....	107	27	34	57
Chlorothalonil…….……	72	45	26	32
Difenoconazole.....	72	46	14	59
Mancozeb……..……..	58	76	42	109
Tebuconazole…….…..……..	54	31	25	46

Information Contacts

Process	Unit	Telephone	Email
Estimation	Environmental Economics and Demographics	(202) 720-4447	HQ_SD_EEDB-EDS@nass.usda.gov
Data Collection	Survey Administration Branch	(202) 720-2149	HQ_CSD_SAB@nass.usda.gov
Questionnaires	Data Collection Branch	(202) 720-8646	HQ_CSD_DCB@nass.usda.gov
Sampling and Editing	Sampling Editing and Imputation Methodology Branch	(202) 720-5805	HQ_MD_SEIMB-Staff@nass.usda.gov
Summary and Estimators	Summary Estimation and Disclosure Methodology Branch	(202) 720-3046	HQ_MD_SEIMB-Staff@nass.usda.gov
Dissemination	Data Dissemination Office	(202) 720-3400	HQOAPAO@nass.usda.gov
Media Contact and Webmaster	Public Affairs Office	(202) 720-2639	HQOAPAO@nass.usda.gov

Access to NASS Reports

For your convenience, you may access NASS reports and products the following ways:

- 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.

For more information on NASS surveys and reports, call the NASS Agricultural Statistics Hotline at (800) 727-9540, 7:30 a.m. to 4:00 p.m. ET, or e-mail: nass@nass.usda.gov.