Organic Farming Research in the Pacific Northwest: Challenges, Opportunities, and Outlook

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Organic farming has grown rapidly in the Pacific Northwest (Oregon, Idaho, and Washington) during the past decade. Certified organic acreage in Washington alone increased eight-fold between 1993 and 2002. Yet the 145,000 certified acres in the three states still comprise less than 1% of the total farmland base. With the growth of the organic sector has come a commensurate expansion of research, education, services, and product development for organic farmers. In this paper, we discuss the current situation, trends, and key lessons learned about organic farming research in the region.

Current Status of Organic Farming in the Pacific Northwest

Based on the most recent USDA data (Table 1), there were 145,000 certified organic acres in the Pacific Northwest in 2001 (USDA-ERS, 2002). Nationally, Idaho has been one of the top states for certified acreage. In 1997, over 50,000 certified acres (47% of the total) were for wildcrafted plants, and the decline in certified acres in Idaho in 2001 was largely due to a reduction in St. Johnswort acreage, a wildcrafted plant. Currently, forages and barley are the largest organic crops in Idaho. Oregon is a major producer of organic nursery plants, and was home to nearly 50% of the national acreage of organic herbs/nursery in 2001. In contrast, Washington is a clear leader in organic acres of apples, pears, and cherries, and 37% of the organic apple acreage in the U.S. and over 20% of that in the world is in Washington (Granatstein and Kirby, 2002). Thus, while the three states have many agricultural similarities, the evolution of organic farming is somewhat distinct in each one (Table 2).

Historically, organic farming in the Pacific Northwest had its roots on small farms that were commonly located near population centers. As the organic market has expanded, larger farms in the major agriculture production areas have become more common and more prominent. For example, western Washington has provided the philosophical, political and consumer base for the growth of organic farming in the state. However, in 2001, 82% of the certified organic acres and 98% of the acres in transition were in eastern Washington (Granatstein, 2002), which is the dominant commercial farming region in the state. In contrast, one-third of the organic farms were in western Washington, and two-thirds were in eastern Washington. Farms in western Washington tend to be smaller than farms in eastern Washington. The two regions have quite different populations and biophysical environments, and correspondingly distinct research needs. The research community will need to track the demographic nature of organic farms in order to effectively serve them.

History of Organic Farming Research in the Pacific Northwest

Prior to the introduction of agrichemicals in the pre- and post-WWII period, much of the research at Land Grant Universities (LGU) in the Pacific Northwest was essentially “organic.” Soil organic matter management, crop rotation, and cover crops were common research topics. All three LGUs in the region, Washington State University (WSU), Oregon State University (OSU), and University of Idaho (UI), had numerous long-term systems studies of soil quality, crop rotation, alternate crops, and cover crops in the first half of the 20th century (Granatstein, 1992). However, these types of studies became less frequent after the 1950s and shorter-term reductionist research projects became the norm.

In the “modern” organic era (post-1970), the main proponents of organic farming research in the Pacific Northwest, as in the rest of the country, were often farmers on the fringes, such as the “back-to-the-landers” commonly found in all three states. These individuals tended to view the LGU, its researchers and extension agents, as antagonistic to their point of view, and they were often outspoken on this subject.

Grass-roots organizations such as Oregon Tilth and Washington Tilth (both formed in 1974) pushed for more public research support for organic farming and often ended up conducting their own on-farm research in the absence of public support.

During the Carter Administration, Secretary of Agriculture Bob Bergland began to notice the organic farming movement, in part due to several studies done on the energy implications of organic farming in the wake of the 1974 oil embargo (Lockeretz, 1978). He commissioned a USDA study on organic farming by a team of scientists from across the country (USDA, 1980). The team was led by Dr. Robert Papendick, a USDA-ARS soil scientist based at WSU in Pullman, Washington. Dr. Papendick's team produced the "Report and Recommendations on Organic Farming," the first official acknowledgement that "modern" organic farming was viable and warranted serious research support. His presence at WSU helped to create an early foundation for faculty interest in organic farming at WSU. With the change in White House administration in 1981, the nascent organic farming attention within USDA was diverted elsewhere.

Yet the effect of the USDA report did not end there. The report provided important scientific legitimacy for organic farming, and this helped pave the way for the first symposium on organic farming at a scientific society meeting. The symposium on "Organic Farming" at the 1981 American Society of Agronomy Annual Meeting was the first of its kind and resulted in ASA Special Publication No. 46, "Organic Farming: Current Technology and Its Role in a Sustainable Agriculture" (Bezdicek et al., 1984). Several scientists from WSU were involved, and they began to attract graduate students to work on organic farming projects. One project, a paired farm study in the Palouse region (Reganold et al., 1987), was published in *Nature*, sending an important signal to fellow researchers that organic farming research was scientifically legitimate and acceptable to the leading peer-reviewed journals. At WSU, organic research projects and students were mostly found in the WSU Crop and Soil Sciences Department during the 1980s and 1990s. Scientists in other disciplines are now actively involved in organic farming research, including horticulture, entomology, and agricultural economics (Table 3).

In addition to research with an explicit focus on organic farming, considerable work has been done in the region on topics that directly benefit organic farmers. A good example is organic apple production, where control of the codling moth (*Cydia pomenella* L.), the key pest of apples in the region, was not very successful with available organic methods. The general move towards more Integrated Pest Management (IPM) induced researchers to look at the use of the codling moth sex pheromone to disrupt mating. Without mating, there are no eggs, and thus no larvae to make the "worms" in apples. Researchers at WSU and OSU did extensive work on the field development of this technique for IPM purposes (Brunner et al., 2001). It became commercially available in the early 1990s, and organic growers were some of the first adopters. The success of pheromone mating disruption is probably the single most important production breakthrough for the expansion of organic apple production in the region (Granatstein, 2000). Thus, it is difficult to accurately characterize how much public research was directly helping organic farmers when the term "organic" may not have been in the project description.

Current Body of Knowledge on Organic Farming

The historical research on organic farming helped pave the way for the rapid expansion of organic farming research today. Many more faculty have organic research projects today than five years ago. In a recent survey of WSU faculty (Miles et al., 2002), over 50 faculty responded and cited 90 projects (research and education) that were directly focused on organic farming or were applicable to organic farms. Pest management was the most common category, followed by soil management. This is a reflection of the extensive work on IPM and biological control, particularly for insect pests, that is of direct relevance to organic growers, and of the early work of soil scientists in organic farming research (e.g., soil health, organic matter management).

Soil and Water. The National Organic Standards (NOS) require growers to "maintain or improve soil and water quality." Extensive research in the region on soil quality, soil conservation, organic matter management, nutrient dynamics, cover crops, and management of organic amendments (e.g., Bary et al., 2000) provides a solid base for soil management on organic farms. Organic growers can find common ground with other growers around the strong interest on soil biology research, as evidenced by the 350 people who attended a one-day symposium on the topic in 2002 (http://www.puyallup.wsu.edu/soilmgmt/SoilbiologyWS.htm).

In Idaho, on-farm research on organic potatoes systems has been underway for over six years, focusing on nitrogen mineralization from compost, rapeseed meal, radish as a green manure crop, and commercially available humic substances (Seyedbagheri, 2000; Seyedbagheri, 2003). Studies at Oregon State University looked at the potential for minimum or no-till organic vegetable production (Luna, 2003).

Topics requiring more research include the transferability of fertilizer recommendations (based on commercial fertilizers) to organic farms, accuracy of tissue test critical levels, predictability of N release from numerous organic sources, and development of successful direct-seed organic systems. Organic farmers need to follow good management practices in utilizing organic fertilizer sources, as they can inadvertently contribute to water pollution without careful attention. Practices to protect water quality are well-developed in the Pacific Northwest based on numerous research and extension projects over the past two decades (e.g., Pacific Northwest Regional Water Quality Program, http://www.pnwwaterweb.com/).

Pest Management. Pest management remains a high priority for additional research, given the numerous crops grown in the region and the diversity of agroclimatic conditions. Organic insect pest management is well-developed for the tree fruit sector, and disease control is relatively simple in the irrigated regions. Alternatives to the reliance on sulfur as a fungicide are needed. Matching crop and location for inherently low insect and disease pressure represents an important strategy for organic farms, and thus organic growers in some areas have little problem with a given pest while growers in another area desperately need controls. The diversity in the region can dilute the critical mass for research on organic pest controls, especially given the declining research funding at the LGUs. However, more private companies are recognizing the market potential for organic pest management products and are investing in their own research and development. For example, Dow Agrosciences developed a spinosad insecticide in the late 1990s with a naturally occurring active ingredient. The commercial formulation, Success®, contained inert ingredients that are not allowed under the NOS. This product showed great promise for organic growers, and Dow reformulated it to meet the organic standards and introduced the product Entrust® in 2003.

The most widespread need in pest management is weed control on organic farms. Many organic farms struggle to find effective and affordable weed control strategies. Perennial weeds such as quackgrass (*Agropyron repens*) are particularly troublesome, and the traditional control method of intensive tillage is in conflict with the soil quality requirements in the NOS. More research is needed on strategies to reduce the soil weed seed bank, and to utilize cover crops and allelopathy effectively. Documentation is needed for the successful use of the many old and new mechanical and thermal weed control devices, including their adjustment, timing, and economics. Effective and commercially available biocontrol agents, such as insects and pathogens, are needed for key weeds, particularly perennials.

University of Idaho researchers (Brown and Morra, 1995; Brown and Morra, 1997; Eberlein et al., 1998) have studied the effects of several mustard varieties in rotations, as green manures and as applied meal in traditional wheat cropping systems of the Palouse. While the research was not originally geared toward organic systems the basic research has implications for weed and disease control in wheat systems and organic vegetable production. (Johnson-Maynard and Morra, 2002).

Entomologists at the University of Idaho have been leaders in both weed and insect biocontrol research for more than a decade. Many biocontrol agents for weeds in pastures and rangeland have been tested and released (McCaffrey, 1998; Cheyney, 2001). Again the research was not aimed at organic production but clearly applies where the particular weeds are a problem.

Numerous local, on-farm studies such as a 1999 project on weed control for organic basil (Idaho) often don't get published in scientific journals but contribute to the body of knowledge on alternative weed control strategies in organic systems (Parker-Clarke, 1999).

Knowledge of vertebrate pest management in organic systems is another weak area. No LGU faculty member in the region currently works on these pests. In particular, rodents can cause major economic loss in grain fields, hay fields, vegetable crops, and orchards. Organically approved control methods for rodents are few.

Plant Breeding. While much of our current knowledge of agronomic and horticultural management of crops is transferable to organic systems, there has been little plant breeding specifically for the conditions on organic farms. This work is just beginning, with vegetable breeding at OSU, wheat breeding at WSU, and regional blight resistant potato development. The increased emphasis on organic seeds in the NOS is encouraging development of organic seed production in the Pacific Northwest, a region already heavily involved in seed production. Organic seed production brings new challenges, particularly with seed-borne pathogens, seed quality, and seedling diseases. With an increase in organic seed production, we expect more interest and work on development of varieties and seed treatments tailored for organic farms.

Mechanization. Research on agricultural mechanization has often received less attention over the past decades as other technologies have taken precedence. However, organic growers can benefit from some aspects of precision farming, including water management, precision guidance for cultivation, and potential robotic assistance for certain labor-intensive tasks. Organic growers tend to be equipment innovators like most farmers, but often have more impetus to develop new tools due to the lack of other options.

University of Idaho has taken a lead in variety development and technology advancements supporting the use of biodiesel fuels (Peterson et al., 2002; Thompson and Peterson, 2002). This holds potential for future organic cropping systems in the PNW, especially in light of the simultaneous research focus on canola and mustard varieties as cover crops and green manures with both disease and weed allelopathic effects (Brown et al., 1991).

Livestock. The most overlooked area of research in the region is organic livestock production. Expansion of organic livestock in the Pacific Northwest has not been as dramatic as the expansion of cropland and has not drawn as much attention. However, with the NOS in place, demand for organic meats and dairy products is growing rapidly, and the need for organic livestock information, particularly health care, is strong. Veterinary medicine faculty in the region have had little involvement to date with organic livestock health care. Small acreage producers in southwestern Idaho have completed initial studies on developing a pastured poultry industry in Idaho. The findings indicate high grower and consumer interest, but state regulations on livestock processing remain a hurdle. The University of Idaho currently has little expertise to help these producers with poultry production issues, especially in the area of organic or pastured poultry systems.

Food Quality. Beyond production issues, there is tremendous public interest regarding the impacts of organic production on the nutritional and health-promoting qualities of foods. Well-designed studies are needed to begin to understand this topic and validate or refute the many claims in the media and marketplace. There is ample evidence that organic production can lead to biologically meaningful changes in food composition (Heaton, 2001) but the effects are not consistent. Studies are needed to separate the combined variability of soil, fertility, crop variety, weather, and location from the core effects of organic management.

Systems Research. Discussion of organic research often includes an emphasis on systems studies conducted on certified organic land that has gone through the typical "transition" period (OFRF, 2003). WSU hosted a national conference on "Science and Sustainability" in 1994 to explore the opportunities and constraints for systems research. There are many more systems studies in the region today, particularly looking at direct seeding, and organic studies are now beginning. Several dryland grain systems studies focus on erosion control and may have limited transferability to organic farms. Recent new systems include direct seeding, organic, and perennial crops (Pullman, WA), and reduced tillage vegetable systems with rotation, cover crops, and water management (Prosser, WA). A current on-farm orchard systems study (apples) in the Yakima Valley, established in 1994, compares conventional, integrated, and organic production (Reganold et al., 2001). Tree growth, crop yield and quality, economics, energy use, and soil quality have all been monitored. A quantitative soil quality index was developed that shows the benefits of organic amendments and the losses due to tillage (Glover et al., 2000). An organic sweet cherry systems study was established at the OSU research center in Hood River in 2003.

The UI Parker Farm (Moscow, ID) has 2 acres in transition to certified organic status. Research will focus on diverse crop rotations that include mustard, which will in turn be used as a meal on vegetable crops and for biodiesel production. Similar research funded through the Organic Farming Research Foundation (OFRF) related to brassica meal application in organic systems was initiated last year on a certified organic farm near Moscow (Johnson-Maynard and Morra, 2002). WSU now has 13 certified acres and 6 transition acres at three research facilities, and several other locations are beginning organic systems studies as well.

Looking at the kinds of organic research projects that have been established, both component and system type studies, it is common to find a focus on "input substitution." Such work is important in meeting immediate needs, particularly for the larger farms that are transitioning into organic production for the first time. But for the long term viability of organic farming, there needs to be more emphasis on agroecology and redesigning of agroecosystems to make them more self-regulating and less in need of intervention, be it for pest control or fertility enhancement. This is the frontier of organic farming research, and researchers in the PNW are just beginning to explore it. Organic farms can deliver certain benefits to society, such as improved soil quality, increased energy efficiency, less reliance on non-renewable resources, and reduced pesticide impacts. Which of these are inherent to organic systems? What mechanisms from organic systems can be utilized by all farms? Can organic systems be intentionally blended with integrated crop management to produce a more sustainable system? These kinds of questions should help drive future public research on organic farming.

Lessons Learned in Developing Organic Farming Research

While hindsight is often "20/20," many of the early organic farming advocates and researchers had excellent acuity in their foresight. They could see some of the emerging issues related to modern agriculture and the potential for organic systems to mitigate them. However, their zeal often created significant friction with the mainstream research community. Researchers who had spent their careers as public servants solving problems in agriculture to provide safe, affordable, and abundant food were hearing how they were "poisoning the planet." This "culture clash" clearly slowed the development of interest in organic farming research at LGUs. The lesson learned might be to begin the dialogue from a base of common values, of which there are many (e.g., protecting soil and water, maintaining rural community health), rather than from judgmental criticism that is bound to alienate the participants.

A few organic growers were able to interest researchers in the unique biological opportunity that their organic farms provided. This approach led to a number of successful collaborative projects in the Pacific Northwest that were effective in shifting research programs in a direction more supportive of organic farmer needs. Furthermore, the gradual acceptance of sustainable agriculture during the 1990s by the research community and agricultural industry also opened doors for organic farming research, as the parallels were easier to see. However, as organic farming advocates pushed public researchers for more attention to organic farming, they often failed to recognize the on-going work at the LGUs that was of direct benefit to organic farming. Parallel research in fields such as IPM, conservation tillage, and sustainable agriculture all helped expand the knowledge base of practices that were useful to organic farmers. Organic advocates sometimes failed to recognize research relevant to their needs (e.g., biological control studies) if the same researcher was also conducting studies on topics that did not fit the organic regime (such as chemical pesticides).

Another lesson relates to funding and impact, two important motivators for what researchers study. Money drives much of the research agenda at LGUs, and the USDA SARE program provided an early source of funds to begin supporting organic research. Other sources, such as the Organic Farming Research Foundation and the USDA organic transitions program, have expanded the base and the opportunity for researchers to start organic projects. The mandated IPM/biocontrol funds for the Washington Commission on Pesticide Registration also provided an important new source, and some commodity commissions are more open to organic projects.

Researchers were slow to work on organic farming in part because the land base was so small. It may have been hard to justify dedicating time and resources to a sector where the potential impact seemed very limited. With the expanded acreage, organic farming has a higher profile and the results of research have higher impact potential. A missed opportunity in the past was the understanding of potential benefits to all farms that can accrue from organic research.

A lesson we can continue to learn from is the tremendous crossover between organic and “conventional” farming systems. The crossover works in both directions. Practices pioneered on organic farms, such as compost and cover crops, are implemented on conventional acres, especially by growers who farm both conventionally and organically. Conversely, practices developed in the conventional arena, such as pheromone mating disruption for codling moth in apples, can play a critical role in solving problems on organic farms. Organic and conventional farmers both stand to benefit from research on both systems. Growers and researchers need to avoid polarization and “zero sum” thinking (if we fund organic, it robs from conventional) and see the mutual benefit from each type of research.

While systems studies are needed, we have learned more about their challenges. Organic systems studies face the same constraints as in other farming systems. Systems studies tend to be very costly due to larger plot size, numerous personnel for the various disciplines and parameters to measure, and the need for longer time frames. Thus, they are usually conducted in one location only, which can limit the extension of results across a region as agroclimatically diverse as the Pacific Northwest. There is and will be a continuing need for component studies to solve discreet problems faced by organic growers. With the trend of declining public research dollars, innovative research approaches are needed to help serve organic growers. Use of more on-farm documentation of existing organic farms can be a cost-effective and statistically valid approach, particularly when the research question requires a farm to have reached an equilibrium under organic management. New systems studies often spend the first three to five years, and the accompanying fiscal resources, going through the biological transition, which may not be relevant to the research question at hand.

We have learned that one-size research does not fit all needs. Systems and component studies can produce complementary results. The former may answer questions about the impacts of farming on the environment, usually over a long time frame. The latter may provide short-term help for growers with a specific production problem. Comparison studies (organic vs. conventional) can shed light on system performance but may do little to develop new practices for growers. How we allocate resources to these differing efforts is an important choice that needs broad-based input to serve the greatest need.

Outlook

Organic farming research appears to be gaining momentum in the Pacific Northwest. The number of researchers involved and projects funded is increasing. It is harder to predict how the organic acreage trends will change, and how this will impact research. There appears to be a leveling off of the expansion of larger-scale organic fruit and vegetable production in Washington, probably due to production increases outstripping demand increases, as well as competition from other regions and countries. In contrast, the number of small farm, direct market organic growers continues to increase, but a number of these growers are choosing not to certify due to dissatisfaction with the National Organic Program and thus they are less visible in the statistical profile of organic farming in the region.

The outlook for organic research in the region is positive, based on a number of recent developments. OSU faculty have formed an organic working group and are meeting with growers to determine research needs. OSU and WSU joined with Oregon Tilth and Washington Tilth (organic grower groups) to sponsor the first organic farming research symposium in the region in November 2002. Over 220 people attended, and fifty research and education projects were showcased during the successful poster session. WSU received a USDA special grant for organic cropping research which will hopefully continue for five years. Organic orchardists worked with WSU and the Washington Tree Fruit Research Commission to develop a set of research priorities, and several organic growers sit on the Commission. A B.S. degree in organic agriculture is planned for fall 2004 at WSU, an effort to train a future generation of organic researchers, educators, and practitioners. UI's Sustainable Ag Program and three UI faculty members have been partnering with the Idaho Organic Producers (now the Idaho Organic Alliance) to offer educational conferences and workshops for both sustainable and organic producers for the past five years. Many of the farmers involved in this organization are helping the University to identify potential organic research needs and directions.

Organic livestock has great potential for expansion in the Pacific Northwest, and there are significant research opportunities in support of this sector. The newly formed Center for Organic Education and Promotion, a part of the Organic Trade Association, will be pushing for more research on the relationship between growing practices and food quality in an effort to establish defensible claims about organic food benefits, and they are looking for research programs to partner with. With the implementation of the Conservation Security Program in the 2002 Farm Bill, there will be new opportunities to quantify the environmental benefits of organic farms in order to qualify for payments.

In closing, a final lesson we can continually learn is humility. For all our knowledge, we really cannot say whether organic farming is the evolutionary endpoint for contemporary agriculture, and researchers and the public should not assume this. Certainly, organic farming IS part of a major paradigm and practice shift in agriculture today. But as the noted sustainable agriculture leader and farmer from Iowa, Dick Thompson, likes to say, "The best way to farm has not yet been invented, and I reserve the right to change my mind tomorrow." Sustainability is the more defendable goal for all of agriculture. Research that furthers the sustainability of organic systems is needed. Public research that simply revolves around compliance with organic rules may be harder to justify. We should make sure our research probes the sustainability of all farming systems, including organic, so we can learn their strengths as well as their weaknesses, and strive to continually improve.

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Table 1. Acreage trends for certified organic land in the Pacific Northwest (USDA-ERS, 2002).

	1997	**2000**	**2001**	**% change 1997-2001**
Idaho	111,430	108,609	84,048	-25
Oregon	16,984	26,958	27,501	+62
Washington	11,459	37,731	34,238	+199
Pacific Northwest	139,873	173,298	145,787	+4
U.S.	1.347 mil.	2.029 mil.	2.344 mil.	+74

Table 2. Certified organic cropland in Oregon, Idaho and Washington in 2001 (USDA-ERS, 2002).

Crop Category	U.S. Total	ID	OR	WA
Grain	454,598	16,809 (20)[1]	1,100 (4)	2,739 (8)
Bean	211,405	840 (1)	nil	342 (1)
Oilseed	43,722	nil	nil	nil
Hay	253,641	41,184 (49)	4,400 (16)	5,136 (15)
Vegetable	71,677	nil	2,475 (9)	7,190 (21)
Fruit	55,675	840 (1)	1,925 (7)	9,244 (27)
Herb/nursery	14,599	nil	7,976 (29)	3,424 (10)
Other crop	197,085	5,043 (6)	4,125 (15)	3,081 (9)
Pasture	1,039,090	19,331 (23)	5,500 (20)	3,081 (9)

[1] Number in ( ) is the % of the total organic land in this category in each state. ‘Nil’ is used for crops less than 1%.

Table 3. Early “modern” organic farming studies in the Pacific Northwest.

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Opportunities and Challenges in the Internationalisation of the Philippine Higher Education Sector / 1. Executive Summary. engagement.3 Overall, the Philip-pines compares favourably with ASEAN peer countries.Â Our analysis of internationalisa-tion through research looks at the research capability of the Philippines higher education system and at research produced in international collaboration. The Philippinesâ€™ ability to retain and attract talent is less strong than its peers. So, too, is the number of researchers per million of the population.