

**Summary of Air Quality Research and Extension
July 2005**

Researchers in Iowa State University's College of Agriculture continue to look for ways to reduce odor and gas emissions from livestock operations. ISU Extension specialists work with producers as this research leads to new knowledge. Funding from farm and commodity groups, industry and state and federal government agencies is vital to making these efforts possible. Here are some examples of recent work in this area.

- Iowa State University is one of 11 institutions receiving new funding in 2005 from the U.S. Department of Agriculture for air quality research. A four-year project announced in spring 2005 is studying dietary strategies to reduce gas emissions from turkey, laying-hen and growing-finishing cattle operations. Iowa State is partnering with Purdue University on the \$482,000 USDA grant. The first step is to establish baseline emission measures for gases and particulates when cattle, laying hens and turkeys are fed typical diets. Once baselines have been determined, dietary changes will be made to see if emissions can be reduced. Laying hen work began in April 2005 and will continue into August 2005. (Wendy Powers, James Russell, Animal Science)
- The USDA funded a similar four-year project in 2004 that covers growing swine, broiler chickens and lactating cows. Iowa State is the lead institution on this four-year project that also includes the University of Maryland and the University of California, Davis. Growing swine was the first species tested in this project, beginning in September 2004. Groups of pigs were fed one of three diets until reaching market weight in December. Preliminary results show ammonia concentrations declined as the level of protein in the swine diets declined. No differences in hydrogen sulfide emissions were found. Broiler chicken work will begin in August 2005. (Powers)
- A new lab opened in September 2004 to make it possible for researchers to conduct studies on the impact of diet and animal/manure management practices on air emissions. Animals of all species can be fed individually or in groups, with emission measurements collected the same way. Results of the work could lead to new dietary recommendations for livestock producers that will improve air quality both inside and outside of production buildings. (Powers)
- Monitoring began in April 2005 to help determine if trees planted around an Iowa poultry production facility can reduce odor and dust. The monitoring at the Sparboe Farms facility near Eagle Grove is one part of a research effort to study the use of trees, shrubs and other perennial plants to reduce odors around poultry and egg production facilities. A \$440,000 USDA grant announced in March 2004 is funding the three-year study, which also involves the University of Delaware and Pennsylvania State University. Trees were planted in spring 2004 at the Iowa site. Similar plantings were done in Pennsylvania and Delaware. (Joe

Colletti, Natural Resource Ecology and Management; Steve Hoff, Agricultural and Biosystems Engineering)

- A USDA grant of nearly \$480,000 announced in spring 2004 is being used to investigate odor dispersion from swine facilities. Iowa State is the lead institution in a three-state effort that also includes the University of Minnesota and the University of Nebraska. The project involves measuring downwind odors from swine production facilities and how those odors are affected by such things as weather patterns, season of the year, growth cycle of the animals and building design and management. (Hoff, Jay Harmon, Dwaine Bundy, Agricultural and Biosystems Engineering)
- That new project builds on an existing six-state, \$2.2 million air-quality study also funded by the USDA. State-of-the-art monitoring equipment was used to collect particulate and gas emissions from six types of animal confinement facilities from October 2002 through March 2004. A final report will be released in September 2005, with some preliminary data available this summer. (Hoff, Bundy, Jacek Koziel, Agricultural and Biosystems Engineering)
- In 2004-2005, there have been 32 externally funded projects — either ongoing, recently initiated or recently completed — that address research and extension issues on air quality/odor, animal waste and manure management. The projects are conducted by scientists in the College of Agriculture, as well as by ISU Extension.
- Researchers are working on lowering odor emissions from a swine barn's ventilation air by using biofilters. Continued funding from the Iowa Pork Producers Association and the USDA is making this work possible. The idea is to exhaust air filtered through compost, which has been shown to reduce odors by up to 90 percent. The challenge is the increased cost to operate fans on a constant basis. Researchers now are studying ways to only run the fans through the filters when it's needed the most, such as at night when odors don't disperse quickly. (Hoff, Harmon)
- A \$47,000 grant from the National Pork Board is being used to collate research on best management practices (BMP) for minimizing air quality concerns and to create a searchable database on effectiveness, economics, advantages and disadvantages of the BMPs. This one-year project began October 2004. An online, interactive "decision tree" will allow users to select a substance (ammonia, hydrogen sulfide, odor) and a specific area of concern (housing practices, storage practices, application practices) before clicking on possible solutions. (Ken Stalder, Powers, Animal Science; Angela Rieck-Hinz, Agronomy)
- A campus lab has been equipped to measure hydrogen sulfide and ammonia. Methods are being developed to collect gas samples from the field to bring to this lab for analysis. A full-time research associate has been hired. Funding provided by the Iowa Pork Producers Association. (Hoff)
- Calibration efforts continue on an odor dispersion model. The computer model will help determine how far odors from livestock production facilities will travel

under a variety of atmospheric conditions. The model makes predictions based on historic weather patterns, type and size of facility, number of animals and kind of ventilation system. Funding has come from the Iowa Pork Producers Association and the Iowa Farm Bureau Federation. (Hoff, Bundy)

- The National Pork Board funded a project to establish baseline survey data on downwind concentrations of ammonia, hydrogen sulfide and odor from deep-bedded swine facilities. Six sites were visited monthly to establish "typical" levels. Single-point monitors were used to continuously measure hydrogen sulfide levels 100 feet downwind. Results have been presented at two symposia and will be compared to a similar study on deep-pit finishing. (Harmon, Bundy)
- The Olfactometry Laboratory in the agricultural and biosystems engineering department continues to be heavily used. Trained panelists evaluate the strength of odors from livestock sources. The lab evaluates an estimated 60-70 percent of all odor samples from livestock in the United States. One of the main purposes of the lab is to evaluate odor-reduction technologies being tried at livestock facilities and helping producers determine when their management methods are effective in reducing odors. The lab also is analyzing samples for the purpose of compliance of anaerobic lagoons in Colorado. (Bundy, Hoff)
- Research funded by the National Pork Board is being conducted to monitor hydrogen sulfide concentrations near swine production systems and at nearby residences. Ammonia and hydrogen sulfide concentrations also are being monitored inside residences near swine production systems to assess the influence of animal agriculture on indoor air quality. (Hoff)
- Research is being conducted on sampling techniques for assessing odors and gases. A novel wireless controlled sampling system has been developed that can remotely sample air at locations up to a clear line-of-sight of 10 miles from a transmitter. Samples are initiated with prescribed weather patterns as dictated by research needs. (Hoff)
- In spring 2003, small groups of swine were fed diets containing different amounts of crude protein and amino acids. Feeding to the amino-acid needs of the animal allows dietary crude protein content to be reduced, and therefore, potentially lower ammonia emissions. Some animals also were fed commercial products that bind to ammonia. Air sampling was done to test what feeding strategies reduce ammonia emissions. Reducing crude protein decreased ammonia emissions by 55 percent but no benefits were demonstrated with the commercial product. (Powers)
- In a related study, freshly excreted manure from swine was collected for lab tests that involved stirring, temperature changes, commercial additives and other strategies that might reduce emissions from manure pits. Findings were reported in the May 2005 issue of the Journal of Environmental Quality. (Powers)
- Work has been ongoing to develop baseline information on ammonia emission factors for poultry operations as influenced by housing, manure management and time of year. House-level emission factors for laying hens and broilers have been

established from intensive monitoring for one year of 10 layer houses and 12 broiler houses. Study findings have been disseminated to producers, poultry industry professionals and academic community via conference presentations, extension publications, Web publication, producer educational workshops and refereed journal articles. Funded by the USDA, in collaboration with the University of Kentucky and Pennsylvania State University. (Hongwei Xin, Agricultural and Biosystems Engineering)

- Work was conducted to evaluate alternative methods for measuring ammonia emissions from livestock production facilities. An indirect method of measuring building ventilation rate based on carbon dioxide balance was compared with direct measurement of the building ventilation rate in a commercial manure-belt laying hen house. Findings have been published. Funded by USDA and the Six-State Animal Waste Management Consortium. (Xin)
- Work was conducted to develop the framework of a process-based model to predict ammonia emissions from animal feeding operations, in collaboration with the University of California (Riverside and Davis). Funded by the Lake Michigan Air Directors Consortium. (Xin)
- Research evaluated the performance of Single Point Monitors (SPMs) for measuring ammonia and hydrogen sulfide under laboratory and field conditions. SPM, a portable instrument that can monitor a specific gas, has been used by some states and agencies to monitor ammonia and/or hydrogen concentrations near livestock facilities. The project report and a journal article are available. Funded by the National Pork Board. (Xin, Hoff)
- Controlled experiments have been ongoing that quantify gaseous (particularly ammonia) emissions from storage of poultry manure as affected by stacking configuration, time of storage, manure properties and environmental conditions. Research findings have been shared with the egg industry and academic community. A project report is available. Funded by Iowa Egg Council, Institute for Physical Research and Technology and Midwest Poultry Consortium. (Xin).
- Work is in progress that seeks practical means to mitigate ammonia and odor emissions from poultry manure. To date effects of dietary manipulation and surface application of some manure amendments have been evaluated, with promising results. Several intermediate reports are available. Funded by the U.S. Poultry and Egg Association, Iowa Egg Council and Agricultural Experiment Station. (Xin, Koziel; Kristjan Bregendahl, Animal Science)
- A new 18-month project to extensively monitor two commercial broiler houses in Kentucky is underway. The project involves continuous monitoring of ammonia for one year using mobile labs and state-of-the-art monitoring instruments. It will collect more baseline data on ammonia emission rates from commercial broiler houses. Funded by Tyson Foods. (Robert Burns, Agricultural and Biosystems Engineering, Xin)

- Work is underway to develop a mobile emission lab to be used in field evaluation or verification of emission mitigation techniques for poultry operations. Funded by USDA. (Xin, Hoff)
- Iowa State is coordinating a 14-member national environmental scientific panel that provides research-based information resources, technical advice and recommendations for the United Egg Producers regarding air emissions for the U.S. egg industry. The panel consists of representatives from the egg industry, the USDA and leading researchers of land-grant universities. It is chaired by Hongwei Xin from Iowa State University. (Xin)
- In February, the College of Agriculture and ISU Extension provided comments to the EPA on its Animal Feeding Operations Consent Agreement, which outlines air-quality emissions plans that will impact the nation's swine, poultry and dairy industries. ISU's Iowa Pork Industry Center, the Iowa Pork Producers Association and ISU Extension sponsored a satellite program in March to help answer questions about the agreement and outline producer options and responsibilities.
- As new emissions data emerges from research studies and from measurements by state agencies, ISU continues to provide new scientific information, analysis and testimony to lawmakers and regulators. Several faculty members assisted with the development of the Iowa Department of Natural Resources' Animal Feeding Operations Technical Workgroup report, finalized in December 2004.
- Since 2003, 17 ISU Extension publications regarding air quality best management practices, producer practices, odor measurement, and the science of odor have been completed and printed. All of the publications are available on the Web at: <http://www.extension.iastate.edu/airquality/pubs.html>
- The Animal Agriculture and Air Quality Web page was established in February 2002 and updated in April 2005. It now includes a policy and regulations page, plus links to current news, research reports, policy and regulations, publications and a list of ISU faculty serving on the College of Agriculture's Air Quality Issue Team. The Web page receives about 1,150 hits per month. It's at <http://www.extension.iastate.edu/airquality/>. (Rieck-Hinz, Agronomy)
- The Iowa Manure Applicator Certification program, started in 1999, mandates annual training for confinement site and commercial manure applicators. The Iowa Department of Natural Resources contracts the educational and training program to ISU Extension. Campus-based faculty and staff and field specialists plan and conduct annual workshops that provide information on regulatory requirements and odor control management practices. (Rieck-Hinz)
- The *Iowa Manure Matters - Odor and Nutrient Management Newsletter* is a quarterly, eight-page publication made available at no charge to subscribers. Currently 7,700 copies are distributed. The newsletter includes articles related to odor control strategies, air quality issues and regulations. It is available at: <http://www.extension.iastate.edu/Pages/communications/EPC/> (Rieck-Hinz)