

Introduction

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System. *noun*. A group of elements that interact and function together as a whole." (Berkley Books, 1984). In research, it has always been important to define the system in which one works in terms of its components and boundaries. And, extension professionals and others must apply the results of research to real-life production systems. The most common approach to agricultural research has been to limit the boundaries and number of components in the system in order to address issues with maximum resolution. This approach has tremendous scientific and practical benefits. Yet, with increasing regularity, scientists, educators, and others now face different questions which are difficult to answer with standard approaches. As a result, a strict reliance on discipline-defined reductionist approaches is being supplemented with more holistic approaches involving the integration of various areas of expertise. This trend has been slowed, though, by a generally lower ability among some horticulturists to conduct, interpret, publish, and apply holistic rather than reductionist science. The workshop "Vegetable Cropping Systems Research: Techniques, Evaluation, and Application," which is the subject of this proceedings, was held to help address this problem.

The Vegetable Cropping Systems Research Workshop

In discussions following the successful colloquium on organic horticulture held in Minneapolis, Minn., at ASHS-99 (Brumfield, 2000; Creamer et al., 2000; McGiffen et al., 2000; Miles, 2000; Thompson, 2000), most agreed that a systems approach to existing and emerging issues in horticultural research and extension is useful. Evidence for this included observations that practical questions are framed within a systems context with apparently greater frequency. Regardless of basic production system (i.e., conventional, low-input, organic), stakeholders are increasingly interested in the interrelationships among production practices and system components. Organic farmers, in particular, recently cited explorations of relationships among fertility management and crop health, pest and disease resistance as a leading research priority (Walz, 1999). Organic producers rely strongly on interactions among diverse farming system components which influence nutrient availability, pest and disease pressure, and other issues.

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Salaries and research support provided in part by State and Federal funds appropriated to the Ohio Agricultural Research and Development Center, The Ohio State University. Journal article HCS01-22.

However, organic producers reportedly face a serious lack of access to applicable research-based information and knowledgeable extension personnel (Creamer et al., 2000; Gaskell et al., 2000; Walz, 1999). In the same discussions at ASHS-99, it also became clear that a greater understanding of how to conduct, interpret and publish systems-based research is needed. Appropriate refereed publications will be critical to the advancement of horticultural systems-related research and education. For example, they often play an important role in securing grants. The number and dollar value of private and public granting programs receptive or dedicated to systems work appear to be increasing. The USDA Initiative for Future Agriculture and Food Systems (IFAFS), USDA Sustainable Agriculture Research and Education Program (SARE), Organic Farming Research Foundation (OFRF) and many other programs have supported horticultural systems-oriented research and education. USDA figures suggest that a total of nearly \$37 million in grants were awarded in Program 15 (Farm Efficiency and Profitability) of USDA-IFAFS in 2000 and 2001. OFRF also reports that \$820,000 has been awarded in support of 150 research and education projects since 1990. Demonstrating the ability to conduct systems-oriented work through refereed publications will be important for horticulturists to remain competitive in grant competitions. With these and similar challenges in mind, a volunteer workshop organizing committee of Nancy Creamer (North Carolina State Univ., Raleigh), Matt Kleinhenz, chair (Ohio State Univ., Wooster), Carol Miles (Washington State Univ., Vancouver), and Chris Wien (Cornell Univ., Ithaca, N.Y.) convened with sponsorship of the ASHS Vegetable Crops Management Working Group. The committee's charge was to facilitate access to systems-related information through the development of a workshop.

Workshop speakers brought a wealth of recognized expertise to the forum. Each commented plainly on a number of issues and provided several key recommendations for completing, publishing, and applying systems-based research. For example, citing specific experiences in establishing the Center for Environmental Farming Systems

(CEFS), Nancy Creamer emphasized the value of planning, consensus building, funding, and incorporating long- and short-term objectives in developing systems studies (Mueller et al., 2002). The CEFS near Goldsboro, N.C., was established in 1994 to serve a diverse mission of cropping systems research, extension, and education (Creamer et al., 2000). Delate (2002) described the importance of the Long-Term Agroecological Research (LTAR) sites located in four areas of Iowa. LTAR sites provide multi-disciplinary teams of researchers and their industry collaborators an opportunity to evaluate production methods and develop evidence regarding mechanisms underlying their success or failure. Work at LTAR sites may provide unique insight into production, economic, environmental and social impacts of various production methods, including in conventional and organic vegetable production systems. Experimental design is critical in every study, especially in systems studies in which hypotheses often cannot be addressed with familiar factorial-based treatment lists alone (Shennan et al., 1991). Drinkwater (2002) asserted that the central underlying assumptions of experimental designs used to study production systems are that agroecosystems are complex and interrelationships among system components are important. Drinkwater (2002) also elaborated on comments shared at the workshop in discussing the relative merits and limitations of several general approaches to the study of production systems. Drinkwater (2002) also stated, using several examples, that specific statistical procedures are often required to analyze data collected in systems-related studies.

Analysis and interpretation of data derived from cropping systems studies for the purpose of their publication in ASHS journals were also addressed in the workshop. Candid discussion among *HortScience* Science Editor Frank Dennis, *HortTechnology* Editor Neal De Vos, and workshop participants regarding the review and publication of manuscripts based on production systems studies led to consensus on several points. For example, it was accepted that developing and applying information from cropping systems studies is increasingly important. Obviously, refereed publications are

an indispensable means of communication among scientists and practitioners. Therefore, many at the workshop were eager to discuss ways to increase the availability of high-quality systems-oriented papers, especially in ASHS journals. Since the workshop, two steps have been taken to facilitate this process. *HortTechnology* was targeted as the primary recipient of horticultural production systems-related manuscripts. Acceptance for publication will be based on the manuscript's meeting established standards of quality in horticultural science and writing, and value as a unique contribution to the practice and application of integrated production systems research. Manuscripts based on studies involving significant contributions of at least two traditional discipline areas (e.g., cultural, disease, insect, nutrient, water, or weed management) irrespective of commodity and general production system (e.g., conventional, organic) are strongly encouraged. Successful manuscripts will be published in the appropriate section of *HortTechnology*. And, an associate editor for Integrated Production Systems manuscripts was appointed to facilitate their review.

Improving horticulturists' application of research-based cropping systems information was the final goal of the workshop. Extension horticulturists increasingly find it necessary to take part in the development and dissemination of new and different types of information (Creamer et al., 2000; Miles, 2000). Demand for targeted issue-specific information remains strong. Yet, some clientele want to know more about how to integrate certain strategies (Lewis et al., 1997) or how individual decisions or activities impact their operation at-large (i.e., *their* system). Likewise, others express interest in knowing more about alternative management strategies which de-emphasize the use of pesticides and synthetic fertilizers. This encourages both the development of systems-oriented research-based information and the communication of that information in updated formats and media. Making information available continuously and to a wider, computer-literate audience is critical. It is also important to present information so that alternative management strategies and relationships among system elements are clear. Petzoldt et al. (2002) described the development of Cornell

University's *Integrated Crop and Pest Management Guidelines for Commercial Vegetable Production*. As a communication tool, the guidelines are unique compared to previous Cornell recommendation-oriented documents in several key aspects: 1) they integrate discipline-specific information previously presented in separate documents, 2) they clearly outline and do not subordinate alternative management strategies, and 3) they are available online, which increases access and fosters communication (e.g., a question-answer feature is available).

Outcomes of the workshop

The workshop attracted a total of approximately eighty faculty, graduate student, research staff, and industry participants. Nearly 25% of the participants provided written feedback on the program using the tool made available by the organizing committee. Unanimous positive answers were provided in response to the questions: 1) The workshop was useful to me, 2) The workshop addressed important issues in vegetable research and extension, 3) I would like more information on vegetable cropping systems research and extension, and 4) I would participate in other programs like the workshop related to vegetable cropping systems research and extension, especially if they were part of annual ASHS meetings. Respondents indicated that the mechanics of how to conduct cropping systems research are most important to them. Respondents ranked the publication of cropping systems-related research in refereed journals and the development of extension tools describing findings from cropping systems-related research as strong but secondary priorities. Responses to the statement "What I liked most about the workshop" included "breadth," "balanced and inclusive format," "examined the profound conclusions that could only have been gained from

systems research," "information presented," "learning how cooperative teams were established and function given complex, conflicting priorities," "speakers gave theory and good examples," and "documented important, cutting edge work." Responses to the statement "What I liked least about the workshop" included "not enough conventional systems," "not enough time devoted to discussion of publication of cropping systems-related research," "need more information on how hypotheses drove choices of systems to study," and "more time needed." Finally, other suggestions and comments about the workshop included: "We need leadership from publishing agencies to establish criteria for acceptance to publish articles," "Need more long term research results on vegetable cropping systems," and "I think it is probably the best one I have ever attended in my 11 years of ASHS. We may have begun to turn a corner and deal with the real world—like growers want their land grant systems to do." All quoted statements from Kleinhenz (unpublished data, available upon request). In summary, workshop participants appeared driven to match their enthusiasm for horticultural systems-oriented work with a better understanding of its associated principles and procedures. The following articles will clearly contribute to that process.

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