Organic Research
Background

Organic farming is one of the fastest growing segments within U.S. agriculture. With an annual growth rate of 20% for the past 10 years, organic production in 2003 reached $10.8 billion in consumer sales, representing 1.9% of total U.S. food sales (OTA, 2005). Certified organic cropland for corn, soybeans, and other major crop commodities more than doubled between 1997 and 2001, with organic poultry and dairy growing even faster (USDA-ERS, 2005). More than 2.3 million acres of crop and pasture lands were used for organic production in 2001. Adoption of organic agriculture continues to increase because increasing numbers of producers recognize the prospects for high-value markets and increased farm income, especially as prices fall for staple commodities. Also, the environmental benefits from organic production systems are being recognized as demonstrated by the establishment of Federal and State subsidy programs to encourage conversion to organic farming. Many producers, manufacturers, distributors, and retailers specialize in growing, processing, and marketing an increasing diversity of organic food and fiber products. However, even though organic production has grown rapidly, less than 1% of all U.S. agricultural lands are under organic production. Obstacles to farmer adoption include high managerial costs and increased risks associated with shifting to new ways of farming, limited awareness of organic farming system practices, lack of marketing infrastructure, and inability to capture market share (USDA-ERS, 2005).

The definition for organic agriculture by the National Organic Standards Board (1995) is:

> *An ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony*.

The guiding principles that characterize certified organic farming include biodiversity, diversification and integration of enterprises, sustainability, natural plant nutrition, natural pest management, and integrity (ATTRA, 2004). Organic product labeling standards are based on these principles.

Organic producers have done well to develop production systems that work, but a well-planned research strategy is needed to realize the full potential of organic farming systems. Both basic and applied research is needed to increase the productivity and profitability of existing organic agricultural systems. For example, not only does more need to be known about relationships between biological fertility and soil quality to enhance soil fertility so that yields can be increased, but to do so without need for purchased organic inputs. Also, effective whole-system strategies are needed to naturally suppress insect and disease populations that are otherwise controlled in conventional production systems with pesticides. In addition, how organic production practices affect food quality and nutrition, and food safety and security are important issues to organic producers and consumers.

ARS Organic Agriculture Research

ARS Organic Agriculture Research History: The USDA Agricultural Research Service (ARS) has a long history of conducting research that solves problems faced by producers, allied agricultural industries, and consumers. However, there has been no formal ARS research effort for organic agriculture. Past organic research was conducted by ARS scientists having interests that coincided with those of organic producers and organizations whom they had personal contact. In 1979, Secretary of Agriculture Bob Bergland organized the USDA Study Team on Organic Farming that prepared the *Report and Recommendations on Organic Farming* and recommended increased organic research efforts. A full-time coordinator for organic farming was appointed, but the position was abolished in 1982. Some ARS scientists continued their work in organic systems, but the amount of research was limited and not well coordinated. In 1999, ARS National Program Staff funded seven organic research projects at approximately $50,000 each and proposed a $4-million dollar budget initiative to support organic research. An internal ARS survey at that time identified 63 scientists

conducting research on organic agriculture problems, and at that time there was no formal coding of these projects within the ARS accounting system that clearly identified them as organic.

Organic research components are found in the present Action Plans for National Programs NP-207 Integrated Agricultural Systems, NP-304 Crop Protection & Quarantine, and NP-305 Crop Production. In FY-2005, approximately $3.5-million of the ARS research budget is directly applicable organic agriculture. An additional $10-million of ARS funding is directed towards research with organic farming's needs in mind. Presently, organic agriculture research is being conducted at more than 20 ARS locations and more than 100 scientists. These locations include: Salinas, California; Weslaco, Texas; Beltsville, Maryland; Orono, Maine; and Morris, Minnesota. Vegetable, grain, dairy and other production systems are addressed by these research projects. ARS intends to expand these efforts to more locations, commodities, and activities as resources permit. Additionally, ARS carries out a significant research effort in the area of low-input sustainable agriculture. More than 40 percent of the total ARS programs contribute to low-input sustainable agriculture. ARS conducts research on diverse topics such as biological control, integrated pest management (IPM), weed control, soil management, food safety and food quality. In many instances this research involves working directly with organic producers.

ARS held a three-day workshop January 11-13, 2005 in Austin, TX to begin formally organizing agency organic agriculture research efforts. The workshop attendees represented organic growers and advocacy group customers; other USDA and university stakeholders; and ARS scientists and administrators. The workshop was used to identify the needs of the organic industry, define what they believe constitutes productive organic farming systems, and describe how systems research should be conducted to meet the unique specifications of organic agriculture. The meeting also served to bring together ARS scientists to develop a national organic research network and define national research objectives directed at customer needs, share information on research approaches and findings, and facilitate development of research projects to solve problems important to organic producers and consumers.

What the Organic Community Believes is Important

Based on the input received from the organic community at the Austin, TX Organic Research Workshop, themes and problems important to our organic agriculture customers were identified. These are summarized below.

A Way to Do Productive Organic Research:

- Multi-disciplinary research that is done in regionally appropriate systems.
- Involvement of the organic community when identifying problems and looking for possible solutions.
- Organic research needs to be done under organic production conditions that compare to organic certification requirements.
- Some research should be done on organic farms.
- Realize organic production is done at different scales.
- A focus on the benefits of organic production to the environment and nutrition.
- Effective communications between researchers and organic producers so that research findings and products are relevant to producer needs.

The Kinds of Research Questions ARS Can Answer:

- Environment: What are the ecosystem servicing and environmental benefits from organic production systems?
- Food safety, quality, nutrition and security: How do organic management practices affect food nutritional quality and safety
- Economic viability: *To what extent can organic agriculture substitute for or replace conventional agriculture?*
- Farm productivity: *What are the impacts of ecological management strategies on soils and the function of above- and below-ground biological communities? What are the best ways to manage the productivity of organic systems?*

Topics to Consider when Answering the Research Questions:

- How organic production contributes to different aspects of food quality, safety, and security.
- Developing production systems to increase profitability.
- Ways to manage and measure the health of soils.
- The environment benefits from organic production systems.
- Ways to achieve the greatest productivity in organic production.
- The contributions of organic production to overall sustainability.
- Develop genetic materials specific to organic production systems.
- Biological-based strategies to manage diseases, weeds, and insect pests.

ARS Organic Agriculture Research Mission:

Systems-oriented research that engages the Organic Community and uses organic principles to solve problems and produce products specific to their needs.

ARS Organic Agriculture Research Vision:

The Agricultural Research Service is uniquely positioned to conduct research to increase organic agricultural productivity and profitability across the diverse conditions found in the U.S. ARS scientific expertise in integrated agricultural systems with National Programs in Natural Resources & Sustainable Agricultural Systems, Crop Production & Protection, and Animal Production & Protection, and Nutrition & Food Safety/Quality provide a nation-wide network of resources to solve problems and answer questions important to organic producers and consumers. ARS research into components of organic production systems will determine why specific responses occur, while integration research will determine how multiple components interact and contribute to overall sustainability within a whole-farm setting. A key product of ARS organic production systems research will be identification of a range of possible solutions that organic producers can choose from that are appropriate to their location and the scale of their operation. ARS organic agricultural research will rely heavily on collaborations across scientific disciplines and use partnerships with organic producers and other stakeholders interested in organic production values. This effort to partner with the organic community will help ARS solve problems and produce products unique to organic food production.

ARS Organic Agriculture Research Organization:

The need for organic agricultural research goes beyond identifying productive and profitable production systems that meet organic certification standards. Many questions also need answers regarding the influence of organic production has on the quality and safety attributes of food products and the impact of production on natural resource quality. There are principles and practices found in organic production systems that should benefit producers using other production approaches not committed to organic principles (ATTRA, 2004) and organic certification standards (USDA-AMS, 2005). ARS' research in organic agriculture will be focused on understanding the scientific basis of organic production practices that will result in new and more effective farming methods.

This Action Plan provides a structure in which ARS organic agriculture research can be done to address large system-wide questions and specific component topics important to organic producers and consumers. This approach is built upon the research action plan developed for ARS National Program 207 (Integrated Agricultural Systems), but is designed to meet the specific needs of organic agriculture based on input from the Austin, TX workshop. ARS' research has primarily been directed

towards research issues related to biological and physical environment processes influenced by agricultural production. However, through strategic partnerships with other government agencies and private organizations, the context of our research can also consider economic and social factors as well. Where a researchable questions are raised that are important to the organic industry, we will work together with our partners to get an answer.

Production Systems. Every farm or ranch is a complex system of interacting components that exist in integrated natural and socio-economic environments. These production systems may be found next door and look like any other farm in a rural setting, or may be found within the urban fringe of a large metropolitan area. The sizes of organic production operations are just as varied as their location. Because of this, various solutions to organic producers problems will be found using a systems approach to determine how different components interact and how their combined effects impact whole-farm productivity, food quality and safety, and profitability. Organic fruit, nut, vegetable, grain, and livestock production systems should serve as frameworks for conducting organic research. Cross-discipline teams should identify emergent properties, principles, and innovations within organic production systems that can benefit organic producers and other general kinds of agricultural production systems.

ARS research has traditionally solved production system problems for specific agricultural commodities. Using this classification, we have organized three kinds of primary commodities, with further commodity subgroups within each. We understand that a principle guiding value of organic production is *Diversification & Integration of Enterprises* (ATTRA, 2004), so this classification should be viewed as organizational to help identify ARS research efforts, and not value-driven.

Fruit & Nut
Tree, Vine, and Caneberry
Field Crops
Vegetable & Fruit, Fiber, Grain & Seed, and Forage
Livestock
Meat, Milk, and Hair

Topics ARS Research Can Address. ARS research has traditionally solved problems related to specific aspects of producing an abundant, safe, and nutritious supply of food. These research topics address issues that may distinguish organic products from those produced by other means, or limit the productivity and profitability of organic agricultural systems. Some of these topics can be considered as individual components that when combined make up a production system, while others can be used to measure the success of a production system. Certain management tools and practices are used to manage a specific animal or crop commodity within a particular production system. Again, for organizational purposes, we have identified five general research topics for organic agriculture with unique topic areas within each.

Food Quality
Nutrition and Storability
Food Safety
Microbes and Pesticides
Productivity
Genetics,
Livestock Science (Health Management, Shelter, Nutrition)
Crop Science (Soil Management, Water Management, Pest Management)
System Integration
Environmental Impact
Profitability

Planning Organic Agriculture Research Projects. Research project planning will rely heavily on input from organic producers and other organic organizations to identify the highest priority problems that may have researchable solutions. ARS National Program Staff will establish a liaison committee made up of

partners and customers from the organic community to annually receive input regarding high priority research questions and to discuss ARS research findings. Research units are encouraged to develop similar appropriate partnerships with local producers and other potential customers of ARS research.

Once research problems have been identified, the research hypotheses will be clearly stated.

The Program Logic Model (Kellogg Foundation 2001) approach is recommended to determine the desired outcomes from the research, setting up the research plan with milestones, and to assess the resources needed to answer the research question. Based on the needed resources to solve the specific problem, the kinds of expertise needed for the research team will become clearly identified. With member roles and responsibilities identified, an initial team should be formed. The typical steps taken to incorporate organic agriculture attributes into research strategies follow those developed for projects in NP-207 Integrated Agricultural Systems. The diagram is based on the concept of needs being identified to ARS by customers. The process begins with initial stakeholder communication to the partnering ARS scientists to clarify their concerns, and flows through different scenarios determined by whether the problem is a production systems issue, its relevancy to ARS, or possible duplication of previous research.

Some other things to keep in mind as we develop organic research projects:

- Organic community members asking for research help may be motivated by social or ecological considerations.
- Expected research outcomes and resources needed to complete the project should be clearly defined before beginning the research.
- A research team is not limited to ARS personnel, especially when addressing socio-economic questions such as marketing strategies.
- Problem selection may be influenced by how much can be accomplished and how long it will take, particularly if other high-priority problems need attention.
- New organic research must meet the objectives of the project OSQR plan. A good time for considering new organic objectives is when writing new project plans after completion of the National Program cycle.

Outcomes from ARS Organic Agriculture Research:

We anticipate outcomes from ARS organic agriculture research will make contributions to the following Goals and Objectives of the USDA-ARS Strategic Plan.

Goal 1: Enhance Economic Opportunities for Agricultural Producers.

Objective 1.2: Contribute to the Efficiency of Agricultural Production Systems.

- Understanding how organic production systems affects long-term productivity.
- Crop varieties contributing to improved soil properties, biological pest management principles, and increased nutrition for human or animal consumption.
- Livestock breeds adapted to high productivity with minimal environmental impact and whose products are safe and healthy for consumers to use.
- Identification of exotic, heirloom, traditional, and improved plant varieties for conventional and new specialty uses.
- Access to archiving genetic resource information from indigenous producers and different end-users.
- Identification of sustainable practices for intensively managed small land parcels in or close to urban population centers.
- Easy-access databases containing organic research results and their application.
- User-friendly geographic information systems databases to easily access climactic and soil data to assist production decisions.

- Identify properties, principles, and innovations within organic production systems that can benefit organic producers and other general kinds of agricultural production systems.

Goal 3: Enhance Protection and Safety of the Nation's Agriculture and Food Supply.

Objective 3.1: Provide Science-Based Knowledge on the Safe Production, Storage, Processing, and Handling of Plant and Animal Products and on the Detection and Control of Toxin-producing and/or Pathogenic Bacteria and Fungi Parasites, Mycotoxins, Chemical Residues, and Plant Toxins So as To Assist Regulatory Agencies and the Food Industry in Reducing the Incidence of Foodborne Illnesses.

- Methods to rapidly determine contamination and chemical constituents in foods that contribute to food safety and nutrition.
- Knowledge of levels of pathogens and agricultural chemical compounds found in foods throughout the organic agriculture production cycle.
- Development of post-harvest processing methods that enhance shelf life and sensory appeal and are consistent with organic practices and certification standards.

Objective 3.2: Develop and Deliver Science-Based Information and Technologies To Reduce the Number and Severity of Agricultural Pest, Insect, Weed, and Disease Outbreaks.

- Knowledge of the effects of organic practices on soil food web structure, weed, insect pest, and pathogen populations, and numbers of beneficial micro-organisms.
- Biological-based pest management strategies characterized by optimal use of on-farm produced resources and not substitutions of purchased inputs that meet organic standards.

Goal 5: Protect and Enhance the Nation's Natural Resource Base and Environment.

Objective 5.2: Provide Science-Based Knowledge and Education To Improve Quality and Management of Soil, Air, and Water Resources.

- Techniques that quantify the effects of organic production systems on natural resource quality, including soil quality.
- Measurements of the benefits to the soil including improvements in water, nutrient and carbon cycling efficiency, increased soil organic matter, and improved soil structure.

References

ATTRA. 2004. Organic Crop Production Overview, Fundamentals of Sustainable Agriculture. National Center for Appropriate Technology. Favetteville, AR

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National Organic Standards Board. 1995. Organic definition passed by the NOSB at its April 1995 meeting in Orlando, FL as reported by the Organic Trade Association at: http://www.ota.com/organic/definition.html

USDA-AMS. 2005. National Organic Program – Program Standards. http://www.ams.usda.gov/nop/NOP/standards.html

USDA-ERS. 2005. Briefing room. Organic farming and marketing: questions and answers. Website reference: http://www.ers.usda.gov/Briefing/organic/Questions/orgqa3.htm

Other Web-based Information Sources

National Agricultural Library – Alternative Farming Systems Information Center
http://afsic.nal.usda.gov

Economic Research Service – Organic Farming and Marketing Briefing Room
http://www.ers.usda.gov/Briefing/organic/

Agricultural Marketing Service – The National Organic Program
http://www.ams.usda.gov/nop/indexNet.htm

Cooperative State Research, Education, and Extension Service – Organic Agriculture
http://www.csrees.usda.gov/ProgView.cfm?prnum=3928

States Department of Agriculture – Organic Certification

http://www.usda.gov/wps/portal/!ut/p/_s.7_0_A/7_0_1OB?navid=ORGANIC_CERTIFICATIO&parentnav=AGRICULTURE&navtype=RT