A Training Series for Cooperative Extension Agents on Organic Farming Systems

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SUMMARY. More than 50 agents participated in a series of workshops that were offered as in-service training and as a graduate level North Carolina State University (NCSU) course worth four credits. The Organic Unit at the Center for Environmental Farming Systems (CEFS), a 100-acre (40-ha) facility dedicated to research and education in organic farming systems, served as a home base for training activities. These training activities consisted of lectures, hands-on demonstrations, group discussions, field trips, and class exercises. Two unique features of the workshops were the interdisciplinary, team teaching approach and the emphasis on integration of information about interactions among production practices. This well-received, successful training program will serve as a model for future extension training. A training manual, slide sets, extension publications, and an organic farming web site are being created to provide agents with the resource materials they need to conduct county-based educational programming in organic production systems and enterprises. The model for extension training presented in this report is an effective means for engaging county agents in continuing education and professional development. Interdisciplinary teaching teams allow for a full, integrated treatment of subject matter and present a whole systems perspective to agents. Regularly scheduled, intensive sessions that accommodate busy calendars and utilize time efficiently provide a strong incentive for regular attendance. Awarding graduate level university credit hours for completion of required course work attracts and retains prospective student and agents. Encouragement of active participation by agents through hands-on field activities, open discussion of issues that impact agricultural and rural life, and field trips to view concepts presented in a real world context ensure that educational goals are fulfilled and that active learning takes place. This model should be used in future extension training programs.

Increasing consumer demand for organically produced food underscores the need for research and extension programs that focus on organic farming systems, enterprises, and production practices. Nationwide, organic producers are the largest growth segment in agriculture today (Natural Foods Merchandiser, 1996). According to the Organic Trade Association (OTA), national organic sales for fresh fruits and vegetables increased at an average annual rate of 24% between 1991 and 1996. In 1995, there were nearly 4,900 certified organic farms that raised organic food products in 45 states, or a 35% increase since 1992 (Dunn, 1995).

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Raterman (1997) estimated organic retail market share between 1.0% and 1.5% of U.S. grocery store sales. Brandt (1998) reported that U.S. organic produce sales at natural and traditional grocery stores approached $670 million in 1998. The OTA estimates annual sales of organic foods at $4.7 billion (Allen, 1999).

Mainstream supermarkets are increasing their sales of organic produce, and according to a recent survey, 54% of consumers indicated that their supermarkets carried organic produce (The Packer, 1996). Several studies have noted that consumers were willing to pay premium prices for organically grown food (Estes and Smith, 1996; Govindasamy and Italia, 1997). Consumers purchase organic foods for a variety of reasons. At least four market segments exist for organic products: 1) shoppers who are concerned primarily about health and nutrition issues; 2) consumer advocates who support environmental protection and sustainable use of resources; 3) consumers who do not want genetically modified organisms (GMOs) in their food, and 4) shoppers who believe that organically grown food simply tastes better than conventionally grown food. Industry analysts also point out that organic sales have increased despite higher prices, irregular availability, and limited shelf space in mainstream grocery stores. As farm subsidies are reduced or eliminated, more growers may be looking to expand into the organic market. In addition, when the USDA National Organic Standards are implemented and as international trade increases, the organic market will continue to grow.

A joint North Carolina Department of Agriculture (NCDA), Carolina Farm Stewardship Association (CFSA) survey of 16 North Carolina (NC) supermarkets revealed that organic produce sales rates were among the fastest growing sectors in the NC retail food industry (Davis and Spears, 1996). Demand for organic produce greatly exceeds in-state supply, and as a result, 90% of the organic foodstuffs purchased by NC wholesale and retail grocers comes from out-of-state, primarily California (Estes et al., 1999).

These trends point to the need for the land grant university system to provide information, conduct applied research, and offer extension programming to support organic growers and organic farming enterprises. Many farmers are seeking information that will enable them to farm according to organic standards. They are also seeking assistance in problem solving on their organic farms. Historically however, many organic farmers view the land grant university system and the cooperative extension service (CES) as being unwilling to acknowledge these trends and consider them unresponsive to them. Hanson et al. (1995) reported that a major hindrance to adoption of sustainable agricultural practices is lack of information from educational organizations like the CES. In a 1995 nationwide survey of organic farmers, 63% identified uncooperative or uninformed CES agents as a barrier to beginning organic production (Organic Farming Research Foundation (OFRF), 1996). A more recent OFRF survey included CES agents among the least useful personal contacts for organic farmers (OFRF, 1999). In response to these criticisms, the extension community answers that the primary reasons for any perceived unresponsiveness to demands for information relating to organic production practices and enterprises are a lack of both adequate training and available research-based, resource materials.

In 1998, the USDA Southern Region Sustainable Agriculture Research and Education Professional Development Program (SAREPDP) awarded the Department of Horticultural Science and the Department of Plant Pathology at North Carolina State University (NCSU) a grant to address the need for Extension agent training in the principles and practices of organic production. This model training program was titled "Building Capacity in Sustainable Agriculture: A Comprehensive Training Program in Organic Farming Systems for Cooperative Extension Agents, Specialists, and Other Educators."

A goal of the training program was to increase the extension commitment to organic growers and the organic foods industry by expanding the knowledge base of county agents in organic farming systems. A second goal was to increase agent awareness and recognition that organic enterprises are viable farm enterprises in a growing agricultural industry. Thus prepared, extension agents will be able to provide more support for the existing and prospective organic farmers in the southeastern U.S. and assist these growers in increasing organic market share in this region.

Another goal of the training program was to break down some of the existing barriers that prevented cooperative extension agents from working with organic growers. These barriers included 1) an inadequate research database; 2) limited experience with biologically based farming systems; 3) discomfort in assessing the validity of anecdotal information; and, 4) attitudinal barriers about who organic growers are and what they believe.

Finally, the training program was designed to familiarize agents with technologies that promote sustainability through a more resource efficient system of food production that has less negative impact on the environment. An environmental focus was on improvements to resource use efficiency and soil quality, interactions of components within systems, and a greater reliance on internal or renewable resources. A social focus was on sustainable farm profitability and social viability for farm families and rural communities.

Methods and materials

CURRICULA. The Organic Systems training sessions focused on 14 identified components of organic farming systems. These components included organic fertility management, composting, organic insect, weed, and disease management, marketing, information delivery, organic greenhouse management, cover cropping, soil quality, crop rotation, tillage systems, integrated livestock systems, and farmer-to-farmer networking. These components were organized into six 2-d sessions. Agents attended the monthly sessions from April through September. In order to meet North Carolina Cooperative Extension Service (NCCES) agent in-service educational requirements and professional development guidelines for continuing graduate education credits, the training was formalized as a graduate level special projects class, cross-listed in the NCSU Department of Horticultural Science and the Department of Plant Pathology. Table 1 summarizes topics, demonstrations, evening discussions, tours, and assignments as described below for each workshop.

By its very nature, organic pro-

Table 1. Summary of organic traning workshops. In addition to below activities, each 4-h workshop had a series of appropriate lectures presented by teams of researchers, extension personnel, farmers, or nongovernmental organization participants. Workshops (titles in bold) were combined in 2-d sessions.

Organic Fertility Management	
Field exercises / demos	Effects of organic amendments
	Winter cover crop evaluation
Lab / classroom exercises	Organic nutrient managment plan
Evening discussions	Building soil organic matter and nutrient pools in Southeastern soils
Field trips	Organic farm visit
Homework	Organic nutrient management plan
Composting	
Field exercises / demos	Observing compost rate study in wheat
Lab / classroom exercises	Calculating compost rates
Field trips	Vermicomposting facility
Homework	Farm / composting visit evaluations
Marketing	
Lab / classroom exercises	Certification roundtable
Evening discussions	Can organic agriculture feed the world, and is that the right question?
Field trips	Whole Foods warehouse visit
Information Delivery	
Lab / classroom exercises	Working with organic growers
	Accessing electronic resources
Field trips	Organic farm visit
Homework	Farm visit evaluation
Greenhouse Management	
Field exercises / demos	Southern region IPM greenhouse project
Field trips	Pesticide free greenhouse tomato production
Homework	Farm visit evaluation
Organic Insect Management	
Field exercises / demos	Identifying beneficial insects
Lab / classroom exercises	Case-study: tomato IPM
Evening discussions	A total systems approach to pest management
Homework	Write an organic pest management plan (insects, weeds, and diseases)
Organic Disease Management	
Field exercises / demos	Biological control of potato diseases
Lab / classroom exercises	Case-study: tomato IPM
Homework	Write an organic pest management plan (insects, weeds, and diseases)
Organic Weed Management	
Field exercises / demos	Cultivation practices and equipment
	Cover crop weed suppression
Lab / classr0om exercises	Case-study: tomato IPM
Homework	Write an organic pest management plan (insects, weeds, and diseases)

duction, one type of sustainable system, requires an interdisciplinary and systems approach to research and training. For example, a soil fertility study cannot simply address the effect of fertilizer rate on yield. It is also necessary to understand the corresponding effects of fertilizer rate on weeds, insects, or diseases, because increased pest pressures cannot be managed with pesticides and herbicides. A specific question could be addressed but the use of agricultural chemicals masked the complicated interactions and interrelationships inherent in agricultural systems (Carcamo et al., 1995; Pfiffner and Niggli, 1996). In fact, these complicated interrelationships are critical in organic systems and will require a focused research effort in the years ahead to be fully understood.

Because of this complexity, a key component of the workshops was the integrated and interdisciplinary approach to the teaching of organic production systems. While each workshop addressed specific components

Table 1. Continued.

Soil Quality	
Field exercises / demos	Soil quality field measurements
	Soil microbial ecology
Lab / classroom exercises	Soil quality lab measurements
Evening discussions	Anecdotal vs research-based information in extension programming
Cover Cropping	
Field exercises / demos	Summer cover crop demonstration
	Nutrient cycling
Tillage Systems	
Field exercises / demos	Cropping systems experiment
Lab / classroom exercises	Designing organic tillage management systems
Evening discussions	Genetic Engineering: What are the issues for organic farmers
Field trips	Organic Farm Visit
Homework	Farm Visit Evaluation
Crop Rotation / Intercropping	
Field exercises / demos	Evaluation of rotation study
Lab / classroom exercises	Designing organic rotation management systems
Field trips	Organic Farm Visit
Homework	Farm Visit Evaluation
Livestock Systems	
Field exercises / demos	Pasture poultry / swine / dairy / beef / agroforestry / goats project
Involving Farmers in Sustainable Agriculture	
Lab / classroom exercises	Designing projects with farmer involvement
Evening discussions	How can environmentalists and farmers work together
Homework	Develop farmer-to-farmer project

of organic systems, the component subject matter was placed within the context of an organic, whole farm system. For example, rather than a simple discussion about the types of organic fertilizers available for use, educators provided information about how the application of these materials might affect weeds and other pests, soil quality, and farm economics. Every attempt was made to differentiate organic, whole farm management systems from organic systems that merely substitute individual organic production practices for more conventional, chemical- or resource-intensive practices.

COLLABORATORS. Responsibility for each component rested with an interdisciplinary advisory and teaching team. Team players included researchers and extension specialists from NCSU and North Carolina Agriculture and Technical State University (NCATSU), farmers, and representatives from agriculture-affiliated nongovernmental organizations (NGO) such as the CFSA, the American Livestock Breeds Conservancy (ALBC), and the Rural Advancement Foundation International (RAFI) USA. Professional representation by college and university faculty was interdisciplinary and included horticulture, plant pathology, soil science, entomology, agriculture and resource economics, biological and agricultural engineering, crop science, animal science, environmental science, community development, agricultural education, and administration.

A training coordinator (TC) hired with SARE grant money organized primary meetings at which each team prepared a lesson plan for their respective component sessions. Lesson plans included lecture, demonstration, hands-on activities, problem-solving exercises, readings, field trips to organic farms, and homework assignments. The TC facilitated ongoing communication among team members and completion of a final draft lesson plan for each component session. The TC also organized the 14 component subjects into six 2-d sessions. Subsequently, the component teams for each session met to integrate and synthesize respective component subject matter. Generally, a second meeting of these teams followed to 1) ensure coordination of activities and efforts; 2) explore any whole farm system implications to be addressed during the session; and 3) plan for a topically relevant, evening issues discussion for the session.

TRAINING SITES. In 1994, NCSU, NCATSU, North Carolina Department of Agriculture and Consumer Services (NCDACS), and several farmer and citizen groups, including CFSA, RAFI, and the NC Farm Bureau, initiated the Center for Environmental Farming Systems. CEFS, located near Goldsboro,

N.C., is dedicated to conducting research and demonstrations on sustainable farming systems. The farm consists of three components: an organic unit (OU), a sustainable, farming systems unit (including pasture-based dairy and beef operations), and a no-till unit. The OU represents about 100 acres, 80 of which are currently certified for organic production, and four of the six sessions were held there. Sessions at the OU allowed agents to observe ongoing organic farming research. The other two sessions were held at the NCSU Mountain Horticultural Crops Research and Extension Center in Fletcher, N.C., and on the NCSU campus.

DEMONSTRATIONS. The facilitators for each workshop were provided with funding to provide resources appropriate to the workshops, including implementation of field demonstrations and preparation of training material. Demonstrations were integral to the workshops and had two purposes: 1) to help instructors demonstrate principles through experiential learning opportunities; and (2) to demonstrate activities that agents could subsequently implement in educational programs in their respective counties.

The field labs demonstrated component organic farming principles, practices, and system-wide component interactions. Examples of field and classroom laboratory demonstrations follow.

Field demonstration: The organic weed management workshop focused on various aspects of weed management, including cultural practices, cultivation, and weed suppression by cover crops. A weed management practice commonly recommended to organic growers is to delay planting until soils are warm. Warmer soil temperatures facilitate faster emergence and, in theory, makes the crop more competitive with weeds. It also allows for a preemergent cultivation of weeds. To demonstrate this, field staff planted corn (*Zea mays* L.) at weekly intervals for 4 weeks, keeping planting areas clean-tilled until seeding. Although each planting had similar weed densities, there were evident shifts in weed species. Agents identified, quantified, and discussed these shifts. Field staff also made sequential sowings of soybeans (*Glycine max* L. Merr.) and corn to demonstrate the effect of growth stage on efficacy of several types of cultivators. Agents assisted in setup and observed the effectiveness of several cultivators common to vegetable cropping enterprises, e.g., Bezzerides torsion weeder (Bezzerides Brothers, Inc., Calif.), Buddingh Finger Weeder (Buddingh Weeder Co., Dutton, Mich.), Lely flex-tine weeder (Lely Corp., Wilson, N.C.) , and a flamer. An organic grower (Kenny Haines, Looking Back Farm, Belvedere, N.C.) and weed science specialist (David Monks, NCSU, Raleigh, N.C.) were on-hand to lead discussions about this equipment and assist with setup. In addition, agents also observed the operation of an undercutter designed to kill cover crops and leave residue intact as a surface mulch (Creamer et al., 1995).

Laboratory exercises: Laboratory hands-on learning was also part of appropriate sessions. For example, Laurie Drinkwater, Rodale Institute (Emmaus, Pa.), and Frank Louws, NCSU, supervised soil quality exercises in a classroom setting. Agents made comparisons of soil quality parameters among no-till, organically managed, and conventionally managed soils. These parameters included CO_2 generation and soil aggregate stability, among others. Microscope stations allowed agents to observe differences in soil microbial populations among the management treatments outlined above.

FARM TOURS. The CFSA (Pittsboro, N.C.), a collaborator in the project, helped arrange five farm tours to demonstrate successful organic operations in mountain, piedmont, and coastal plain regions. Generally, a farm visit consisted of a description of the particular organic enterprise by the grower, a tour of the farm that focused on unique production practices, and a question and answer session. Individual farm visits lasted about 90 min.

A written evaluation of all farm visits was required. In order to foster a whole-farm systems analysis, agents were asked to include possible solutions to an identified on-farm problem and to describe how these solutions would impact other production or management practices.

ASSIGNMENTS. Because the entire workshop package could be taken for credit as an NCSU graduate level course, homework assignments were an integral part of the learning experience. Course facilitators attempted to design assignments that integrated principles and practices demonstrated in the classroom, field, and on field trips. Assignments were also designed to be relevant to real-world circumstances that agents might encounter in their home counties. Examples of homework included development of a comprehensive organic pest and fertility management plan for tomato, development of an organic nutrient management plan, and the design of a farmer-to-farmer cooperative project. A final class project requirement was either a written SARE producer grant or an OFRF grant proposal. Agents were encouraged to work with growers in their counties in developing the proposal and to formally submit it for funding. Agents presented their proposals to the entire class at a wrap-up session and luncheon held at the NC annual extension conference in November 1998.

EVENING DISCUSSIONS. After the evening meal, sessions featured an open discussion about a technical or controversial issue related to organic farming. Topics at the six sessions included 1) building soil organic matter and nutrient pools in southeastern U.S. soils; 2) research-based vs. anecdotal information; 3) can environmentalists and farmers work together?; 4) genetic engineering: implications for organic agriculture; 5) can organic agriculture feed the world, and is that the right question; and 6) a total systems approach to sustainable pest management. Evening discussions were attempts at fully open and honest exchanges about issues, and an effort to encourage full participation by all agents at the training.

For example, one of the barriers to cooperative efforts of agents and organic growers is that agents feel that most available organic farming information is anecdotal. Without research-based information to share with organic growers, agents are uncomfortable, reluctant, and in many cases unwilling to relate any information to organic growers, let alone pass along anecdotal evidence of successful practices.

The evening discussion identified the reality that research is critically lagging in organic food production systems, and that much of what is known comes from on-farm, trial-and-error research conducted by organic growers. Agents and specialists discussed the value of user-generated information and, if valuable, when and where dissemination is appropriate. Facilitators attempted to provide agents with skills appropriate to an evaluation of the case-specific usefulness and appropriateness of anecdotal information, including an evalua-

tion of the information based on seven specific criteria presented by Roger Crickenberger, the NCCES Agriculture Program Leader.

As a learning example, agents were asked their response if a grower came to them with a magic powder that, sprinkled on seeds, increased yields. Agents were suspicious of this proposal until reminded that, in fact, this is precisely the benefit provided by *Rhizobium* to leguminous crops.

Results and discussion

According to formal participant evaluations and informal discussions, the organic training program was extremely successful. Many of the agents originally participated in the training to fulfill their 5-year academic professional development requirement, and for some, expectations of learning credible information that would be applicable to all types of production systems was minimal. However, evaluations showed that the agents found the course very valuable and that because of the basic focus on biological systems and interactions, almost every agent took away a body of relevant and useful information. By the end of the final session, most agents agreed organic farming systems were credible as well.

Agents brought diverse ideas, opinions, biases, and philosophies to the training program. This diversity of opinion and thought enhanced the training considerably by facilitating open dialogue and honest intellectual examination of the principles and practices expounded. Evaluations indicated that because of the basic focus on biological systems the information learned would not only be useful in much of their future educational programming, but also in day-to-day problem-solving encounters with all types of farmers and farming enterprises.

Written and oral comments from agents indicated appreciation for the in-depth focus on topics, the hands-on nature of the training, and the interaction with organic farmers and NGO participants. The ability to receive college credit for comprehensive in-service training was particularly well-received. Efficient and intensive session scheduling to accommodate time and travel constraints of agent with heavy workloads won praise as well. Some tenured agents wrote letters to the Director of Extension, indicating that in all of their years in extension (many as county directors), the organic systems training program was the best they had ever taken.

Cooperating with growers in their counties, three of the agents in the class, were awarded SARE producer grants (written as their final assignments) in 1999. Some have initiated organic training sessions in their counties. Twelve of the agents also participated in a statewide cover cropping demonstration in the Fall and Spring 1998–99. Thirty-two agents completed the course for graduate credit, an additional 10 attended regularly, and about 20 more attended at least one session.

The farm tours not only provided a learning experience for all, but also helped to bridge a mutually perceived philosophical, cultural and social gap between agents and organic growers. Organic growers are generally a very educated population of growers, and in fact, nationwide 32% have Bachelor of Science degrees, and a full 18% have Master of Science degrees (OFRF, 1999). Biologically based, organic systems are information and management intensive, and the knowledge about their production systems that organic growers possessed impressed the county agents. Many of the agents had never visited an organic farm. The farm visits helped to eliminate some of the existing barriers and inhibitions for future visits to home county organic farms. From the growers' perspective, seeing the agents display sincere interest in their farming enterprises helped break down the bias with which many view extension. Agents asked many important and relevant questions and provided valuable information about potential solutions to farm problems and answers to production questions. Growers indicated that they would be less hesitant about working with county agents in the future.

A workshop on information sharing and dissemination also served to build that understanding. In a discussion led by a former president of the board of directors of the CFSA, agents had the opportunity to critically examine the organic growers' complaints against extension that have historically interfered with the potentially productive working relationship between agents and organic farmers. Agents emerged from the session with a greater appreciation of the values (e.g. farm life, rural communities, and agricultural production) that they share with organic growers. At the same time, they came away with a better understanding of the environmental and land ethic (and in some cases, spirituality) that many organic growers attach to organic production.

As indicated previously, there is a lack of research-based informational resources, a paucity of reports of research in the literature, and a general absence of reliable and authoritative educational materials on organic farming principles, practices, and business enterprises. Because there is an overwhelming need for these types of resources by extension agents, an organic systems training manual will be published for agents to use in county-based educational programming. This training manual will provide agents and others with chapters covering each topic discussed in the training sessions. Each chapter will include on-farm field activities that demonstrate principle and practices, topical suggestions and references for county educational meetings, educational resource materials, lists of suppliers for various products, and lists of electronic links to pertinent web sites. In addition, a directory of additional sources of information about people and publications, organic certification guidelines, and contacts for marketing organic produce will be included.

It is important to note that most of the materials included in the training manual will be relevant and useful in future efforts to make conventional agriculture more sustainable. For example, chapters will emphasize the importance of soil organic carbon in building soil quality and describe management strategies to build soil organic carbon content. Likewise, the benefits of increased conservation tillage, substitution of renewable resource-based technologies for those that depend on fossil fuels, a greater reliance on biological components in production systems, and use of long-term rotational systems that attempt to integrate crops and livestock in whole farm systems will be included. Associated practices will be outlined. Finally, the creation of more genetically diverse production systems that promote more sustainable agriculture will be emphasized. Participants in the model training program left with an understanding not only of the principles that underlie these practices and concepts but also a willingness to integrate them into conventional, discipline-related

educational programming. The training manual will complement those efforts.

THE NEXT STEP. In the current period of decreasing funding for agricultural research and extension, the CES has searched for ways to improve efficiency of time, effort, and resources. One approach has been to develop recommendations encompassing a wide range of soil and climate conditions, managerial skills, etc., and to find one size fits all guidelines to crop production. However, in the southern U.S., many production regions encompassing diverse individual farms, fields, and farmers exist. There is a need to adjust sustainable farming practices for each of these individuals and specific production situations. Given this need for specificity of recommendations to each farm, individual farmer, and small geographic area, it is important to rethink these guidelines for development of sustainable production recommendations.

The authors believe the next step will be to expand on-farm research efforts by training agents, consultants, farmers, and students in those principles and practices of participatory research that promote sustainable farming systems. On-farm research partnerships can provide individual farmers with the tools to more fully understand the biology and economics of the system and to evaluate various sources of information and potentially conflicting recommendations. They provide opportunities to develop and describe detailed short- and long-term goals for field and farm and allow farmers to derive their own recommendations. They can help farmers achieve farm goals that provide economic, environmental, and social benefits to the farmer and farm community.

The educational model described in this paper presents a successful means for providing extension agents with tools and knowledge base that allow them to work in concert with local farmers in on-farm research projects. Given the overwhelmingly favorable response from agents participating in the organic training program, this model may be a means for efficient and effective agent training in other subject matter areas as well.

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