

Statistical Methodology

Name of Survey: Agricultural Resource Management Survey (ARMS) Phase II: Wheat (Durum, Other Spring, Winter, Organic-All Types) Production Practices and Costs Report

Name of Summary: Agricultural Chemical Usage 2009 Field Crops Summary: Wheat
(Access at USDA-NASS Quick Stats: <http://quickstats.nass.usda.gov/>. See Sector: Environmental, Group: Field Crops, Commodity: Wheat)

Data Collection Period: September to December 2009

Sample Size, Sampling Frames and Methods: The final 2009 ARMS Phase II sample, which consisted of 3,699 individual farms with positive 2009 planted wheat acreage, was drawn from the USDA-NASS list sampling frame through a three-step sampling and screening procedure. The initial sample was selected using a prioritized stratified design; all farms included on the list sampling frame (all known U.S. operations qualifying as a farm under the USDA-NASS definition, theoretically accounting for 90 percent of total U.S. land in farms), excluding abnormal farms, were assigned a positive probability of selection, with farms having recently reported planted wheat acres, and larger farms, assigned a relatively higher probability of selection. Sampled farms were then screened for the presence of planted wheat acreage through the ARMS Phase I Survey, conducted May through July 2009. From the resulting subpopulation of farms with positive wheat acres, the final 2009 ARMS Phase II sample was drawn through Sequential Interval Poisson sampling - a method in which the probability of selection increased with the amount of planted wheat acreage reported. Chemical use and production practice data for one randomly selected wheat field in each sampled operation were collected through personal interview.

Sample Unit and Reporting Unit: The sample unit was the individual farm. The reporting unit was a single, randomly selected wheat field from each sampled farm.

Modes of Data Collection: Personal interview

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 report are at the active ingredient level; one or more active ingredients are present in known amounts in the pesticide products reported in survey.

Estimates of active ingredient use were reported in a single unit of equivalence, per ingredient. For salt, ester, or amine active ingredients, estimates were reported in the parent acid equivalents. For example, the acid derivatives glyphosate isopropylamine salt and 2,4-D, 2-ethylhexyl ester were reported in the glyphosate and 2,4-D equivalents, respectively. For copper compounds, estimates were reported 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 primary 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 is included in 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 of the four primary nutrients; nitrogen, phosphate, potash, and sulfur.

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).

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 is included in report.

Nematodes: Unsegmented, parasitic worms of the phylum Nematoda. Prominent animal pest of wheat and other 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 primary 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 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 is included in report.

Rate per Application: Ratio indicating pounds (lbs) of a fertilizer primary nutrient or pesticide active ingredient applied, per single application, per planted acre. (*In Quick Stats: Applications, Measured in Lb/Acre/Application*)

Rate per Crop Year: Ratio indicating pounds (lbs) of a fertilizer primary nutrient or pesticide active ingredient 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 is included in report.

Data Review and Estimation Procedures: 2009 wheat chemical usage estimates were based on data collected, reviewed, and verified through the cooperative efforts of the USDA-NASS Environmental and Demographics Section and Program-State Field Offices. The initial review of Program-State level pesticide product usage data, as well as the conversion of pesticide product usage data to the equivalent active ingredient levels for publication, was accomplished through the use of NASS-maintained chemical use databases which contain both product recommended use ranges and active ingredient concentrations per product. Review and finalization of all data proceeded with assessment of reasonableness and consistency at the record, State, and U.S. levels. Using official USDA-NASS 2009 wheat acreage estimates by State (published in "Crop Production – 2009 Summary" [Cr Pr 2-1 (10)]), resulting data were expanded in calculation of final Program-State level statistics.

Reliability: Estimates were subject to sampling variability; sampling variability was measured by the coefficient of variation (*cv*), expressed as a percent of the estimate. Coefficients of variation differed considerably by variable, chemical, and crop. The narrower the numerical range of responses per variable, and the larger the number of positive responses per variable, the smaller the sampling variability. For these reasons, *cv*'s were generally lower for active ingredient *Rate of Application* estimates, and for estimates associated with the most often reported active ingredients (application

rates reported almost always fell within the manufacturer's relatively narrow recommended usage range, and a relatively large number of reports were received for the most widely used active ingredients).

Estimates were additionally subject to non-sampling errors. Non-sampling errors result when the target population is mis-defined through list duplication or incompleteness, or sample unit data is mis-recorded through mistakes in reporting, recording, or processing the data. Strict quality controls implemented at each step of the survey and data review process minimized the occurrence and magnitude of non-sampling errors.

Revision Policy: Estimates are final at first publication, and are not subject to revision.