HARRY R. HUGHES CENTER FOR
AGRO-ECOLOGY, INC.

2007 Project Award Summaries
Managing Risk to the Public and the Environment from Poultry Litter Application and from Food-Borne Human Pathogens

Funding for these projects was made possible by the University of Maryland, College of Agriculture and Natural Resources through the Hatch Act. A total of $264,338 was awarded to the three project teams, matched by $267,852 from cost-share and other sources.

1. Dr. Chris Walsh – Univ. of MD, College Park
Risk Management for Maryland-Grown Fresh Vegetables and Fruits: Comparing Organic and Conventional Management Systems for their Effect on Food-Borne Human Pathogens
Project Award: $31,000; Match: $64,100; Duration: 12 months

Farmers rely on Good Agricultural Practices (GAPs) to reduce the risk of microbial contamination of crops and potential food-borne illnesses stemming from the consumption of fresh fruits and vegetables. GAPs are recommended practices with logical bases which were developed and articulated by the U.S. Food and Drug Administration. However, many scientific and technical gaps exist in our understanding of the ways human pathogens survive in the environment and the role of routine agricultural practices on this survival.

Food safety and the potential for bacterial contamination of fresh fruits and vegetables have become primary concerns for producers, marketers, and consumers in the United States. In recent studies, researchers at the University of Maryland found that organic and Integrated Pest Management (IPM) pesticide treatments had dramatically different effects on the bacterial populations found on leaves and fruit. This study will build on that knowledge and expand its scope to four economically-significant high-risk crops grown in Maryland: tomato, cantaloupe, spinach and strawberry. Researchers will study the effects of management systems on bacteria found on the surface of these crops and the potential of chemicals such as pesticides and plant extracts on the ability of bacteria to develop biofilms which allow them to survive in hostile field environments.

Hypotheses:
a. Routine pesticide and fertilizer applications affect the phyllosphere and consequently can affect microbial ecology on the surface of fresh commodities
b. Pesticides and plant extracts can interact with the development of microbial biofilms

Objectives:

- Compare IPM and organic inputs of fertilizer and pesticides in the field using a replicated factorial study to test for the effects of these treatments on the microbial communities present on the leaf and fruit surface of four high-risk fresh-market crops (melons, tomatoes, spinach, and strawberry)

- Conduct *in vitro* assays on the development of *Salmonella* biofilms, to test whether the development of these biofilms is affected by naturally-occurring plant extracts and by commonly-used broad spectrum organic fungicides and insecticides

2. Dr. Daniel Fisher and Dr. Lance Yonkos – Univ. of MD, Wye Research and Education Center

Antibiotics in Land Applied Poultry Litter and Biosolids: Induction of Microbial Antibiotic Resistance

Project Award: $120,300; Match: $120,300; Duration: 12 months

Antibiotic resistance is increasing among most human pathogens. A recent World Health Organization (WHO) report indicated that antibiotic resistance is one of the most critical human health challenges and that in some cases there are few or no antibiotics available to treat resistant pathogens. More than 70% of antibiotics in the U.S. are estimated to be used in livestock production, such as poultry on the Delmarva Peninsula. The majority of these antibiotics are used at sub-therapeutic levels for growth promotion rather than to treat active infections. Since more than 90% of injected antibiotics are excreted unchanged, the vast majority end up in animal and human waste. The Delmarva Peninsula produces 600 million chickens and 1.6 billion pounds of litter annually, most of which is land applied as fertilizer. Similarly, human-use antibiotics enter wastewater treatment facilities where they can be sequestered in biosolids and then applied to land, again as fertilizer. Recent evidence indicates that interactions between bacterial organisms and antibiotics in the environment contribute to the development of antimicrobial-resistant bacterial strains and that resistance to animal use antibiotics can result in resistance to human use antibiotics. Thus, there is concern that antibiotics from poultry litter and biosolids application can confer resistance to human use antibiotics.

Hypothesis:

Antibiotic residues in poultry litter and biosolids are transported via runoff from agricultural fields to receiving waters where they produce distinct patterns of antibiotic resistance in pathogenic bacteria.

Objectives:

- Identify and quantify antibiotic residues and antibiotic resistant bacteria in waste sources including a variety of poultry manures (broilers, organic broilers, laying hens, turkeys, etc.) and two municipal biosolids sources
- Determine, in the laboratory, whether antibiotic resistant bacteria in poultry litter and biosolids can persist in aqueous solution and maintain their resistance to antibiotics over time and whether antibiotic residues in the litter or biosolids themselves can induce antibiotic resistance in non-resistant bacteria in aqueous solutions
- Investigate, in the laboratory, the ability of poultry manure and biosolids sources to generate antibiotic resistant bacteria in natural receiving surface waters
- Identify and quantify antibiotic residues in stream systems (e.g. water and bed sediment) from regions impacted by land application of poultry manure and biosolids;
- Confirm the occurrence of antibiotic resistance in natural waters and bed sediments by isolating bacterial biotypes and testing for resistance to previously identified antibiotics

- Differentiate antibiotic resistance patterns associated with human versus avian fecal sources.

3. Dr. Frank Coale and Dr. Joshua McGrath – Univ. of MD, College Park
Sustainable Use of Pelletized Broiler Litter in the Chesapeake Bay Watershed
Project Award: $113,038; Match: $83,452; Duration: 12 months

Non-point nutrient losses from agriculture, both phosphorus (P) and nitrogen (N), through runoff and leachate continue to be an environmental concern in Maryland. Such losses have been identified as a major component of water quality degradation in the Chesapeake Bay. Many of the farms in the Chesapeake Bay watershed have soils that are high in P and groundwater that is high in nitrate-N. Much of the problem is associated with on-farm and regional nutrient imbalances associated with the poultry industry. One innovative solution that has been adopted is transport of excess poultry litter from poultry farms to a regional pelletizing plant where the litter is converted into an organic fertilizer that can be easily transported to other regions. This solution has the potential to significantly reduce on-farm nutrient surpluses and thereby reduce nutrient contributions to the Chesapeake Bay. However, widespread adoption of pelletized poultry litter as a fertilizer by farmers is growing slowly. Several factors have contributed to the slow growth of pelletized poultry litter use. Primarily, there is concern among farmers regarding nutrient availability and mineralization, application methods, and handling. In addition, there has been little research into the potential environmental impacts of pelletized litter application to row crops. There is a need for science based recommendations on application rates and methods that would provide for crop productivity while limiting nutrient losses to surface and subsurface water.

Hypotheses:
a. Pelletized broiler litter will behave more like fresh litter than inorganic fertilizers
b. The pelletizing process will affect the decomposition and nutrient mineralization rates of pelletized litter compared to fresh litter
c. The physical differences between pelletized litter and fresh litter should make the application and management of pelletized litter different from fresh litter

Objectives:
- To establish the total and plant available nutrient content and the nutrient mineralization rates of pelletized litter
- To determine realistic methods of application of pelletized litter
- To develop effective recommendations that promote environmentally and economically sustainable use of pelletized litter in commercial grain production