Adoption Potential and Perceptions of Reduced Tillage among Organic Farmers in the Maritime Pacific Northwest

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Want to reduce your tillage? Find out what Northwest growers are learning.

Reduced tillage (RT) is a desired yet challenging strategy to achieve for many organic farmers. In the maritime Pacific Northwest, organic RT systems are not widely adopted due to the required technologies and practices that are new to producers in this region. The lack of adoption of these practices provides a unique opportunity to examine producer perceptions about soil quality and barriers to adoption of new soil improvement techniques. During the spring of 2011, three organic vegetable producer focus groups were conducted in western Washington to learn about producer knowledge, attitudes, practices, and the perceived benefits and risks of implementing RT technologies. Focus group participants were eager to share their experiences relative to organic RT practices. Farmers reported to understand the benefits of tillage reduction and cover cropping, but acknowledged there are significant obstacles to overcome before successful implementation can occur on their own farms. The obstacles encompass aspects of organic vegetable production in the maritime Northwest where there is higher soil moisture, a shorter growing season, and smaller scale farms relative to other regions where the RT practices are used successfully. While RT methods improve soil quality, farmers lose the beneficial aspects of tilling the soil related to aeration, soil moisture levels, soil temperature, and weed management. Other concerns pertained to the equipment needed for the RT practices and whether the equipment has been cost-effectively adapted to smaller scale farms. Results from these focus groups have assisted our team to more effectively proceed with RT research and outreach efforts.

Cover crops (barley) terminated by flail mower and roller/crimper (pictured) in preparation for vegetable transplants at the Washington State University Northwest Research and Extension Center, Mount Vernon, WA. Photo credit: Andrew Corbin

Introduction

Washington State has the third highest number of organic farmers and the second highest organic farmgate sales in the United States (NASS, 2010). Organic agriculture in western

Washington is a vibrant and growing industry composed of more than 266 certified organic farms and 25,900 certified acres, up 140% and 280% respectively since 2005 (Kirby and Granatstein, 2012). Growth in western Washington organic agriculture is driven by strong consumer demand in regional metropolitan areas such as Portland, OR, Seattle, WA, and Vancouver, B.C.

Without access to synthetic pesticides and fertilizers, organic farmers are more reliant on cultural management tactics and healthy soils to manage weeds and provide fertility. In addition to a relatively short growing season common to other northern latitude regions, maritime Pacific Northwest farms experience high winter rainfall that encourages erosion, soil nutrient leaching, and soil compaction. These conditions, which escalate the risk of decreasing soil quality and ultimately profitability among organic farmers in this region, may encourage adoption of alternative production strategies.

Weed management is a primary concern for organic vegetable growers (Walz, 2004). Crops and weeds fill the same ecological niche and compete for the same resources. To be productive, growers need to structure an environment that is beneficial to the crops, with minimal weed pressure (Di Tomaso, 1995). In conventional agriculture, herbicides are used to suppress weeds, but most selective herbicides are not permitted in organic farming (Gruber and Claupein, 2009). Primary tillage (plowing/disking) and secondary tillage (cultivation) are methods of suppressing weeds compatible with organic production standards. Most research on reduced tillage (RT) systems has focused on conventional agriculture where herbicides are used (Kaval, 2004). Recent work suggests organic production systems may successfully maintain yields under higher weed pressures as compared to conventional systems (Ryan et al., 2009).

Certified organic growers must use tillage and cultivation practices that “maintain or improve the physical, chemical, and biological properties of soil” (USDA-National Organic Program [NOP], 2000). Frequent tillage contributes to the deterioration of soil quality, which threatens the sustainability of western Washington organic vegetable farms. Regular tillage with multiple passes is a routine practice of growers who rely on tillage to suppress weeds. Unfortunately, over-tilling damages soil structure and promotes erosion (Montgomery, 2008). Frequent tilling also requires labor, machinery and fuel, and expensive inputs that have negative environmental impacts (Grandy et al., 2006; Grandy and Robertson, 2006; Robertson et al., 2000). High biomass, mechanically terminated cover crop mulches associated with RT have been shown to inhibit weeds (Altieri et al., 2011; Mirsky et al., 2011; Ryan et al., 2011). Therefore, researchers are interested in evaluating RT production systems to help farmers improve the economic and environmental sustainability of their operations.

Farms provide regionally important ecosystem services (Costanza, 1997), including flood protection, erosion prevention, increased biodiversity, and carbon sequestration. RT organic farms have fewer negative externalities and more positive externalities in the form of enhanced ecosystem services (Kocian et al., 2012). Decreasing tillage activities reduces wind and soil erosion and creates benefits to society both off-site and on-site. In the United States, off-site soil erosion damage is estimated to cost $37.6 billion annually (Uri, 2001). On-site erosion impacts the future productivity of the land (Walker and Young, 1986). Farmers will also need access to machinery, whether through low-interest loans or special programs like those currently underway by Conservation Districts in Washington and Oregon, the University of Idaho, and WSU Extension (Meyer, 2009). These programs address knowledge barriers and lower risks associated with adopting new technologies by promoting communication and mentoring among farmers.

Recent research has found that traditional predictors of adoption of new innovations such as education, length of time farming, and farm structure, have little or no relationship to the adoption of more complex innovations like broader forms of conservation (Coughenour, 2003; Napier et al., 2000). Adoption of RT practices involves accepting a “loosely coupled system” composed of components that vary independently where farmers choose from a collection of practices based on their personal preferences, farm characteristics, perceived needs, level of knowledge, labor availability, and many other factors. Certain techniques may even be adapted by farmers to fit their specific farm or marketing needs. Because of the flexibility in choosing what, where, why, and how to adopt, no two organic farmers are alike in what they practice or grow. Moreover, each organic farming practice is associated with a different set of perceived adoption constraints (Goldberger, 2008). Fundamental to RT is that growers have knowledge and experiences that lead them to appreciate the complex interaction and relationships of their specific production practices and how these can impact (enhancing or eroding) soil quality and soil biology for their regional growing circumstances. An example of this is while more conventional tillage manages weeds, soil quality is reduced through greater erosion and earthworm populations decrease (Chan, 2001). Additionally, Rogers' (2003) theory of diffusion underscores the importance, advantage, and compatibility that a new technology must have in order to be widely adopted.

Preliminary experimental results and demonstration of the best methods to grow crops using RT will likely facilitate adoption

of RT methods and technologies. In addition to these traditional Extension tools, adoption of conservation practices may be enhanced by internet-based outreach tools, including interactive webinars, web-pages, and web-videos (Case and Hino, 2010; Sobrero, 2008).

Coughenour (2003) found that, in adopting these more complex practices, connections between farmers may be as or more important than connections between farmers and representatives of the scientific community. In other words, conversations between farmers at the local coffee shop or feed store might be more important than the research field or laboratory. Perhaps more importantly, they rely on their peers (who have similar circumstances and similar problems) for informal “expert” consultation. This connection between farmers appears to be related to the ability of other farmers to model implementation of new practices, to talk about it in a way that is easily understood, and to potentially be available for appropriate and immediate help. On-farm trials and demonstration projects can be used to develop expertise among early adopters. Recent economic research has also shown that adoption can be better understood by looking at the demand for specific traits or qualities in complex technologies (Useche et al., 2009). It is also necessary to account for factors that go beyond profitability, including land ownership, scale of production, farm/farmer characteristics, and the life cycle of existing capital–all of which help explain why technologies are not adopted even when it appears they would improve profitability (Isik, 2004; Purvis et al., 1995; Carey and Zilberman, 2002; Barenklau and Knapp, 2007).

Developing a Reduced Tillage Research and Extension Project in Western Washington

Research and Extension efforts to reduce tillage on organic farms in western Washington began in 2008 with the formation of a stakeholder advisory group, an on-farm trial, and a symposium. The symposium, supported by a USDA Organic Research and Extension Initiative (OREI) planning grant, brought together 72 regional organic vegetable growers, agricultural professionals, and national RT specialists. National and regional organic RT specialists were invited to present successful examples and discuss their RT organic production methods. The first day culminated with a field trip to an on-farm trial. The second day focused on understanding local needs and opportunities, and describing how WSU should be involved in research and outreach. Three priorities were identified by the group: 1) Identify production methods that integrate cover crops and RT technologies to improve soil quality and reduce weed populations; 2) Evaluate the economic impact of adopting RT technologies in terms of average profitability, the variance of profits, and factors influencing the likelihood of adoption; 3) Facilitate adoption of RT technologies and ideas, and identify the most effective strategies for encouraging behavior change. Core members of the producer advisory group formed during the symposium have remained engaged as research participants in on-farm and research center trials and have guided the direction of the project to ensure relevance.

Washington Organic Farmer RT Focus Groups

Focus groups were chosen at this stage because they are a useful way to examine grower beliefs and perceptions, and to understand the decisions made on operations. Focus groups are an effective method for interacting with stakeholders and engaging them to learn more broadly about their concerns, knowledge, experiences, and barriers to implementation of RT (Krueger and Casey, 2000; Morgan and Krueger, 1998). The discussion format and what individuals had to say in response to our questions and topics provided information about their attitudes, beliefs, behaviors and their underlying values with respect to RT implementation in agriculture as well as in the high moisture areas where they manage their small to medium size organic vegetable production systems. The goal of the focus groups was to help the project team identify major bridges and barriers in the design, adoption and dissemination of RT production systems for organic vegetable crops in western Washington.

In spring 2011, the RT Working Group, made up of western Washington Extension and research faculty, worked collaboratively with faculty and staff of the WSU Social & Economic Sciences Research Center (SESRC) in the development of the focus group pre-survey, moderator's guide, focus group participant screening and selection, as well as the implementation of focus group sessions.

Focus Group Participants

For focus groups to be an effective methodology, participants need to be randomly recruited from the target population to achieve a mix of contributors comprised of the types of producers to which the research is directed (Krueger and Casey, 2000;

Morgan and Krueger, 1998). Both men and women often work in small farming operations. Furthermore, there is an ethnic diversity of people who participate in area Extension programs for organic vegetable production. Specifically, western Washington has an increasing number of Latino growers involved in organic vegetable production. Focus groups with culturally diverse populations that encompass a much smaller proportion of growers and who are concentrated in some local areas more than others have not been elaborated in the literature for focus groups or Extension programs. In this research, Latino growers participated and engaged in the same session discussions with other area growers about the use of RT.

The RT Working Group provided the SESRC with a list of growers who participated in the 2009 symposium entitled “No-Till Organic Vegetable Production in Western Washington”. These farmers, along with a list of organic vegetable producers gathered from the Washington State Department of Agriculture were selected from the following western Washington counties: Whatcom, Skagit, Snohomish, King, Pierce, Thurston, Lewis, Mason, Jefferson, Clallam, Kitsap, Island, and San Juan (Fig.1). Other names suggested by WSU Extension personnel involved in the project from the counties of interest were provided to the SESRC for a total of 145 potential farmers for screening and selection.

Participants were screened for the person on the farm who makes decisions regarding cropping practices and other farm management decisions and who was 18 years of age or older. Participants also needed to have at least one acre of organic vegetables produced on their farm, but they did not have to be certified organic. The goal for each session was to have approximately ten individuals confirmed for each session.

Figure 1 Western Washington Counties and focus group locations

Implementation of Focus Groups

In spring 2011, focus groups were scheduled in three different locations in western Washington: Mount Vernon, Everett, and Olympia (Fig. 1). Each focus group session was planned for a two hour block of time. One of the SESRC principal investigators served as the focus group moderator while the other principal investigator took notes. In addition, audio recordings were taken during each focus group. The focus group moderator guided the discussion through the main topic areas (Table 1). The same set of topics was used at each focus group session to ensure consistency. A written pre-survey with questions about farm characteristics and a self-rating of RT knowledge was completed by farmers prior to the discussion. Farmers were also given a $50 honorarium for their participation.

Table 1. Focus Group Discussion Topics

1.	From your perspective, what are the main reasons farmers use reduced tillage practices? What tillage practices do you currently use?
2.	What are the main reasons farmers use cover crops? What cover crop practices do you currently use?
3.	What concerns do you have about adopting reduced tillage practices and cover cropping? Identify any barriers.
4.	What tillage equipment do you currently have? What new equipment would be needed in order to adopt reduced tillage practices?
5.	How does your access or lack of access to the proper equipment affect your willingness to adopt new practices?
6.	How do you learn about new farming practices? What factors influence you to make changes in your practice?

7.	What factors/facts would most convince you to adopt reduced tillage practices?

At the Mount Vernon focus group, a Spanish speaking interpreter provided a simultaneous translation for the four Spanish-speaking participants during the discussion. The translator relayed their comments and questions to the larger group and then provided back discussion comments. This allowed for an interchange that offered insight into their unique practices and perceptions of RT and also allowed them to learn about and ask questions of their English-speaking grower counterparts.

Project researchers from the RT working group played a key role in the discussion by interjecting information and clarifying critical points regarding the current project-related research. Researchers also answered questions and provided clarification on RT and cover cropping practices. The sessions encouraged communication between researchers and participants by developing questions that led the conversation around the chosen topics. Farmers from this working group were committed to supporting and promoting the comprehensive resources being developed during this integrated research and Extension project.

Compilation of Findings

After the focus group sessions were completed, SESRC personnel prepared typed transcripts of each session. The data generated from the focus groups is qualitative. The power in focus groups is not a quantitative measurement but rather capturing the breadth of the topics and issues that surface from participants interacting with each other in dialogue during the sessions. Focus groups are a way to listen to people and learn from them. Often the synergy, group dynamic and questions that participants pose to one another in addition the moderator's questions explores new depths and aspects not often uncovered in surveys or other means of capturing interview data.

Results

Participant Profile

In the pre-survey, the majority of participants across focus groups indicated familiarity with RT practices and though most were not using the specific strategies being studied by the RT Working Group, they have tried to reduce the amount of tillage they do in one form or another (Table 2). Twelve Mount Vernon participants, six Everett participants, and six Olympia participants indicated they have used some form of RT on their farm, although the focus group discussion revealed that individual farmers' definition of RT ranged widely. The remaining participants from each of the three locations indicated “No”; they have not used RT practices on their farm. However, all participants indicated a high level of interest in RT for various reasons.

Farmer participants rated their own current level of knowledge about RT in organic vegetable production. While these results have too few respondents to be considered a survey with statistical representation, the rating does provide a profile and guide as to how much session participants knew with regard to RT. There were no strong differences among participants in the 3 local areas in terms of RT knowledge. Mount Vernon and Everett participants rated themselves as having moderate knowledge overall, while Olympia participants tended to rate themselves with a little less than “Moderate knowledge” overall. Most of the session participants were aware there is more knowledge to be gained and that they could increase their knowledge about RT technologies and practices.

Table 2. Focus Group Session dates, Locations, Participants, Farm Composition, and Crops Produced

Session	*Number of Attendees*	*Farm Composition*	*Crops Produced*	*Reduced Tillage Self-rated Knowledge Score*
Date: 4/12/11 Morning Location: Mount Vernon, WA WSU Mt. Vernon Northwest Research and Extension Center	15 Farmers 1 Spanish language interpreter 2 Researchers	10 Certified organic 2 Transitional 3 Not certified --- *Acre range:* 1-420 6 had 1-5 acres 6 had 10-25 acres 3 had 400-420 acres	Mixed vegetables, row crops, asparagus, broccoli, corn, cucumber, squash, onion, radish, tomatoes, spinach, lettuce, grains, herbs, potatoes, berries, fruit, tree fruit, flowers	Range: 1 to 6 Mean: 3.13 # Answering — Category 0 — “None” 3 — “Very little” 3 — “Slight” 1 — “Moderate” 6 — “Quite a lot” 0 — “Great Deal” Overall: < Moderate knowledge
Date: 4/12/11 Afternoon Location: Everett, WA	8 Farmers 2 Researchers	5 Certified organic 1 Transitional 2 Not certified	Mixed vegetables, all row crop veggies, arugula to zucchini,	Range: 1 to 7 Mean: 4.07 # Answering — Category

Key Focus Group Themes

The focus group discussions revealed that farmers were eager to share their experiences and were interested in learning how to effectively use these RT and cover cropping practices on their own farms. Farmers recognize there are downsides to *not* tilling the soil and were concerned whether

WSU Snohomish County Extension Office		---------- *Acre range:* 5-1,000 4 had 5-7 acres 2 had 20-24 acres 1 had 181 acres 1 had 1,000 acres	organic green beans, herbs, grains, small fruits, grass-fed beef & poultry	0 "None" 1 "Very little" 1 "Slight" 2 "Moderate" 3 "Quite a lot" 1 "Great Deal" Overall: Moderate knowledge
Date: 4/13/11 Afternoon Location: Olympia, WA WSU Thurston County Extension Office	8 Farmers 2 Researchers	8 Certified organic ---------- *-Acre range:* 5-70 4 had 5-6 acres 3 had 15-25 acres 1 had 70 acres	Mixed vegetables, garlic, salad greens, culinary herbs, grains, berries strawberries, apples	Range: 1 to 7 Mean: 2.63 # Answering Category 0 "None" 0 "Very little" 3 "Slight" 1 "Moderate" 0 "Quite a lot" 1 "Great Deal" Overall: ≤ Moderate knowledge
Cover crops growers used	Clovers, common purslane, buckwheat, cereal rye, wheat, tritcale, oats, vetch, Phacelia, sudan grass, barley, mustards			

or not the downsides might outweigh the advantages. Farmers also had concerns about whether RT practices would work in their particular situation in the maritime Northwest.

Bridges to Reduced Tillage and Cover Cropping: Improved Soil Quality

Soil quality was the main reason given for pursuing RT and cover cropping practices. Farmers perceived that tilling the soil destroys soil macrofauna and decreases organic matter–both important components of soil health. Farmers were interested in practices that would help to maintain and restore the balance of organic matter in the soil. On ground that has been repeatedly tilled, farmers understood they risk losing soil fertility and organic matter along with large organisms that are important to healthy soil. They also understood that maintaining and building organic matter helps to reduce erosion and regulate soil moisture.

Farmers recognized how rich the soil is when it is first tilled (i.e. when taken out of pasture), but also how quickly it loses its rich quality and organic matter when it is repeatedly tilled. Farmers worried about the number of passes they make through the field because of the probable decline in soil quality. For example, the development of a compacted hard pan has become a problem for some farmers.

Farmers wanted to know how to use RT practices to restore, maintain and improve the quality of the soil that has been compromised after repeatedly being tilled. A key question surfaced towards directing extension research: Is there a rotation strategy for using RT that will decrease soil bulk density and increase soil organic matter without losing the benefits of tillage?

Growers recognized the value of RT for maintaining soil quality but also the potential for reducing costs. One large grower in particular summarized that the fewer tillage passes he has to make through a field or bed, the more he saves on fuel and labor.

Barriers to Using Reduced Tillage Practices

No current regional examples. One of the main barriers to adopting RT was the lack of RT practices adapted to the maritime Northwest. In this area there are different crops, different soil types, different climate, and a shorter growing season compared to other areas where RT practices are currently being used successfully. Farmers were unaware of any examples of RT practices employed in areas similar to their particular situation. As a result, farmers did not feel confident about using the practices.

The scale of the operation impacted the tradeoffs farmers see between tilling and reducing tillage. Farmers wanted to know if RT and cover cropping practices used on Midwestern row crops and grains can be successfully adapted to a small intensive scale in the maritime Northwest.

For growers to be willing to adopt new practices such as RT, they want to see their risk reduced by systematic trials in research and then proven in actual farming conditions and on sites under organic vegetable production. Some growers wanted to see the results of sowing two or more cover crops. Others suggested a need for research to target cover crops that improve soil quality in wet conditions. They recognized that cover crops and RT use are not a “one size fits all” solution.

Managing soil moisture and temperature. One of the main challenges that farmers in the maritime Northwest face is high levels of soil moisture in the spring and areas on their farms that are prone to flooding because of the high levels of moisture. While some farmers indicated that cover cropping protects their soil from erosion, other farmers find that cover cropping is impractical with extremely wet soils (e.g. some farmers have standing water at critical planting times).

Farmers indicated that they were concerned about using RT practices when they have such cool spring soil temperatures because of the shorter growing season in the maritime Northwest. They stipulated that one of the main methods to increase the soil temperature is to till the soil. Furthermore, by having a lighter colored cover crop on top of dark soil, the increase in soil temperature will also be delayed.

Nutrient availability. Farmers were concerned that the nutrients incorporated into the soil during the tilling process would instead be tied up in the cover crop. They wanted to know how to get the nutrients back into the soil. While cover crops increase the organic matter and nutrients in the soil, farmers want to know how those nutrients are incorporated into the soil and become available to the targeted cash crop if the cover crop is not tilled in. Farmers are concerned that an unincorporated cover crop competes for or even drains nutrients out of the soil. Farmers want to know how RT and cover cropping impacts the main crops they are trying to grow. They want to know if there are certain combinations and timings of cover crops that will help compensate for the amount of nutrients that may be tied up in the cover crop.

Weed and pest management. Farmers indicated that they need to know how to address weed problems that may occur as tillage is reduced because they have heard that RT increases the need for herbicides. When planting beans, for example (at least without a no-till drill), there is a need to open up the row and plant the seed. This allows weeds to germinate and it is difficult to control them without further tillage or herbicides. Perennial weeds are also seen to infest ground that is fallow or has not been regularly tilled.

Slugs are another pest specific to the maritime Northwest. Farmers in the group were very concerned, as they have experienced increased slug problems if crop debris was left in the field or if a cover crop was not tilled into the soil. They expressed apprehension that cover crops, especially dense cover, may become an enhanced habitat for slugs which are already a problem.

Adoption of Reduced Tillage and Cover Cropping: Next Steps

Farmers wanted more information about which cover crops to use, how to space the plantings and more about scheduling the planting of the cover crop. One problem farmers have is being able to get the cover crop in early enough to get maturity before having to get their cash crop planted on time. Are there cover crops that have an earlier season that would work well for the farmers in the maritime Northwest? Farmers wondered if there are methods of double cropping of a cover crop with the cash crop. They also wanted to know how to coordinate multiple factors and how to get various practices to work together. Furthermore, because the methods of farming differ for different ways of marketing the products, farmers wondered whether or not these practices will work in their situation. For some cash crops, leaving cover crop “trash” in the field diminishes the value of the cash crop (e.g. green beans).

Equipment Acquisition and Utilization

Specialized equipment was mentioned as a main obstacle in each focus group. Farmers wanted to know more about the specific equipment they would need under a RT system and whether existing equipment could be adapted for RT purposes. Farmers had reservations about purchasing equipment if it was unclear whether it was adaptable to their specific situation and conditions or had a proven track record. Some also inquired as to where to find the specialized equipment. Farmers also considered the feasibility of sharing, renting, or purchasing the specialized equipment.

Growers and researchers discussed the possibility that Extension and Conservation Districts should be explored as resources for cooperative equipment sharing for small growers in a region. The participants' past experiences indicated that often there is such a short window of opportunity when specialized equipment is needed that everyone would need the equipment at the same time, and they foresee that factor as a real limitation. Also, when sharing equipment, farmers wondered who would be responsible for expenses when it breaks down. In addition, just getting the equipment from one farm to another could be a challenge. Equipment sharing can also lead to weed and plant disease problems being transmitted from one farm another.

Conclusions

This series of focus groups provided insight into the perceptions, experiences, and concerns of organic vegetable growers in western Washington. Several recurring concepts in the focus groups have been valuable in directing current and future research on RT and cover cropping practices: 1) the problems organic vegetable growers face with RT in moist maritime conditions, 2) what they want and need to know about RT to adopt it, and 3) the desire for a wider understanding of the possible benefits that accrue from RT use. The size of the sessions in terms of participants allowed for in-depth discussions about RT and cover crops, and this provided insights for guiding researchers in developing protocols that can be used to yield generalizable research results. Participants questioned each other and also questioned researchers at the end of the sessions.

Smaller growers and larger growers viewed the use of RT and cover crops differently. Small-scale Latino/a growers emphasized that since they often hand pick crops, they can use cover crops combined with RT to help keep berries clean (less soil from muddy conditions) and allow them to remain on the vine longer. Larger growers emphasized their need to carefully evaluate the tradeoff of cover crops and RT to difficulty in harvesting (weed entanglement from increased growth in subsequent seasons), changes in hand harvesting, labor and fuel costs as well as any pervasive impacts to product quality.

Focus group participants recognized the benefits of RT and cover cropping but were yearning for more information and stronger evidence of how well the RT practices proposed by researchers would work on their specific farms under their specific conditions and on their specific crops. These growers seek the benefits of the increased soil quality that can occur when tillage is reduced. However, growers have concerns about how well those practices will work for them because of the wetter climate and subsequently wetter soil they are dealing with compared to other areas where these practices are being used successfully. The performance of RT technologies during the shorter growing season in western Washington and overall cooler soil temperatures was also an important concern.

Opportunities for Future Research

Many gaps exist in RT knowledge that impede the adoption of these practices in this region. There is a clear need to understand the trade-offs between the benefits and costs associated with specific RT practices and cover crops used in terms of soil quality, weed management, soil compaction and aggregation, soil temperature, labor requirements and changes associated with proposed practices in fields with high levels of moisture in early spring. Many also indicated that because of their small scale, some specific practices and the specialized equipment in particular will need to be adapted to their situation. Growers have ongoing concerns about weeds and other pests, and about which cover crops work best and when to plant them. Slug control and prevention in RT systems is a key area of research needed in the cool, seasonally wet climate of the maritime Pacific Northwest. This is of special concern for organic growers committed to minimal or no chemical options for pest control.

Grower participants welcomed the opportunity to exchange information with fellow growers about each other's current cover cropping, crop management and tillage practices and to tap into, ask questions and learn about the current WSU research being done on RT and cover cropping practices. They were also interested in learning about some of the specialized equipment and specific practices that are being used. Very few agricultural policies are directed towards supporting small-acreage vegetable growers, and this study points to a need for specialized support and research in the form of shared equipment resources or programs to help offset risk and larger expenses. Another area of research is the role of incentives for reduced environmental impact and how that might play towards inducing organic vegetable growers to further adopt RT and cover crops to reduce soil erosion.

Growers indicated that they use a variety of ways to learn about new practices including workshops, conferences, face-to-face meetings with researchers and other growers, the Internet, YouTube™ videos and books. Growers wanted to know that the practices have been tried in real settings and under conditions similar to their own situations. Inclusion and participation by Latinos in our sessions suggests a need for materials to be translated and made available and accessible in other languages.

The WSU RT Working Group in western Washington has incorporated the valuable findings of the focus groups into their research station and on-farm experimental designs, especially in the areas of cover crop type, variety, and timing, combinations of cover crops and cover crop termination methods and timing. The Working Group continues to involve their stakeholders in workshops, trainings, field days and conferences developed specifically to influence the wider adoption of RT technologies and practices. The focus group sessions highlight that small producers have limited time, capacity, and resources to experiment and test various cover crops and tillage practices during their production season. Research programs like that of the RT Working Group have an important role to address the questions raised in a systematic way using scientific practice and experimental methods towards reducing risk for farmers to adopt RT technologies and practices.

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Additional Resources

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