Sustaining the Pacific Northwest

Food, Farm, & Natural Resource Systems

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Monitoring Greenhouse Gas Fluxes from an Irrigated AgroEcosystem

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Introduction

Supporting an ever expanding human population has intensified demands on land and other natural resources. Converting forests and grasslands to intensive agriculture increased biomass burning and nitrogen (N) fertilizer use worldwide which has contributed to elevated emissions of greenhouse gases (GHG). Atmospheric concentrations of carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) are increasing at a rate of 0.4, 0.6, and 0.25% per year, respectively, (IPCC, 2006) and are projected to continue to increase. Carbon dioxide is the major greenhouse gas, followed by CH4 and N2O. While agriculture is a major emitter of anthropogenic CH4 and N2O to the atmosphere, it is only a minor emitter of anthropogenic CO2. Agriculture contributes about 20% of the world's global forcing from CO2, CH4, and N2O. Agricultural practices contribute approximately 27% of anthropogenic CH4 and 70% of anthropogenic N2O emissions. Consequently, increased concerns for global climate change necessitate agricultural mitigation strategies to reduce greenhouse gas emissions.

The relationship between the application of N-fertilizers to agricultural soils and the subsequent flux of N2O has been studied intensively for the last twenty years. These studies arose from the recognition that N2O contributes to global climate change and that a large percentage of these emissions come from the use of industrially fixed N-fertilizers. Nitrogen fertilizers are thought to be the most important source of anthropogenic N2O emissions, primarily emissions from soils caused by microbial nitrification and denitrification processes. Several factors control these processes, including the amount of water contained in soil pores, temperature, and the concentration of mineral nitrogen. In agricultural soils, adding N-fertilizers and manures generally increases mineral N which increases N2O emissions. The effect of N-fertilization, fertilizer type, and cropping systems on N2O emissions from soils under rain-fed agriculture has been widely reviewed in recent years. However, there is little information concerning trace gas fluxes from irrigated soils in the Pacific North West. We undertook our current research to learn more

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Sustaining the Pacific Northwest
Food, Farm, & Natural Resource Systems

This quarterly newsletter provides a discussion forum for people working towards community-based sustainable food, farm, and natural resource systems using interdisciplinary oriented research and practitioner knowledge.

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about N_2O emissions from irrigated cropping systems in the Columbia Basin of Eastern Washington. The objectives of this research were to: 1) describe cropping season patterns of N_2O emissions and periods of peak losses following fertilization practices in an irrigated high value potato rotation, 2) estimate season losses of N_2O and amount of fertilizer losses as N_2O, and 3) estimate the global warming potential of these fertilization practices.

Field Experiments

Field studies were conducted in 2005 and 2006 to characterize trace gas fluxes from a Quincy fine sand (mixed, mesic Xeric Torripsamments) soil at the USDA-ARS Integrated Cropping Systems Research Field Station located in Benton County, near Paterson, Washington. The area receives annual precipitation of about 6.0 inches, mostly occurring during the winter months. The surface soil (0-4 in.) has a bulk density of 1.33 kg m^{-3} and a sand and silt content of 92% and 6%, respectively. In these sandy soils, total soil carbon ranges from 0.4% – 0.6% and nitrogen averages 0.05%.

We measured trace gas flux measurements by driving 12-inch diameter by six-inch high PVC rings four inches into the soil. The soil-atmosphere exchange of trace gases (CO_2, N_2O, and CH_4) were measured by fitting the chamber anchors with vented PVC chamber caps containing a sampling port. The change in gas concentrations within each chamber was determined by collecting a gas sample every 20 minutes over a 1-hour period, after placing the chamber cap. Gas levels of N_2O, CO_2, and CH_4 were tested in the laboratory using gas chromatography.

The concept of global warming potential (GWP) was devised by the International Panel on Climate Change (IPCC) to allow comparisons of the total cumulative warming effects of different greenhouse gases over a specified time period (U.S. Greenhouse Gas Inventory, 2002). The GWP measures the relative contribution to radiative forcing. The warming effect of CO_2 is assigned a value of 1 and the warming effects of other gases are calculated as multiples of this value. The GWPs range from 20 year to lifetime atmospheric values and are taken from the Intergovernmental Panel on Climate Change's (IPCC) Second Assessment Report. The Third Assessment Report includes revised 100-year GWP estimates, increasing the GWP of CH_4 to 23 and decreasing the GWP of N_2O to 296 (IPCC, 2001). Virtually all GWPs used in the literature to date are from the second assessment. Emissions calculations relevant to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol are also based on these GWPs. Therefore, we use the second assessment's 100-year GWP value of 310 for N20 for means of comparison. GWPs are used to convert emissions of non-CO_2 gases into their CO_2 warming equivalents (CO_2Es). The CO_2E of a non-CO_2 gas is calculated by multiplying the mass of the emissions of the non-CO_2 gas by its GWP. A 100-year GWP of 310 for N_2O means that each pound of N_2O emitted is considered to have cumulative warming effects over the next 100 years equivalent to emitting 310 lbs of CO_2.

> Global radiative forcing is the net balance of incoming and outgoing solar radiation. Different greenhouse gases have different affects on global radiative forcing on a molecule for molecule basis, and therefore relatively more or less global warming potential (GWP). The global warming potential of each gas is always expressed in equivalency to CO_2 (CO_2 = 1). Even though methane and nitrous oxide are much smaller in atmospheric concentration than carbon dioxide, the higher GWP's increase the total percentage contribution agriculture has to global radiative forcing.

Results and Discussion

Nitrous oxide, CO_2, and CH_4 production were measured over the 2005 and 2006 growing seasons in

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conventionally tilled and reduced tilled potato based rotations. CO2 emissions represent the combined amount of CO2 released from organic matter decomposition and soil microbial and root respiration. Figure 1 shows the pattern of seasonal CO2-C emissions for only the 2006 field season. During the 2006 crop year, the patterns of seasonal CO2-C emissions were similar to 2005 but with greater differences between fertilized and unfertilized weeks. Soil CO2 emissions increased as crops matured (maximum 30-50 lbs CO2-C per acre per day) and declined as irrigation decreased and roots senesced following maturity and harvest. Cumulative emissions in 2006 were slightly lower than 2005, averaging 1400 and 1150 lb CO2-C per acre in corn and potato plots, respectively.

Crop, tillage, and fertilizer influenced seasonal changes in nitrous oxide flux in 2006 as evidenced in Figure 1. Tillage effects in sweet corn plots were much larger during fertilized weeks than unfertilized weeks. Conventional tilled (CT) plots produced consistently higher nitrous oxide fluxes than reduced tilled (RT) plots. Reduced till Potato plots tended toward higher seasonal nitrous oxide fluxes, but in spite of the reversal, the effect of tillage was apparently less in potato than in sweet corn. For cropped fields, N2O emissions corresponded to irrigation and fertilization events. By the third week, nitrous oxide fluxes in potato plots were consistently higher during fertilized weeks than unfertilized weeks in both years. Peak N2O fluxes, ranging from 0.04 – 0.05 lb of N2O-N per acre per day occurred during mid-season fertilizations and were 25 times greater than peak fluxes from the native site (Figure 2). Nitrogen lost as nitrous oxide-N, as a percentage of N applied to sweet corn plots, was 0.5% in 2005 and 0.6% in 2006. In both years, 0.26% of N applied was lost as nitrous oxide in potato plots.

Cumulative CO2 and N20 fluxes from the native shrub steppe site were 0.05 lb N2O-N per acre and 400 lb CO2-C per acre for the period of May 15, 2005 through August 30 in both 2005 and 2006 (Table 1). Cumulative CO2 and N20 fluxes from corn and potato fields were 14 and 21 times greater than the native shrub steppe site, respectively. N20-N losses accounted for 0.2% (0.5 lb N per acre) of the applied fertilizer (215 lb N per acre), representing approximately 10,000 lb of N-fertilizer applied to the Quincy sand soil type. Extropolating this loss to other irrigated soils in the Columbia Basin, the loss of N-fertilizer as N2O could exceed 183 tons of applied N-fertilizer. Table 1 provides the flux of N20 CO2 and CH4 for 2005 and 2006 with subsequent columns

Figure 1: CO_2-C, N_2O-N, and CH_4-C Flux Rates - 2006 Growing Season

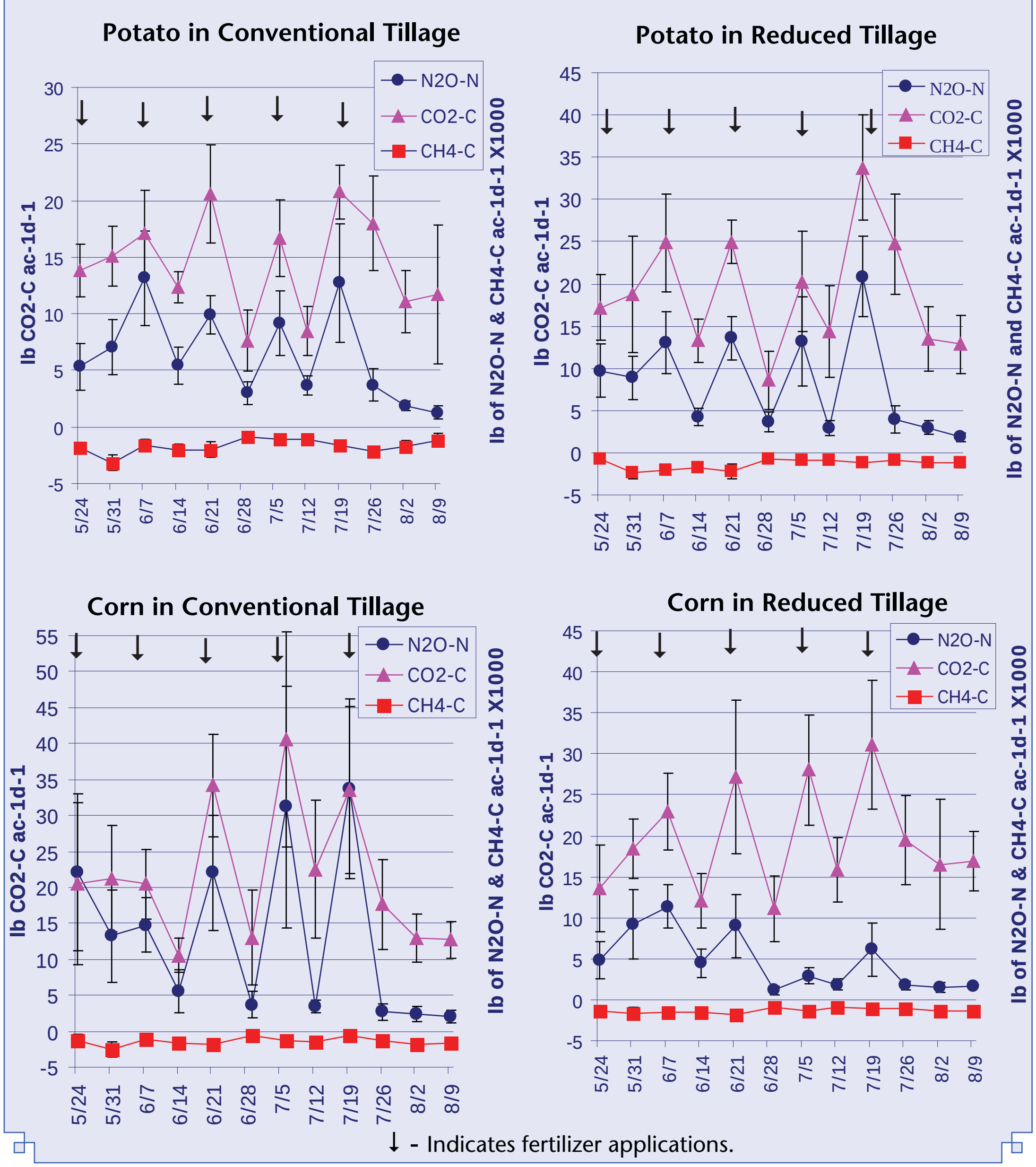

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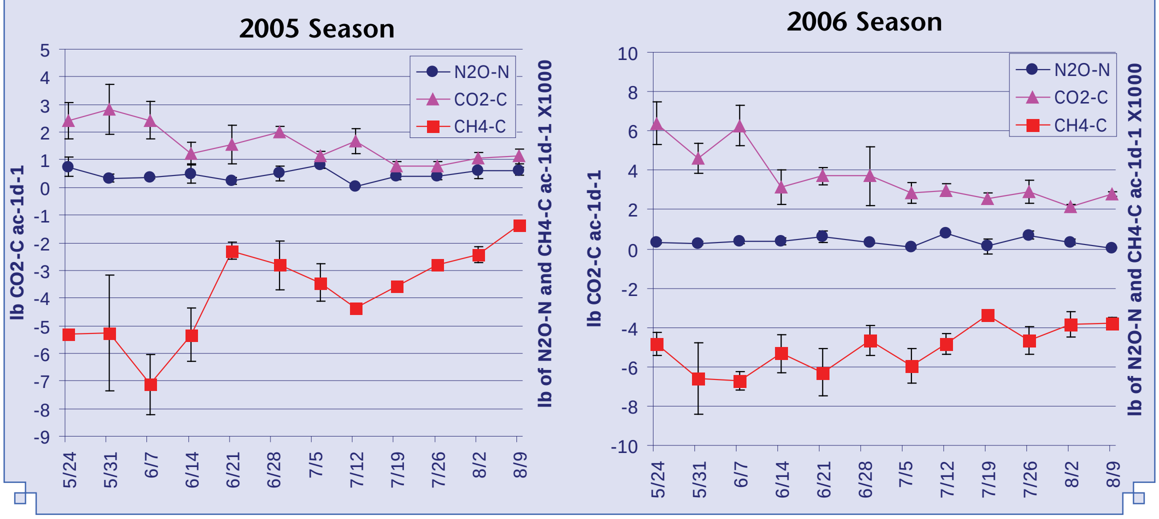
Figure 2: CO_2, N_2O, and CH_4 Flux Rates - Native Control Sites



providing land area and calculation of the Global Warming Potential (GWP) CO2E equivalent. Using the Second Assessment Report (SAR, 2001), a 100-year GWP value of 310 for N2O, the CO2E of 0.05 lbs of N2O per acre emitted from an estimated 5,360 acres of native vegetated sites on the Quincy sand soil yields 83,100 lb CO2E or 42 T CO2E per growing season. Cropped fields on the Quincy sand soil emitted N2O estimated at an average of 2400 T of CO2E, or 60 times greater than native vegetated sites.

Table 1: Estimated Growing Season Fluxes† & Global Warming Potential (USDA-ARS Integrated Cropping Systems Research Field Station, Benton County, Washington on a Quincy sand soil type)

	2005			2006		
Vegetation	**Field Flux†** (Lb/acre/ season)	**Regional Flux** (tons/ season)	**Global Warming Potential** (tons CO2 equivalent)	**Field Flux** (Lb/acre/ season)	**Regional Flux** (tons/ season)	**Global Warming Potential** (tons CO2 equivalent)
N2O						
Native	0.05	0.13	42	0.05	0.13	42
Sweet corn	0.78	6.9	2,139	0.94	8.4	2,600
Potato	0.83	7.4	2,294	0.81	7.2	2,230
CO2						
Native	400	1,072	1,072	905	2,425	2,425
Sweet corn	6,775	60,300	60,300	5,510	49,040	49,040
Potato	5,140	45,750	45,750	4,110	36,580	36,580
CH4						
Native	-0.36	-1	-22	-0.47	-1.3	-29
Sweet corn	-0.15	-1.3	-31	-0.13	-1.2	-27
Potato	-0.21	-1.9	-43	-0.14	-1.2	-28

†Field fluxes were calculated from static chamber measurements integrated over the season. Regional fluxes were scaled to the area of Quincy sand occupied by native vegetation (5,360 acres), sweet corn (17,800 acres), or potato (17,800 acres). Based on 2005 acreage cropped to corn and potatoes on the Quincy sand soil type and estimates that 10% of the soil type remains in native shrub-steppe. ‡CO2 E = CO2 equivalents based on the global warming potential of greenhouse gasses, relative to CO2; CO2 equivalents of N2O and CH4 are 310 and 23 times that of CO2, respectively (IPCC, 2006).

CONCLUSIONS

Cropping systems which optimize rotational crops in irrigated sandy soils are needed to maximize yield and crop quality and minimize potentially adverse impacts to the environment. Although the total amount of uptake is small, this study suggests that semi-arid native shrub steppe soils in the Columbia Basin act as a terrestrial sink for methane during the growing season. Native sites were able to consume CH4 three times higher than the cropped land. Contributions of N2O and CO2 to the GWP from the irrigated sandy soil under corn and potato cropping systems were lower compared to other studies. Approximately 0.35% of the applied fertilizer was lost from sandy irrigated potato fields. This lower value may be due to standard split applications of fertilizer through the irrigation system during the growing season. Considering the amount of fertilizer applied to each crop, sweet corn, because it is grown on greater acreage, contributes much more to the GWP. Potato fields, on the other hand, oxidized more CH4 than sweet corn, which may be due to a better aerated soil environment.

Since agriculture is the major source of global N2O emissions, improving the management of nitrogen is a critical step in reducing agricultural greenhouse gas emissions. Our research seeks to improve nitrogen uptake and nitrogen use

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efficiency while reducing gaseous nitrogen losses through development of improved cropping systems. While N2O emissions in the potato systems studied are relatively high in comparison to the native control, they are substantially lower than values for other cropping systems and sites reported in the literature. While there are likely additional biological factors working in this system, this study indicates that improving nitrogen management (i.e., "spoon feeding" the crops with fertigation, etc.) can be part of an effective strategy to reduce N2O emissions from agriculture.

Improving Nitrogen Use Efficiency in Dryland Cereal Crops With Precision Nitrogen Management Technology

David Huggins, USDA Agricultural Research Service, **Chad Kruger**, WSU Center for Sustaining Agriculture & Natural Resources

Introduction

About 60% of synthesized N worldwide is applied to cereal crops, however, only one-third is recovered in the harvested grain. The remaining two-thirds of unaccounted for N can be lost via gaseous plant emissions, denitrification, surface runoff, volatilization, and leaching. Globally, the amount of reactive N (e.g. NH4+, NO3-) cycling in the environment has more than doubled since the 1940's, with 86% originating from agricultural activities. Consequently, poor N use efficiency (NUE) represents not only a financial loss to the producer, but a serious environmental threat that contributes to global climate change resulting from N2O (a greenhouse gas) emissions, as well as eutrophication and degradation of surface and ground waters via leached NO3-. Poor N recovery by crops can be a function of uniform field applications of N fertilizer as field variability in soil N transformations, N movement, and crop N use result in poor synchrony between N supply and crop demand.

Current strategies for managing N fertilizer in wheat-based dryland farming systems of the Inland Pacific Northwest (PNW) were developed on a regional scale for the uniform, whole-field application of N under intensive tillage systems. The inadequacy of current N fertilizer recommendations has been documented at the WSU Cook Agronomy Farm (CAF) near Pullman, WA, where uniform N applications have resulted in large within-field variations in wheat performance (yield and protein), N uptake efficiencies (12 to 48%), and unaccounted for N estimated at 50 to 100% of applied fertilizer N. Field variation in yield and protein is well documented for dryland wheat producing regions of the PNW and arises from landscape and soil attributes that produce complex spatial and temporal variations in available water, organic matter, and rooting depth. Collectively, these observations show that the consistent and strong influence of topographic and soil factors on grain yield, protein and NUE facilitate their prediction and management through the use of precision N conservation technologies. Tailoring N management prescriptions to site- and time-specific conditions could significantly improve NUE in direct-seed systems. However, despite the availability of powerful precision agricultural technologies such as Global Positioning Systems (GPS), Geographic Information Systems (GIS), yield and protein monitors, and variable rate applicators (VRT), there are currently no N management recommendations for the region and limited grower adoption. A major barrier to adoption of precision technologies for N management has been the lack of their integration into a grower-oriented monitoring, application, and evaluation system that assesses tradeoffs and optimizes the economic and environmental performance of N use.

Evaluation of Precision N Management Technology

In 2006, the Climate Friendly Farming Project Team was awarded an NRCS Conservation Innovation Grant to evaluate and demonstrate the potential for Precision Nitrogen Management technology at the Cook Agronomy Farm in Pullman and on two cooperating growers' farms.

Our development of precision N management strategies requires evaluation of grain yield and protein goals as well as N use efficiency (NUE) goals. Evaluation of site-specific yield, grain protein and NUE will result in definition of a site-specific N requirement, as well as aid overall development of strategies to effectively vary N applications at different times and field locations during the course of cereal crop management. Variable rate and timing of N were tested and compared to uniform N applications at the WSU Cook Agronomy Farm (CAF) and at two grower cooperators' farms.

At the CAF, relative crop yields are used to define yield goals across the landscape. Once relative yields are defined, historic yields for a field are used to distribute the yield variability across the field. For example, if the average field yield for hard red winter wheat is 85 bu/ac, the relative yield map can be used to distribute this overall historic yield across the field. At the CAF, field average yields for hard red winter wheat are 85 bu/ac, however, yield varies from 50 to over 100 bu/ac. The historic, relative yields are then used to estimate site-specific yield goals for a given location. Combine mounted yield monitors can greatly enhance our ability to rapidly develop relative yield maps for grower fields. Comparison of hand sampled yields with combine mounted yield monitors at the CAF indicated satisfactory performance of yield monitors (Figure 1). Estimates of N mineralization at CAF were based on 369 geo-referenced soil samples analyzed for organic matter. This amount of detailed information is cost-prohibitive for a grower, however, preliminary data show that soil organic matter levels are related to historic crop yields and we are examining the use of relative yields

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to predict N mineralization from soil organic matter.

A combine mounted grain protein monitor was tested to determine if it would provide reliable grain protein mapping to support variable rate strategies. Comparison of hand sampled field data of grain protein with a combine mounted protein monitor indicated that the hardware, while promising, will require further field testing and calibration to be viable (Figure 2). Some problems with grain protein sensing technology that were identified were: (1) interference of non-crop biomass (weed and other green material) and foreign materials (dust) with sensor readings/output; (2) in some cases, sensitivity of equipment to positioning within the combine to ensure self-cleaning; (3) limited farmer-based software to download and display data or to post-process data if needed.

Variable N fertilizer rates for hard red spring and winter wheat were based on yield and protein goals and the unit N requirement defined for each (3.65 lbs N/bu for Hard Red Spring Wheat and 3.0 lbs N/bu for Hard Red Winter Wheat). These rates of N were applied and compared to uniform N applications based on the overall yield goal of the field. Variable rate fertilizer application equipment was tested for capabilities of achieving targeted N rates across the field (Figure 3). Dry fertilizer applications were made with a variable rate controller coupled with a Barber spreader while liquid applications were made with the same variable rate controller attached to a direct-seed drill. The liquid system was able to achieve target N levels with more accuracy. Results for hard red winter wheat showed a distinct advantage for the precision N management. Although preliminary, these data show that the same yield and protein levels were achieved with a 20% reduction in applied fertilizer and a significant increase in N use efficiency. Losses of reactive N to the environment, such as N2O emissions, are assumed to be reduced by an equivalent amount.

Figure 1: Hand Samples versus Yield Monitor Data for Hard Red Winter Wheat

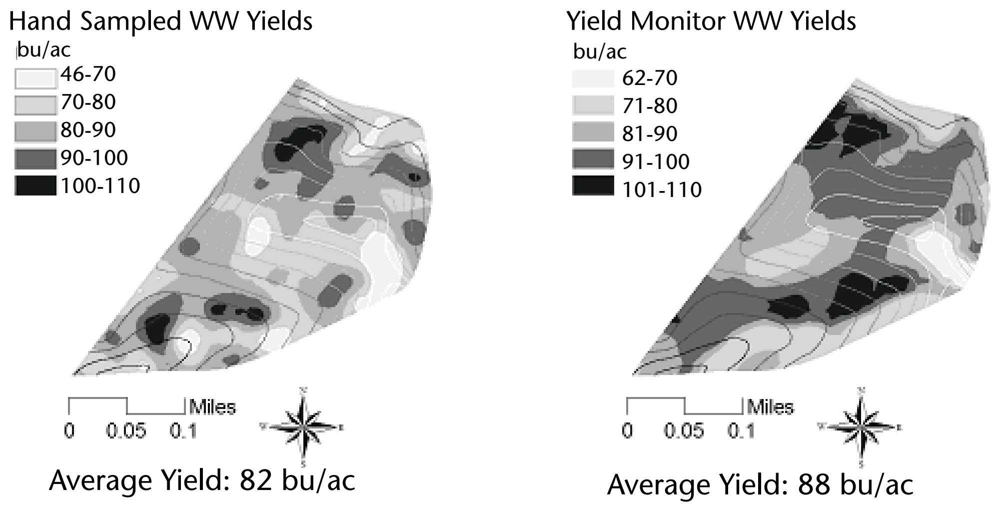


Figure 2: Hand Samples Versus Combine Grain Protein Analyzer of Hard Red Spring Wheat (12-ha field)

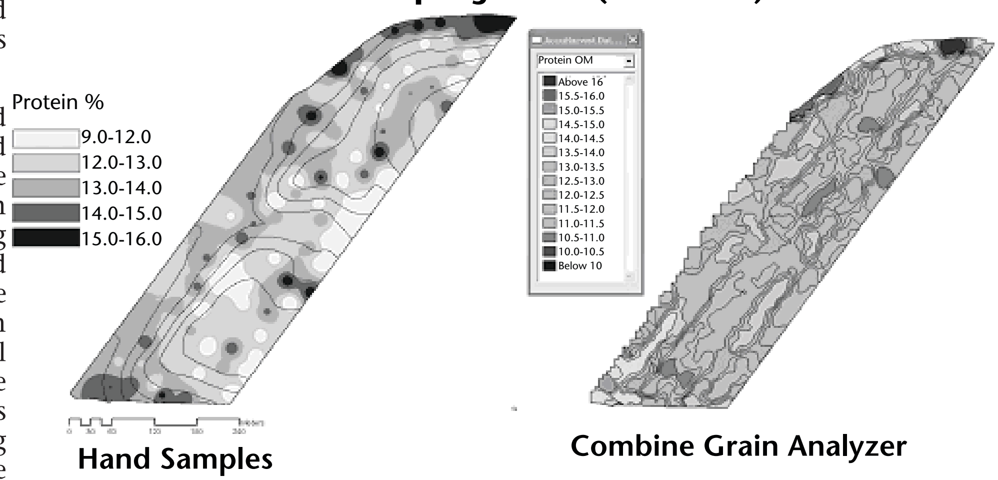
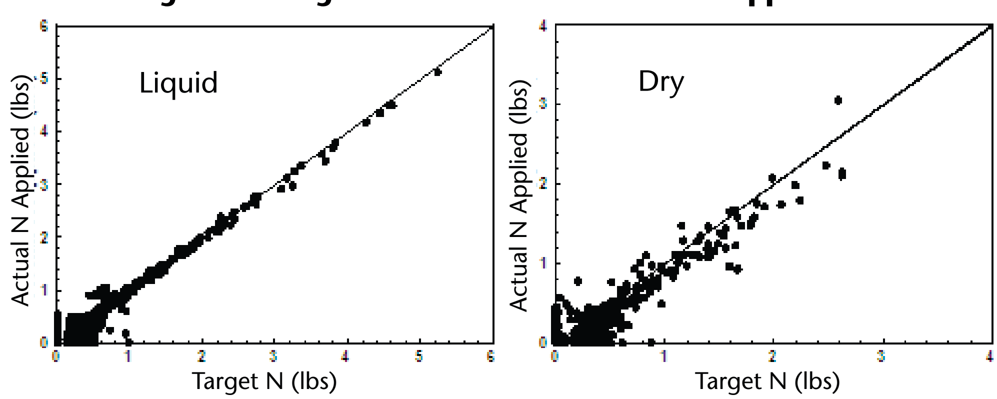


Figure 3: Target Versus Actual Amounts of Applied N



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Considering high fertilizer costs and assuming growers are able to achieve similar results, the technology would rapidly pay for itself.

Conclusions

The potential for Precision N management as well as other precision technologies to be widely used by producers is high and will likely increase as the cost of nitrogen fertilizers and other agrichemicals increase. In the past few months ,there has been tremendous interest in precision farming technologies and farmers across the state are making initial investments and reporting anecdotal savings in agrichemical use by reducing application overlap and tailoring fertilizer rates to site-specific needs. In addition, potential economic incentives through market-based mechanisms for greenhouse gas mitigation (ie. Western Climate Initiative) could further encourage adoption. Continued refinement and extension of decision-support aids will improve the results that producers achieve with the hardware investments they are now making.

Innovations in Anaerobic Digestion at WSU

Craig Frear, WSU Biological Systems Engineering, & Chad Kruger, WSU CSANR

Introduction

Atmospheric concentrations of methane (CH4) are increasing at a rate of 0.6% annually (IPCC, 2006). Agricultural practices contribute approximately 27% of the total anthropogenic emissions, primarily due to enteric fermentation (ie. the natural digestive process of ruminant animals), rice-paddy cultivation, and manure management. Anaerobic digestion (AD) of manure captures methane and is the state of the art for reducing methane emissions from manure. Compared to typical open lagoon storage, AD offers major benefits, including odor control, methane capture, and renewable energy generation. As concerns over climate change increase and energy prices rise, there are renewed interests nationwide in using AD for animal manure management. According to the AgStar Program, the need for AD systems on large farms will exceed 6,500, even though they currently number less than 200 in the entire US. Two major barriers constrain a wider adoption of AD technology. First, capital costs often surpass the return from the electrical generation from biomethane. Secondly, the anaerobic digestion process alone does not reduce the nutrient content of the manure, exacerbating nutrient management considerations for animal feeding operations.

With a 2004 grant from the Paul G. Allen Family Foundation to the Climate Friendly Farming Project, an interdisciplinary team comprised of 15 scientists, engineers, agronomists, and extension specialists made anaerobic digestion a priority topic area at WSU. The team has engaged in research and Extension outreach around AD technology innovation, nutrient recovery, bioproduct development, commercial technology evaluation, co-digestion of food waste and manure, and targeted public policy analysis. This article provides the highlights of WSU Climate Friendly Farming Team activities and accomplishments from anaerobic digestion work.

Novel Digester Technology

Although a relatively mature technology, there still exists potential for scientific and engineering improvements to the AD process to promote greater conversion yield and productivity, as well as improved economic performance through reducing capital costs. WSU immediately recognized a gap in available commercial technology specifically designed for flush manure (~1 – 2% total solids) dairies in cold climates like Washington State. Thus, WSU embarked on a series of laboratory and pilot-scale studies in order to optimally digest flush manure, resulting in an invention disclosure and preliminary patent on a beta-version of the pilot-tested system at the WSU Dairy Center. Unlike others, this system fractions out and treats the entire flow of flush manure, rather than only treating the liquid fraction or the solids fraction. The result provides more complete digestion for enhanced productivity and air/water quality protection.

The system comprises three parts: a high-rate sequencing-bed reactor, a complete stir tank reactor (CSTR), and a high-solids wash process. The high-rate sequencing-bed reactor, a key accomplishment, operates under psychrophilic temperatures (little added heat). It distinguishes itself from other high-rate designs by not requiring external support media to provide surfaces for biofilm growth and not requiring removal of solids to protect the support material from clogging. By controlling flow parameters to induce biofilm growth on the fibrous solids contained within the manure, no external support material is needed to develop a biofilm required for high-rate digestion. In addition, eliminating external support material reduces cost and most importantly, removes the risk of clogging and need for solids removal.

Additional, larger scale tests are planned, pending funding, active commercial partners, and potential demonstration farms. We expect this technology will enhance flush manure digestion and fill a technology gap. Moreover, the reduced reactor size and increased efficiency might allow for its application to smaller type dairies (~500 cows) utilizing flush manure management.

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Auxiliary technologies for nutrient recover, bioproducts, and high-solids digestion

AD is an excellent tool for converting much of the organic carbon (a vector contaminant) to inorganic carbon in the form of biogas that can be recovered for methane reductions and renewable energy generation. However, AD technology alone does not address nutrient loading concerns for dairies. In fact, AD can increase the availability of nutrients (primarily N and P) in the effluent, especially if high-nutrient materials like food waste are co-digested with manure. Therefore, AD systems need auxiliary technologies that recover nutrients as co-products to be exported from the dairy. While existing technologies can recover nutrients, they tend to be too expensive for dairy applications. Our efforts have focused on recovering and developing products from digested manure that provide additional value to the AD project.

WSU developed and patented a post-AD process where recovered, fibrous solids can be used as a one to one replacement for peat moss as a potting substrate for the horticultural industry (see SPNW December 2006). This simple process produces a product with correct pH, water and air holding capacities, fibrous content, density, and chemical/nutrient composition to replace peat as a renewable potting substrate. In addition, WSU developed an auxiliary operation that will allow for the production of this high quality soil amendment prior to digestion for operations that remove the fibrous solids prior to digestion.

Another patented and pilot-tested auxiliary nutrient recovery process produces nitrogen and phosphorous-based fertilizers easily exported from the farm. This process removes and recovers ammonia and phosphorous solids in series and in integration with an AD process. WSU is now completing extensive field trials with these materials to develop fertility recommendations and concomitant biological impacts on various crops. In addition, the process pre-scrubs (removal of CO2 and H2S) the biogas. The scrubbed gas methane content increases from 65% to 90%, enhancing combustion and reducing CHP engine maintenance costs.

Lastly, WSU has developed a technology with preliminary patent protection for second-generation high solids digestion for digesting the organic fraction of municipal solid wastes (OFMSW). Several commercially-available high solid AD units originated in Europe during the last two decades, but are limited by critical engineering deficiencies, such as high mixing and recycling costs. WSU's design removes the intensive mixing and recycling needs, while providing effective high solids digestion without pH inhibition. Developing this technology could increase adoption of AD not just on farms, but also in solid waste management facilities (such as large compost facilities and industrial operations). WSU is presently working with several cities, counties, government agencies, and large solid waste handlers in developing and commercializing high solids digestion.

Commercial Digester Evaluation

Extensive economic and biophysical monitoring and analysis was performed on an existing, commercial AD system operating at the Vander Haak Dairy in Lynden, Washington. A critical insight affecting both economic and biophysical performance of the digester is that co-digestion of more volatile food wastes with manure provides synergistic performance improvements for the project. A roughly 17.5% volumetric flow of highly digestible food increased total biogas production by over 60%, dramatically increasing the economic performance of the system through increased electricity sales and tipping fees collected for accepting food processing wastes. Co-digesting materials from off-farm raises new questions (technical and regulatory) regarding safety in solid waste handling and nutrient loading. Continued efforts to refine nutrient recovery technologies are essential to making co-digestion a

long-term option for AD projects. WSU has developed a beta-version of a co-digestion process model and simulation software that predicts the effect of co-digestion on digester performance and outputs. WSU is working with the State Departments of Ecology and Agriculture to provide the best science to support improvements in the regulatory system to ensure environmental and human health protection for AD projects co-digesting non-manure materials.

Educational Outreach and Demonstration

An active Extension outreach program has been integrally involved in all of the AD research and technology development efforts. Up-stream interactions by Extension with industry, government, and other stakeholders proved critical to defining the highest priority issues for research. Down-stream efforts to provide results, educational opportunities, and consultation with users has been extremely effective. Strong partnerships formed with dairies, technology providers, project developers, local, state, and national agencies will ensure that the results of successful research and technology development move into the private sector. In addition to direct technology demonstration, evaluation, and consultation, efforts to inform the public sector about the benefits and constraints of AD led to substantial public funding for project

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development, enabling legislation, and improved potential for AD projects to provide "carbon offsets" into a carbon market mechanism, such as the emerging Western Climate Initiative. Today, two digester projects operate in the state, processing manure from approximately 6,000 cows. A third digester designed for 2,000 cows is under construction and other projects are in various stages of development. WSU provided critical support for each of these projects through research and education.

Climate Change Policy and Agriculture in Washington State

Chad Kruger, WSU Center for Sustaining Agriculture & Natural Resources

What is the Washington State Climate Action Team?

In early 2007, Governor Christine Gregoire issued Executive Order 07-02 which set goals for reducing greenhouse gas (GHG) emission to 1990 levels by 2020 and 25% below that by 2035, creating 25,000 new 'clean energy' jobs by 2020, and reducing the amount of money Washington residents spend on imported fuels 20% by 2020. In order to achieve these goals, she jointly charged the Departments of Ecology and Community, Trade and Economic Development (CTED) to form a Climate Advisory Team (CAT) and to facilitate a public process to generate recommended actions for the state.

Membership of the initial CAT included representation from various industries, government, non-governmental organizations (environmental, labor, and poverty reduction), utilities, and higher education. Five Technical Working Group (TWG) subcommittees were established to make an initial assessment of potential GHG emission reduction strategies related to various aspects of the state's economy: 1) residential, commercial and industrial, 2) energy supply, 3) transportation, 4) forestry, and 5) agriculture / waste management. The TWGs forwarded 47 distinct GHG emission reduction strategies for consideration by the CAT who included them as action recommendations to the Governor in the CAT's report completed in late January 2008.

The CAT's report, entitled Leading the Way: A Comprehensive Approach to Reducing Greenhouse Gasses in Washington State, has been published on the Department of Ecology's website. In addition to the 47 recommended actions, the report captures much of the CAT's deliberations regarding the importance of building a strategic climate change policy framework for the state, including a set of 12 "powerful, directional recommendations" (Section IV of the report) for how Washington State's political leadership should prioritize climate action. The two recommendations most critical to agricultural interests are:

> *Recommendation 1:* Build market-based mechanisms to unleash investment in the creativity and innovation of Washington's economy to deliver cost effective emission reductions.
>
> *Recommendation 10:* Restore and retain the health and vitality of Washington's farms and forest lands to increase carbon sequestration and storage in forests and forest products, reduce the releases of greenhouse gas emissions and support the provision of biomass fuels and energy.

These two recommendations provide the basis for the "implementation" efforts that will take place in 2008.

Recommended Actions from the Agriculture / Waste Technical Work Group

The Agriculture / Waste Technical Work Group (AW TWG) assessed and submitted eight distinct GHG reduction strategies to the CAT. Seven of these strategies were directly related to agriculture and include:

AW-1 Manure Digesters / Other Waste Energy Utilization,

AW-2 In-state Production of Biofuels and Biofuel Feedstocks,

AW-4 Agriculture Carbon Management,

AW-5 Agriculture Nutrient Management,

AW-6 Reductions in On-Farm Energy Use and Improvements in Energy Efficiency,

AW-7 Preservation of Open-Space / Agricultural Land,

AW-8 Support for an Integrated Regional Food System (this strategy was not assessed for GHG reduction potential due to lack of sufficient published data).

These seven strategies were selected from a list of multiple options based on relevance to Washington agriculture, importance, potential for assessment, and capacity of the TWG to complete the assessment in the given time. The completed assessments estimated the potential GHG reduction and cost effectiveness if a strategy was completely implemented based on existing literature (published and unpublished) and recommendations for how the strategy might be best implemented. The purpose of this exercise was to provide a rough framework for evaluating which strategies were "most promising" in relation to each other.

Implementing CAT Recommendations in 2008

The charge for agriculture by the CAT in Directional Recommendation 1 and subsequently codified in Engrossed Second Substitute House Bill 2815 (ESSHB 2815) passed during the 2008 Supplemental Budget session was to provide recommendations on how Washington "agricultural lands and practices may participate voluntarily as an offset or other credit program in the regional multisector market-based system," of the Western Climate Initiative. Directional Recommendation 10 provides further clarification that the focus should be on encouraging the adoption of sustainable agriculture practices and technologies that store carbon,

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reduce GHG emissions and provide biomass feedstocks to substitute for fossil fuels.

Chad Kruger of the WSU Center for Sustaining Agriculture & Natural Resources (CSANR) and Kirk Cook from the Washington State Department of Agriculture (WSDA) are co-chairing the Agricultural Sector Work Group that includes farmers, agency and NGO personnel, and a team of technical advisors from WSU that will provide recommendations to the state. In 2008, the Ag Work Group will provide guidance to the Legislature on how to ensure that Washington agricultural producers have the best opportunity to participate in emerging carbon markets, such as the WCI. The Work Group will provide general recommendations about characteristics of the carbon market that are favorable and fair for our producers. In addition, the Work Group will provide guidance for how a carbon market should treat four specific types of agricultural offset projects:

- Agricultural carbon management (i.e., improved cropping systems, tillage technology, and use of organic amendments).
- Carbon management (including existing carbon) in "set-aside" conservation and grazing lands.
- Improved nutrient management.
- Anaerobic digestion of manure and food wastes.

The Ag Work Group has been meeting and working on these recommendations since June. All of the information from meetings and working documents are available on the Ag page of the 2008 CAT website. Interested members of industry and the community are welcome to attend the meetings and provide input directly in the meetings or through the email link on the CAT website. The work group will complete deliberations and forward recommendations to the 2008 CAT (Climate Action Team) for consideration by late October and inclusion in the 2008 CAT report for the legislature. While the ultimate outcome of the WCI process (and other carbon market mechanisms) is still uncertain, the work being done in Washington should enable our producers to be very well-positioned to take advantage of opportunities to be paid for providing carbon mitigation.

Food Safety Starts on the Farm: Produce and Pathogens, Factors Influencing Presence, Survival and Growth

Karen M. Killinger, WSU Department of Food Science

Several foodborne outbreaks in produce demonstrated that produce can serve as a vehicle for foodborne pathogens. This article is the second in a series and discusses produce foodborne outbreak trends, pathogen reservoirs and habitats, and potential mechanisms of pathogen transfer. It is important to remember that the overall presence of pathogens in produce is low. However, when pathogens are present, particularly Escherichia coli (E. coli) O157:H7, the risk of illness is high. It is not possible to completely eliminate risk from raw produce, highlighting the importance of addressing food safety from farm-to-table.

Pathogens and Produce

Produce can become contaminated with human pathogens from a variety of sources (water, manure, soil, animals, humans). Contamination can occur at any point from farm-to-table, including growing, harvesting, packing, processing, transportation, and food preparation (FDA, 2004). Produce associated foodborne outbreaks increased over the past 30 years (Ayers, 2006; Sivapalasingam et al., 2004) and produce is among the top three food categories involved in foodborne outbreaks. Produce outbreaks have been linked to pathogenic viruses, bacteria and parasites. The pathogens most commonly associated with produce include Norovirus, Escherichia coli (E. coli) O157:H7, and Salmonella. Other pathogens associated with produce include Hepatitis A, Campylobacter, Shigella, and the parasite, Cyclospora. From 1982-2002, produce was the second leading food product associated with outbreaks of E. coli O157:H7 (Rangel et al., 2002). Raw produce items commonly contaminated with pathogens include lettuce and leafy greens, melons, seed sprouts, berries, tomatoes, green onions, and carrots (Sivapalasingam et al., 2004). Lettuce and leafy green outbreaks occur most frequently. From 1995-2005, 26 outbreaks associated with lettuce and leafy greens have occurred, the most common pathogens linked to the outbreaks were Norovirus and E. coli O157:H7 (Ayers, 2006). Among leafy greens, lettuce has been the most common product associated with foodborne outbreaks.

A 2006 outbreak of E. coli O157:H7 in fresh spinach caused deliberation on food safety issues in the produce industry.

This summer an outbreak of Salmonella Saintpaul linked to jalapeno and serrano peppers occurred. Initially, certain types of tomatoes were also suspected of being involved in the outbreak based on initial epidemiological evidence. Although tomatoes were not associated with this particular outbreak, outbreaks associated with tomatoes have increased over the last decade. From 1998-2006, 17% of produce foodborne outbreaks were associated with tomatoes, primarily linked with Salmonella (Buchanan, 2006).

Once pathogens are introduced onto raw produce, removal is difficult because most food safety practices and interventions for raw produce can only reduce, but not completely eliminate pathogens. Pathogens such as E. coli O157:H7 and some Salmonella strains

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have a low infectious dose and the mere presence of these organisms is a food safety concern. Irradiation of fresh, iceberg lettuce and spinach has recently been approved by FDA as a treatment to reduce the presence of pathogens. Irradiated products are required to be labeled as "treated by irradiation/radiation" and have a radura logo (FDA, 2008)

Pathogen Reservoirs: Environmental Sources of Pathogens.

Every pathogen has unique and specific places where they tend to reside. For example, soil and vegetative matter are considered natural habitats for Listeria monocytogenes and Clostridium botulinum. E. coli O157:H7 can be harbored in the gastrointestinal tract of animals, particularly ruminants. Salmonella has an even wider host range including the gastrointestinal tracts of both warm and cold blooded animals. Therefore, direct and indirect fecal contamination can introduce pathogens to produce fields and raw agricultural products.

The reservoirs or natural habitats of foodborne pathogens subsequently transmit the organisms to other environmental sources. A variety of domestic and wild animals introduce foodborne pathogens to produce fields through direct fecal contamination. Indirect fecal contamination can also occur through several environmental sources. Water can serve as a vehicle for foodborne pathogens, and contaminated water sources were listed as a potential contributing factor in the 2006 E. coli O157:H7 outbreak associated with spinach (FDA, 2007). The use of raw manure or improperly composted manure used as a soil amendment also introduces pathogens into fields. Although soil may not be considered a natural habitat for E. coli O157:H7 and Salmonella, soil can become contaminated with pathogens from a variety of sources. Evidence of E. coli O157:H7 and Salmonella survival in contaminated soil for long periods of time (56 - 203 days) is increasing (Franz et al., 2005; Islam et al., 2004a; Islam, et al., 2004b). Finally, workers in the field and packing plant as well as consumers can also introduce pathogens if proper hygiene is not maintained. Washing hands with soap and water after using the toilet can significantly reduce risk of pathogen contamination.

The body of knowledge regarding mechanisms of produce contamination with foodborne pathogens and pathogen survival and growth on produce is increasing. However, most topics, such as pathogen uptake through root systems, will require more evidence to provide definitive answers. Outbreak investigations and knowledge of pathogen sources have provided insight into sources of produce contamination and opportunities for pathogen survival and growth throughout the food chain. For example, while the tomato skin serves as a microbial barrier, removing pathogens from the stem area is more difficult (NATTWG, 2006). Tissue damage and bruising offers opportunities for pathogen entry into the product. If proper processing interventions are not maintained, opportunities for cross-contamination exist.

Working Together

All sectors of the food chain must work together to limit opportunities for pathogen introduction from farm to table, and to reduce opportunities for pathogen survival and growth during packing, processing, transportation, and final preparation. In order to protect fields and raw agricultural products from pathogens, Good Agricultural Practices (GAPs) recommendations have been developed to address potential sources of pathogens in order to reduce risk on the farm. Future articles will discuss components of GAPs, such as water quality, composting and manure practices, worker hygiene, and harvest sanitation practices.

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Davenport Living Snowfence Demonstration

Gary Kuhn, USDA NRCS-Spokane Staff Forester, Donald Hanley, WSU Extension Forester, & Kevin Gehringer, Principle, Biometrics Northwest LLC, Redmond, WA

Snowfences, a specialized windbreak, divert drifting snow so it will accumulate in a predictable location and are common in areas subject to significant snowfall. Wind slows as it blows downwind through a semi-porous, tree-based snow fence, causing the snow in the air to drop and gather behind and among the trees, thus minimizing the amount blown onto roadways. Snow accumulation reduces the cost and time needed for road maintenance and snow plowing. Evergreen trees and shrubs make excellent snowfences due to their ability to reduce wind and trap snow, but they are not commonly used in the dry land wheat-growing areas of Eastern Washington. It is uncertain why more snowfence-type windbreaks are not used in this part of the state. Previous unsuccessful snowfence projects in eastern Washington can be attributed to poor planning, poor seedling stock, poor planting, and inadequate care. These failures helped create an attitude that windbreaks and living snowfences are too difficult to establish and grow in that area. However, we do know snowfences can be grown successfully utilizing new technologies and designs.

Successful snowfence demonstrations in southeastern Idaho and dry land test plantings near Ritzville, Washington, led to an interagency snowfence demonstration project on State Route 25, north of Davenport, Washington. The USDA National Agroforestry Center, in partnership with the USDA Natural Resource Conservation Service (NRCS), developed a living snowfence project with key state and local agencies. The project proposed to demonstrate new establishment technology and the value of living snowfences in this dry cropland region. Interagency meetings held in 2001 helped educate local agencies about living snowfence technology. Interagency teams formed to plan and install the project, and team members spent significant time identifying snowdrift sites on highways radiating out of Davenport, field reviewing potential sites, and securing landowner cooperation.

Methods

Snowfence Establishment

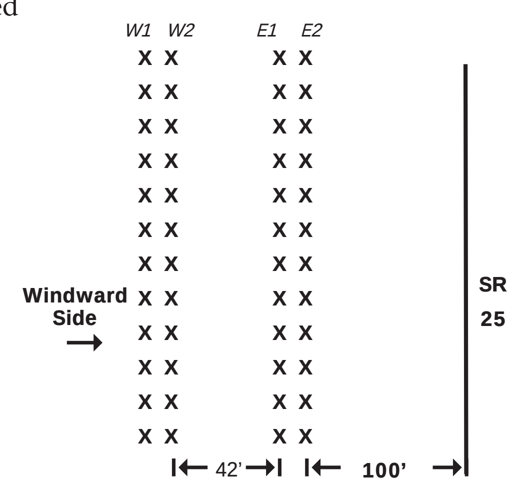
Sixteen snowdrift sites on Lincoln County state highways were identified by road maintenance personnel from Washington State Department of Transportation in Davenport. The project site, located on Highway 25 approximately 14 miles north of Davenport, is a highly traveled north/south road with a prevailing Westerly wind direction. Given this location, snow often clogs the road at this point. The landowner supported the project and cooperated throughout the planning and installation.

The dry cropland site soil consists of deep silt loam and receives an annual average of 16 inches of precipitation. Deep ripping prepared the locations of the tree rows before planting. Using high-quality 20 cubic inch container-grown Rocky Mountain juniper (Juniperus scopulorum) seedlings, a double, twin-row high-density design (Helwig, 1983) was selected since it minimizes the windbreak footprint and has proven successful elsewhere. The windward twin row was located 142 feet windward (west) of the road while the leeward twin row was located 42 from the windward row and 100 feet from the road. Tree-to-tree spacing within each row was 6.5 feet and the spacing between twin-rows was eight feet. The land between the twin row pairs was seeded with Durar hard fescue, a low growing bunchgrass, to provide site protection. Lumite® fabric mulch (a black woven polypropylene mat, Shaw Fabrics Inc. www.shawfabrics.com) was used for weed control and soil moisture conservation.

In April 2003, an interagency crew planted the trees and installed fabric mulch on each 880 feet long row. The entire demonstration site comprises 532 trees. Larger, high-quality Rocky Mountain juniper seedlings, grown at the University of Idaho seedling nursery, were used. Stock province is Bridger Select from the USDA NRCS Bridger MT Plant Materials Center. This larger evergreen stock has proven superior for establishment in Washington and Idaho's semi-arid regions.

Since we wanted not only to demonstrate a windbreak, but also to measure growth rates, we identified the twin-row locations in the installation as west (W) and east (E), with the east pair of rows being closer to the highway. Individual rows located within each pair of rows were identified as row one (1) and row two (2), with row two being closer to the highway, or east of row one for each location. Row E2, then, designates the row that is closest to Highway 25, and row W1 designates the row furthest from Highway 25. Each row was further subdivided into three equal segments, north, middle, and south, that were used to assess potential variation in tree development by north-south position within a row (Figure 1.) Results based on these identification criteria follow in this article. Annual tree height and crown measurements were taken

Figure 1: Snowfence Design



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starting in October 2003. Every fifth tree in each row was measured beginning with the northern-most tree and proceeding southward along the row. There were 27 trees sampled in each row, resulting in 108 possible measurements each year: 54 trees for each location, 27 trees for each row within a location, and 9 trees for each position within a row.

Experimental Results

While the project's primary purpose was to demonstrate the feasibility and functionality of living snowfences in Eastern Washington, we also documented how well the trees grew year-by-year and if there was any twin-row, row-to-row, or within-row differences. The metrics selected were total tree height, crown-width, and annual tree height and crown-width growth. Biometrics Northwest LLC of Redmond, Washington, conducted the statistical analysis. Five-year results are reported here.

Tree Growth Results

Tree Heights and Growth Rates

Mean height values ± one standard error were 22.4±0.42 inches, 40.1±0.58 inches, 54.1±0.71 inches, 69.4±0.88 inches, and 79.4±1.14 inches, respectively, for measurement years 2003 through 2007. (Table 1). As mean tree size increased, so did the variability in individual tree size, as indicated by increasing values for the standard errors over time. These tree growth values exceeded our expectations and we believe that windbreak functionality was achieved partially after the fifth-year. We expect increased functionality in the years ahead.

The observed annual mean height growth rates ± one standard error were 17.7±0.31 inches, 14.0±0.37 inches, 15.3±0.40 inches, and 10.0±0.48 inches, respectively, for growing years 2004 through 2007. In the last year of measurement, tree height growth has declined. See the section below addressing the potential implication of precipitation.

Tree Crown-width and Annual Crown-width Growth

The average crown-width was 50 inches, excellent in the five-year period. Annual mean crown-width growth-rates varied over the four growing years, with 2004 producing an intermediate value, 2005 and 2007 producing the smallest values, and 2006 producing the largest value. Differences in annual mean crown-width growth-rates among the measurement years were highly statistically significant. The observed annual mean crown width growth rates ± one standard error were 12.3±0.27 inches, 7.8±0.28 inches, 20.1±0.54 inches and -3.4±0.50 inches, respectively, for growing years 2004 through 2007. Crown closure has not occurred fully, but partial functionality has been achieved after five years. In retrospect, tree-to-tree spacing of 5.5

Table 1: Tree Growth Rates for Five Growing Seasons

Year	Mean Height (inches)		Annual Mean Height Growth Rates (inches)		Annual Mean Crown Width Growth Rates (inches)	
	Height	± one standard error	Height Growth Rate	± one standard error	Crown Width Growth Rate	± one standard error
2007	79.4	±0.42	10.0	±0.48	-3.4	±0.50
2006	69.4	±0.58	15.3	±0.40	20.1	±0.54
2005	54.1	±0.71	14.0	±0.37	7.8	±0.28
2004	40.1	±0.88	17.7	±0.31	2.3	±0.27
2003	22.4	±1.14				

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to six feet, instead of 6.5 feet, probably would have resulted in more complete windbreak functionality after five growing seasons.

Living snowfence capturing snow in January 2008.

Early analyses showed us that tree growth between the west and east twin-rows were significant, however after the fifth year, these differences disappeared. Twin-row differences were not statistically significant from each other, nor were the within-row differences. Crown width did retract during the fifth growing season. We suspect that as the trees start to compete for site resources, height growth is favored over crown width. Annual precipitation in this area was also well below normal during the fifth growing season, which may have influenced these results. The drought did not result in mortality.

Annual Growth Rates as Influenced by Precipitation

A cursory comparison of precipitation amounts measured in Davenport indicated a strong correspondence between precipitation and the magnitude of the growth rate (both height growth and crown-width growth). The 2005 and 2007 growing years produced smaller growth rates than the other two growing years. The 2006 growing year received the most precipitation and produced the second largest height growth rate and the largest crown-width growth-rate. This brief comparison was not intended to be definitive, but rather suggests a possible relationship between the growth rates observed and impacts from local climate.

Conclusions

Total height growth, crown width, and survival rates were remarkable, and can be attributed to proper planning, site preparation, quality nursery stock, proper planting, annual maintenance and the use of Lumite fabric mulch. If all of these conditions are met, living snowfences show great promise in Eastern Washington and will provide service for many years. Partial functionality of twin-row Rock Mountain juniper windbreaks can be expected after the fifth growing season.

We wish to stress the importance of using fabric mulch. In this demonstration, as well as those located elsewhere, the use of fabric much is mandatory for successful establishment and growth. At this site, we maintained 100% survival of the measured trees after five years and averaged over 6.5 feet in height with the mulch. While no control group was planted, we did measure eight trees planted at the end of each row without fabric mulch. These trees were half as tall and half as wide as those trees planted in the fabric.

Don Hanley (WSU Extension) and Mark Stannard (NRCS) measure tree heights after five years.

Next Steps

The successful establishment and growth of this planting resulted in living snowfence demonstrations near Anatone, Washington, and Athena, Oregon. We encourage landowners and professionals working with landowners to incorporate windbreaks into their conservation measures. It is well documented that windbreaks provide many environmental benefits for many decades before renovation would be required. We believe that their use in the arid areas of the west can help achieve these benefits.

Acknowledgements

Many professionals worked to make this demonstration successful. We wish to thank the following:

Bill and Kathy Reinbold, Landowners

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Lincoln County Conservation District

USDA-Natural Resources Conservation Service

*USDA National Agroforestry Cente*r

Washington Department of Fish and Game

Washington Department of Transportation

Washington State University Extension

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Announcements

Sustainable Agriculture Network Becomes SARE Outreach

The Sustainable Agriculture Network (SAN) has become SARE Outreach, although their mission remains the same: SARE's national outreach arm, producing practical, how-to information for farmers, ranchers and educators across America. In addition to our trademark line of books, bulletins, and other information products featuring SARE-funded research , they will increase conference sponsorship programs, further develop SARE's website, and work collaboratively with SARE's four regional offices and state coordinators on innovative outreach to SARE audiences.

There are new email addresses include for Andy Clark, Diana Friedman, Mandy Rodrigues, Andrew Zieminski, and ASCO Book Fulfillment (for questions about book orders).

FDA to Allow Irradiation of Spinach and Lettuce

ATTRA. In a Federal Register notice published August 22, the Food and Drug Administration announced regulations allowing the safe use of ionizing radiation for control of food-borne pathogens and extension of shelf-life, in fresh iceberg lettuce and fresh spinach. The MercuryNews.com reports on varied expert, industry, producer and consumer response to the ruling.

USDA Seeks Ag Business Contacts

The Department of Agriculture (USDA), Agricultural Marketing Service (AMS), Fruit and Vegetable Programs, Commodity Procurement Branch (CPB) purchases fruits, vegetables, nuts, beans and specialty crops for distribution to the National School Lunch Program and other domestic nutrition assistance programs. CPB procures these products year-round in institutional and household sized packaging.

CPB would like to request a list of agricultural businesses (small and large) that we may contact with regard to possible contracting opportunities with USDA. CPB is committed to providing contracting opportunities to a variety of business concerns especially small businesses. Annually, CPB has an established goal to increase the number of opportunities for all small businesses, but especially for: small disadvantaged businesses, women-owned small businesses, service-disabled veteran-owned small businesses, Hubzone small businesses and 8(a) firms. Our intent is to provide opportunities for all small businesses to grow their enterprises utilizing Federal contracting opportunities. As such, we are interested in expanding our vendor base.

Businesses interested in selling fruits and vegetables to USDA should visit the USDA webpage that describes how to sell to USDA and provides paperwork required to become an approved vendor.

We suggest potential vendors visit our website and read the commodity specifications and announcements for products they may be interested in selling to CPB, FV, and AMS. Announcements and Specifications can be found in the upper right of the page under I Want To.

AMS, FV awards contracts to large and small growers, packers and brokers across the country all year long. We hope you will consider providing us with a list of businesses so we may contact them in an effort to provide them with an opportunity to participate in our program.

Please contact Diana Blackwell with any questions at 202-720-8825 or contact Ron Ulibarri at 202-720-9191.

SARE Gets a New Mission and Logo

In celebration of SARE's first 20 years and in preparation for the next, SARE announces a new vision, mission statement, and logo!

View a short, fun animation of SARE's new logo.

SARE
Sustainable Agriculture Research & Education

SARE's vision is an enduring American agriculture of the highest quality: profitable, protecting the nation's land and water, and providing a rewarding way of life for farmers and ranchers whose quality products and operations sustain their communities and society.

SARE's wants to advance innovations that improve profitability, stewardship, and quality of life by investing in groundbreaking research and education.

For 20 years, SARE's contributions to sustainable agriculture have been driven by, and dependent upon, crucial partnerships with some of the nation's most innovative farmers and ranchers, land-grant universities, and other organizations.

We are looking forward to 20 more years of successful partnerships that advance profitability, stewardship, and quality of life through SARE's grants and outreach.

Peace Corps Seeks Environmental, Forestry, and Agriculture Volunteers

The Peace Corps is seeking environmental, forestry and agriculture volunteers to work with communities in the developing world to create and implement sustainable solutions. Environmental, forestry and agriculture Peace Corps Volunteers would live and work at a local, grassroots level in collaboration with host nation community leaders. Although one must be at least 18 years of age, and a U.S. citizen, there is no upper age limit to serve in the Peace Corps. The most in-demand candidates will have

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any combination of the following qualifications:

Associates degrees in forestry, watershed or natural resources management, environmental science or ecology.

Bachelor's or Master's degrees in forestry, watershed or natural resources management, environmental science, ecology, biology, botany, ornamental horticulture, geology, wildlife biology, wildlife management or recreation and park administration.

Experience in organizing and leading environmental activities, nursery management, forestry, tree planting, organic vegetable gardening, grant writing, biological surveying, landscaping, environmental education or farming.

Interested parties should apply now. For more information, visit the Peace Corps web site.

Tidbits

USDA Renewable Energy Grant Awards

USDA. Agriculture Secretary Ed Schafer today announced that 639 individuals and businesses in 43 states and the Virgin Islands have been selected to receive $35 million in grants and loan guarantees for renewable energy systems or to improve energy efficiency in farm and business operations. The grants and loan guarantees are being awarded through USDA Rural Development's Section 9006 Renewable Energy Systems and Energy Efficiency Improvements program. The program provides financial assistance to agricultural producers and rural small businesses to support renewable energy projects across a wide range of technologies encompassing biomass (including anaerobic digesters), geothermal, hydrogen, solar and wind energy. It also provides support for energy efficiency improvements, helping recipients reduce energy consumption and improve operations. Of the $35 million announced today, $27.5 million are grants and $7.4 million are guaranteed loans. Visit the Rural Development site for a recipient list.

Consumers Find Grass-Fed Beef Acceptable

eXtension. High feed-grain prices and the growing interest in "natural" foods have spurred both consumers and farmers to consider grass-fed beef. According to John Comerford, associate professor of dairy and animal science, a study showed that most consumers find the taste and tenderness of grass-fed beef acceptable in blind taste tests. He recommends that producers look for ways to interest more potential customers in grass-fed beef. The study found that some of the preconceived notions held by farmers about the physical type of the cattle and the length of the grazing season needed for high-quality grass-fed beef may not be true. "The results of the study showed that most consumer evaluations of the cooked meat were not influenced by frame sizes of the cattle, weight at harvest, range of grazing period from 120-180 days, and final fat composition of the carcass," Comerford explained.

Annual Survey of Agricultural Conservation Easements

AFT. AFT's annual survey of Local Purchase of Agricultural Conservation Easements (PACE) programs found that selected local programs spent $159 million to protect 46,974 agricultural acres in 2007. PACE programs compensate farmers and ranchers for permanently protecting their land from future development. To date, local programs have acquired 2,527 easements covering 326,457 acres.

AFT Assists Klickitat Co., WA

AFT. AFT is addressing the issue of impacts on communities when local farms and farmland are lost for Klickitat County Commission this fall by helping host a series of public meetings and researching potential tools and models from around the country for protecting agricultural land, improving the environment and expanding local foods. A report and recommendations will be provided to help the Commission ensure local food, strong communities and clean air and water for the future.

Committee Named for National Sustainable Agriculture Standard

ATTRA. Leonardo Academy, the neutral, third-party American National Standards Institute (ANSI)-accredited organization facilitating the development process of a national sustainable agriculture standard, has announced members selected for the Standards Committee that will drive the standard forward for ANSI approval. Due to an overwhelming number of applications to serve on the committee, the size of the standards committee was increased to 58 members.

Certified Organic Agriculture in Washington State

Organic farming is one of the fastest growing segments of U.S. agriculture. According to a recent USDA-ERS report, Washington State has the third highest number of certified organic operations of all states in the country. It is important to understand the characteristics, marketing strategies, information sources, needs, opinions, and challenges of the state's organic producers. Jessica Goldberger, Assistant Professor in the Department of Community and Rural Sociology and member of the Center for Sustaining Agriculture and Natural Resources (CSANR) Leadership Team at WSU, conducted a survey (in October - December 2007) of all certified organic producers in the state. Survey participants included producers certified by both the Washington State Department of Agriculture (WSDA) Organic Food Program and Oregon Tilth. The survey was implemented with the assistance of WSU's Social and Economic Sciences Research Center (SESRC). Over 350 producers completed the survey, resulting in a 56% response rate.

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Online Magazine Focuses on Sustainable Agriculture

Sustainable Farmer provides information to consumers and farmers on sustainable agriculture. Sustainable Farmer offers articles, videos, blogs and forums to serve the entire spectrum of sustainable farmers, from large-scale growers to families and communities seeking to raise more of their own food.

Farm Foundation Issues Food Price Report

ATTRA. What's Driving Food Prices?, a new study released by the Farm Foundation, identifies three forces driving food price increases: global changes in production and consumption of key commodities, the depreciation of the U.S. dollar, and growth in the biofuel production. Understanding the complex and multiple factors influencing food prices today is important as future policy options are debated. Read the full report online.

SARE Releases New Publication

SARE. The Sustainable Agriculture Research and Education program released a publication, SARE 20/20: Celebrating Our First 20 Years, Envisioning the Next. This 20th anniversary edition chronicles 20 years of agricultural innovation, starting with SARE's formation in 1988, including stories of farmers, ranchers, researchers and educators working across America to develop and implement sustainable marketing and production practices.

Study Compares Fuel Efficiency in Local Food Distribution

ATTRA. A new study from the Leopold Center for Sustainable Agriculture looked at which transportation option consumed less fuel and emitted less carbon dioxide: farmer delivery or customer pick-up of food products for an Iowa Community Supported Agriculture (CSA) enterprise. Findings are outlined in the report, *Assessing fuel efficiency and CO2 emissions of two local food distribution options in Iowa.*

Urban Farm Trend Brings Food to Cities

ATTRA. In cities across the country, vacant lots are becoming community gardens and thriving urban farms producing fresh food for city dwellers. These plots provide significant incomes for crop producers, according to a story in The New York Times. Some producers grow hard-to-find specialty crops to serve immigrant markets while others grow high-value vegetable crops that help them derive income from even small plots. A variety of non-profit organizations in cities coast to coast help secure urban land to farm and train people to grow food on it.

Resources

Farm Bill Comparison

ATTRA. The USDA's Economic Research Service has a side-by-side comparison of the new farm bill with previous legislation. Summarized but substantive, it offers a time-saving reference to farm bill provisions. In addition to key provisions and details by Title, the side-by-side includes links to related ERS publications and to analyses of previous farm acts. The Food, Conservation, and Energy Act of 2008 (Farm Bill), enacted into law in June 2008, will govern the bulk of Federal agriculture and related programs for the next 5 years.

Eat Well Guide

ATTRA. Cultivating the Web, a new publication from Eat Well Guide (EWG), shows how digital tools are being used to do everything from support local farmers to lobby giant players in the food industry, as online communities reject industrial food. EWG distributed 20,000 copies of Cultivating the Web at Slow Food Nation, the four-day gathering held on the Labor Day weekend in San Francisco.

How to Identify, Scout, and Control Insect Pests in Vegetable Crops

The Extension publication, *How to Identify, Scout, and Control Insect Pests in Vegetable Crops* (EC 1626-E), is now available online. By Silvia Rondon, George Clough, and Mary Corp.

New Tool Tracks Produce

Leopold Center. Consumers who want to know where their apple or bunch of broccoli might have been grown can check out a new online resource that tracks the origins of 95 different fresh fruits and vegetables typically sold in U.S. supermarkets. Besides showing product origins, the tool allows the user to see which state is the leading domestic producer of these crops. The new web site tool, Where do your fresh fruits and vegetables come from?, was developed by the Leopold Center for Sustainable Agriculture and the Center for Transportation Research and Education at Iowa State University.

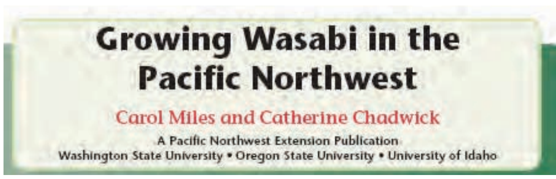
New Guide Helps Identify Beneficial Insects

A new guide has been published by the Oregon State University Extension Service and Oregon Tilth called *A Pocket Guide – Common Natural Enemies of Crop and Garden Pests in the Pacific Northwest*. The publication includes macroscopic photos of many types of natural predators in their various life stages, along with identification and observation tips. OSU's Integrated Plant Protection Center (IPPC), has been working with

Pacific Northwest growers to help them foster beneficial invertebrate predators, parasitoid insects and native pollinators on their farms. These tiny creatures can have a big impact on managing crop pests such as aphids, cutworms, earworms, slugs, leaf miners, spider mites and earwigs.

Growing Wasabi in the PNW

This new WSU Extension publication examines the potential for growing Wasabi in the Pacific Northwest. A perennial plant native to Japan and grown for its unique enlarged stem (sometime called a 'root' or 'rhizome'), Wasabi's specific growing requirements are well adapted to the Pacific Northwest. This publication provides information on cultivar selection, propagation, planting, harvest, and pest and disease management. Other links about Wasabi can also be found.


Growing Wasabi in the Pacific Northwest
Carol Miles and Catherine Chadwick
A Pacific Northwest Extension Publication
Washington State University • Oregon State University • University of Idaho

New Study Finds Consumers Will Pay More for Local Foods

ATTRA. New research suggests that the average supermarket shopper is willing to pay a premium price for locally produced foods. The study also showed that shoppers at farm markets are willing to pay almost twice as much as retail grocery shoppers for the same locally produced foods. Both kinds of shoppers also will pay more for guaranteed fresh produce and tend to favor buying food produced by small farms over what they perceive as corporate operations, according to the study. The study, conducted by Ohio State University researchers, is published in the May issue of the American Journal of Agricultural Economics.

Events

WSU BIOAg Symposium Features State of the State's Organic Agriculture Sector

The State of Organic Agriculture in Washington will be the topic of the keynote presentation at the Washington State University symposium on its biologically intensive and organic agriculture program, or BIOAg.

The symposium will be held on Tuesday, October 28, in the Junior Ballroom of the renovated Compton Union Building on WSU's Pullman campus. The symposium will begin at 10:10 am with a session of poster presentations by faculty involved in BIOAg research projects. The symposium is open to the public and free of charge. The agenda can be found at http://css.wsu.edu/bioag

The keynote presentation will begin with an introduction by John Reganold, Regents Professor of Soil Science, who spearheaded the establishment of the nation's first organic agriculture major at WSU. That will be followed by a presentation by Jessica Goldberger, assistant professor of Community and Rural Sociology, and David Granatstein, WSU sustainable agriculture specialist. Goldberger recently completed the first comprehensive statewide survey of Washington's organic producers and Granatstein is lead author of WSU's annual state organic profile.

The keynote will be followed by an address by WSU Vice President for Extension and Economic Development John Gardner. His topic will be "Engaging the University in Sustainability Research, Education and Extension in the 21st Century."

Food Safety and Risk Management for Farmers

November 7, 2008, at the Best Western Lakeway Inn and Convention Center, Bellingham, WA. This Washington Tilth Symposium will cover food safety and good agricultural practices in response to recent outbreaks associated with produce. This symposium will provide specific information regarding on-farm produce food safety (Good Agricultural Practices, GAPs tract) and risk management involving value-added dairy products (Dairy Tract).

Registration, hotel information, and agenda can be found on-line with Tilth. For questions, on GAPS, contact Karen Killinger (WSU Food Safety Extension Specialist) at 509-335-2970. For dairy, contact Fred Berman (WSDA Small Farm Prog. Coordinator) at 360-676-2059.

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