

Program Title: Improving Commercial Vegetable Production and Management.Introduction

Agricultural operations in Portage County are becoming larger in scale and more intensive. Irrigated vegetable production provides substantial benefits to the local economy (Portage County Agriculture: Value and Economic Impact. 2011). Portage County leads the state in the production of potatoes, snap beans, sweet corn, and cucumbers and is the state's second largest producer of green peas. Portage County ranks twelfth among counties nationwide for all vegetables harvested. Twenty-four percent of Portage County's cropland is dedicated to vegetable production annually, of which 94 percent is irrigated. Most of the irrigated land is sandy, creating an environmentally sensitive situation due to increased potential for chemicals and fertilizers leaching into the groundwater.

County residents identified maintaining productive agricultural regions and protection of the county's natural resources as priority issues in a countywide needs assessment survey completed by the UW-Extension Central District in 2007. An agricultural survey of Portage County private pesticide applicator trainees from 2007 and 2008 indicated priority issues for vegetable growers are: cost-of-production, appropriate fertilizer rates, and irrigation scheduling (**Exhibit 17**). On-farm visits in 2008 with ten vegetable growers that produce 50,800 acres of vegetables annually (38 percent of all vegetable acres in Central Wisconsin) and four area agribusinesses confirmed the above high priority issues of input costs, soil fertility and crop nutrient needs, irrigation management, and water quantity and quality. I chose the following programming priorities; soil fertility and vegetable crop nutrient needs; and irrigation management, water quantity and water quality. There is a need for environmentally sustainable agricultural practices promoting integrated crop management on farms to prevent degradation of groundwater and other natural resources in the County. My programming reaches beyond the County lines to Adams, Green Lake, Juneau, Marquette, Waushara, and Wood Counties as the commercial vegetable production specialist for the Central Wisconsin Agriculture Specialization (CWAS) team.

Soil Fertility and Crop Nutrient Needs

Many key agricultural input prices rose dramatically between 2006 and 2007 and continued to rise at unprecedented rates into fall 2008. Diesel fuel prices rose almost 40 percent from 2006 to 2007 and then doubled from fall 2007 to fall 2008. With record high oil prices and increasing global demand, fertilizer prices skyrocketed along with other crop production inputs. This situation left growers asking questions such as: How can I control input costs? Can I cut back on my fertilizer application rates and still be profitable? Are there alternatives to high priced commercial fertilizers? Are there ways to better utilize soil and applied nutrients for more efficient crop production? In response, I organized and facilitated a Soil Fertility Management Strategies Workshop for potato and vegetable growers in November 2008. Fifty-two potato and vegetable growers and crop consultants attended. Leading potato and vegetable researchers from the University of Wisconsin (UW) - Madison, UW-Extension, the University of Minnesota, and industry professionals were brought together to address cost-of-production issues. Topics included: best management practices for nitrogen, phosphorous and potassium, a global fertilizer outlook, a look at input prices, benefits of using cover crops in vegetable cropping systems, nutrient management plans, and nutrient removal rates and replacement costs. I developed and presented information on nutrient removal rates and replacement costs for vegetable crops (**Exhibit 16**), which I also presented to 30 attendees at the Central Wisconsin Processing Crops Meeting in March of 2009. My presentation focused on plant nutrient cycling on commercial vegetable growing operations, how nitrogen, phosphorous, and potassium are exported from the farm in the produce being sold and what that costs growers. Presentations were evaluated on topic understanding before and after using a Likert scale of none, little, moderate, a lot, and complete (**Exhibit 18**). Evaluations (n=22) showed increased knowledge of all subject areas from all speakers. Before my presentation, 35 percent indicated none or little understanding of nutrient removal rates, 60 percent moderate to a lot, and 5 percent complete. After my presentation, 90 percent indicated moderate to a lot, and 5 percent complete. Participant comments about the workshop included: timely information with good economic updates, very good spectrum of information, good workshop with informative relevant presentations, good refresher updates, very well organized. I developed a spreadsheet for vegetable growers to calculate replacement costs for nutrients removed and exported from their farm (**Exhibit 19**). This spreadsheet is available on my Portage County UW-Extension, Potato and Vegetable Resources webpage <http://portage.uwex.edu/agriculture/potato-vegetable-resources/>. Kathrin Olson-Rutz, Research Associate, Department of Land Resources and Environmental Sciences, Montana State University referenced my slide presentation and spreadsheet in Home Garden Soil Testing and Fertilizer Guidelines MT200705AG she revised 5/10 http://landresources.montana.edu/soilfertility/PDFbyformat/publicationpercent20pdfs/Home_Garden_Soil_TestingMT200705AG_revision_2011.pdf (744 downloads October 2010 to October 2011).

Sweet Corn Yield Response to Nitrogen Fertilizer Application Rates

Wisconsin ranks second in the nation for production of sweet corn for processing, growing over 88,000 acres annually, 24 percent of the total United States acreage (USDA 2008). UW publication A2809, Nutrient Application Guidelines for Field, Vegetable, and Fruit Crops in Wisconsin recommends applying 70 to 150 lbs. of nitrogen per acre (N/ac), depending on soil organic matter content, to grow two to ten ton of sweet corn per acre. Current production practices have growers applying 200 pounds or more N/ac on irrigated sweet corn. Mike Novak, Company Farm Supervisor for Seneca Foods Corporation, a Central Wisconsin vegetable grower and processor, stated that the usual N application rate is 50 lbs. more per acre than UW recommendations in A2809. He said “vegetable growers believe that 150 lbs. N/ac will not be enough to meet today’s yield goals of 8 to 10 tons of sweet corn per acre”. Mike manages the production of about one third of the sweet corn in Central Wisconsin annually.

With today’s new hybrids and better fertilizer application management, the potential exists for better crop N use efficiency which may allow growers to reach their yield goals using lower rates of N fertilization. I lead an investigation working with Matt Ruark, UW-Madison Soil Scientist; Don Genrich, Adams County Agriculture Agent; Eric Hurley, Portage County Land Conservation; and Mike Novak, Seneca Foods Corporation, setting up on-farm field trials looking at sweet corn response to N fertilizer application rates. Trials were set up at three locations in Waushara County and one in Adams County; four planting dates, April through June in 2009, 2010, and 2011; six nitrogen levels from 100 to 230 lbs. N/ac; and four replications per field using a randomized complete block design. I coordinated the project, directing field layout, fertilizer application, harvesting, and data collection and did the data analysis.

I presented preliminary results to 75 vegetable crop consultants and processors at the Midwest Food Processors-Processing Crops Conference in Rochester, MN in December 2009 and 35 growers, crop consultants and processors at the Central Wisconsin Processing Crops Meeting in March 2010. After two years of data collection, I analyzed the data, developed a Power Point and presented the results to 50 attendees at the Central Wisconsin Processing Crops Meeting in March 2011 (**Exhibit 12**) and 40 attendees at a Fresh Market Vegetable Meeting in Dalton, WI. I received a communication award for this presentation from the Wisconsin Association of County Agriculture Agents in 2011. Evaluation results for my presentation at the Central Wisconsin Processing Crops Meeting (n=27) indicate a 19 percent increase in knowledge (**Exhibit 20**), with the quality of that presentation at 3.9 on a scale of one to five, with five being excellent. When attendees were asked what they liked about the program, several comments referred directly to my research and presentation: nitrogen and groundwater related topics, nitrogen trials on sweet corn, and N use in sweet corn. One person indicated learning the applied study results is valuable. Another said “the research presented was very interesting and potentially useful.” When asked how likely it is that they will use information learned from this meeting, 56 percent of the attendees indicated very likely and 44 percent somewhat likely. Attendance at the Central Wisconsin Processing Crops meeting increased from about 25 in 2007 to over 50 in 2011 indicative of the importance of this meeting to growers, crop consultants, and processors.

Two years of trial results indicate: Sweet corn yields of 10 tons per acre can be achieved with only 155 lbs. N/ac (as recommended in A2809). There was no statistical advantage to applying more than 155 lbs. N/ac at 83 percent of the sites. There is a low probability of a yield gain by increasing N application rates above 155 lbs./ac. I coauthored an article, “*Field-Scale Evaluation of Sweet Corn Response to Nitrogen Fertilizer Application Rates on Wisconsin’s Central Sands: Results After Two Years of Data Collection*” that was published in the Badger Common “Tater in May of 2011 (circulation 4,100) (**Exhibit 1**) and published in the Wisconsin Crop Manager, April 21, 2011 (circulation 1,350). Joan Viney from the Wisconsin Crop Production Association reprinted it in the summer edition of their magazine “Industry News Quarterly”, summer 2011 (circulation 1,470). Follow up phone surveys conducted by my office assistant in October 2011, indicated that as a result of my research; four of seven growers contacted, accounting for approximately half of all sweet corn acres grown in Central Wisconsin, have reduced the amount of N they apply to their sweet corn by 10 to 25 lbs./ac (**Exhibit 21**). Of the other three, one is already down to that rate or lower and two are thinking about reducing their N fertilizer application rate. If more data indicate producers can reach their sweet corn yield goals using less N/ac, six of seven growers said they are very likely to somewhat likely to consider using less N. One hundred percent of crop consultants surveyed echoed that statement.

On the 88,000 acres of sweet corn grown annually in Wisconsin, a reduction of 25 lbs. of applied N/ac amounts to 2.2 million pounds less N applied by growers in the state of Wisconsin at a potential savings of \$1.1 million for area vegetable growers. Reducing N applied to sweet corn also reduces the potential for excess nitrates leaching into our groundwater reducing environmental impacts of sweet corn production. This local research is a rare win-win for growers and the environment, saving growers on production costs and protecting our area’s sensitive water resource. Over 70 percent of growers and 100 percent of crop consultants surveyed said groundwater quality will be a very important issue in the future. Additional comments: Ken is doing a good job bringing us new ideas, these matters should have been brought up years ago; keep working on groundwater issues; increasing grower awareness and understanding of issues will help finding and adopting solutions; doing excellent work – hope you will expand on this research.

After the 2011 growing season, I will analyze all the sweet corn N fertilizer rate study data, write and publish journal articles, and give presentations to growers and processors at the Midwest Food Processors Association annual conference and

Sweet Corn Yield Response to Nitrogen Fertilizer Application Rates (continued)

other vegetable grower meetings throughout Central Wisconsin. These results will add to information from small-plot research being conducted at this time by A.J. Bussan, Matt Ruark, and Bill Tracey, researchers from UW-Madison, to quantify the response of sweet corn hybrids to different N fertility rates and evaluate the interaction of crop density and N fertilizer rate on sweet corn yield. Results will help to confirm or rebuke vegetable grower's belief that 150 lbs. N/ac is not enough to meet today's sweet corn yield goals. This is important to avoid over fertilization and the increased potential for nitrates leaching into the groundwater.

Enhancing Vegetable Production and Quality

Potato bruising is a serious problem in the potato industry. Bruising is estimated to cost the U.S. potato industry at least \$298 million annually (Thornton and Bohl, University of Idaho Cooperative Extension System Agricultural Experiment Station BUL 725 1998). Most of this cost is to the grower in the form of lower prices, reduced demand, and increased storage losses. Potatoes may be bruised any time they are handled, especially at harvest. As we approached the 2010 potato harvest season, I authored an article "*Reducing Potato Bruise Damage at Harvest.*" This article was published in the UW Vegetable Crop Update #11 July 23, 2010 (circulation 900 +) (**Exhibit 22**) and in the July 2010 issue of the CWAS newsletter (distributed to 3,000 growers, crop consultants, and agribusinesses in the 7 counties) to remind growers of the importance of taking measures to reduce bruising to increase the value of their product thus increasing profitability.

Between 2007 and 2011, I authored the following additional articles published in the quarterly CWAS team newsletter to inform commercial vegetable growers about current issues related to vegetable production:

- *Snap Bean Halo Blight Identified in Western Wisconsin*
- *Be on the Lookout For Volunteer Potatoes*
- *Harvest Concerns from Heavy Rains Across Central Wisconsin*
- *Scout Tomato and Potato Plants for Late Blight in Your Gardens and Fields*
- *Putting Late Blight to Rest*
- *Field-Scale Evaluation of Sweet Corn Response to Nitrogen Fertilizer Application Rates on Wisconsin's Central Sands: Results After Two Years of Data Collection*
- *Reducing Nutrient Loss Using Perennial Cover Crops in Vegetable Production Systems*
- *Degree Days and Pest Management.*

With my expertise in vegetable crop production, I was asked to teach the vegetable crop diseases lecture for the University of Wisconsin – Stevens Point (UWSP) Natural Resources 336/Biology 498 class *Integrated Pest Management (IPM) Crop Scout Workshop*. Completion of this workshop prepares students to become crop scouts and certified crop advisors (CCA). Crop scouts walk the farm fields of the majority of our vegetable growers and many of our larger farms in Central Wisconsin playing a very important role in the profitability of their operations. One crop scout is often responsible for 3,000 or more acres. Scouts help protect crop yield by providing regular, field-specific assessments of environmental conditions, beneficial insects, pest insects, weed and disease pressure and crop performance. This information guides the appropriate selection and application of nutrient and crop protection products. It is important to avoid over application of chemicals and fertilizers for both economic and environmental reasons. I developed a presentation with Walt Stevenson, UW-Madison Plant Pathologist, on vegetable crop diseases that I presented to the 2008 and 2009 spring semester classes. The IPM class size ranges from 20 to 25 students annually. In 2011, I was asked to teach a portion of the class again and to talk about pest control methods used by our growers. I developed and presented a Power Point, "*Pest Management Tactics*" (**Exhibit 14**). Assistant Professor, Meghan Buckley, lead instructor for the class reports "some UWSP students pass the CCA exam right out of school and many develop successful careers in crop consulting."

Irrigation Management, Water Quantity, and Water Quality Issues

Wisconsin crop producers irrigate 377,680 acres of land for harvested crops. Central Wisconsin, the heart of processed vegetable country irrigates 196,274 acres most of which is under vegetable production. Ninety-four percent, 91,640 acres, of Portage County's vegetable acreage is irrigated. Most of this irrigated ground in Central Wisconsin is sandy, creating increased potential for groundwater contamination when crops are over watered. Fifty percent of wells tested for atrazine (~1,200) in Portage County had atrazine detects, with 1.5 percent of these above the health standard, and 30 percent of approximately 4,000 wells tested for nitrate nitrogen had concentrations above the health standard (Ray Schmidt – Portage County Water Quality Specialist, personal communication).

Irrigation improves crop yield and quality. Reduced moisture stress leads to increased dry matter production, resulting in increased size and/or numbers of tubers, roots, pods, or fruit (UW-Extension BioIPM Potato Workbook. Sexon and Connell. 2004). Crop quality improvements include, uniform crop maturity, well filled bean and pea pods and corn ears, and a reduction of misshapen potato tubers and carrot roots. Good irrigation management often plays a role in disease management

Irrigation Management, Water Quantity, and Water Quality Issues (continued)

as well. Managing soil moisture at potato harvest helps control shatter, impact, and black spot bruises and reduces storage problems from tuber decay. Proper soil moisture levels are critical to successful potato production from planting to harvest.

With soil moisture management so important to vegetable yield and quality, water quality (controlling nutrient and pesticide leaching to the groundwater) and water quantity, I worked with Bill Bland, Birl Lowery, and John Panuska, UW-Madison specialists to field-test the effectiveness of using portable electronic soil moisture sensors to manage crop irrigation. I recruited three potato growers in Portage and Adams Counties to assist with the project. They collected daily soil volumetric water content data using Hydrosense portable soil moisture sensors, and recorded the amounts and times irrigation water was applied. Objectives were; to have growers get hands-on experience using electronic soil moisture sensors to compare estimating soil moisture by feel and appearance with determining soil moisture using an electronic soil moisture sensor and to look at possible water savings from using electronic soil moisture sensors. Based on data collected, I prepared a presentation titled “*Irrigation Management Using Portable Soil Moisture Probes*” (**Exhibit 15**). I gave this presentation to 35 potato growers and crop consultants at the state-wide UW-Extension and Wisconsin Potato and Vegetable Growers Association Grower Education Conference February 2-4, 2010. To assess impacts of the project on participating growers I conducted a follow up phone survey in 2011. Growers agreed that managing soil moisture is very important to extremely important to their businesses. They said benefits to good soil moisture management are: disease management and control, better yields, maximizing production, less pollution, less nutrient leaching, and more efficient use of water. All growers felt they could better manage their soil moisture with electronic moisture sensors. They also felt moisture sensors can help them use less water. Following is what they said:

- Tended to use less water, more efficient use of water
- Actually needed to use more at times and less at others (providing adequate water at crucial times can boost yields and quality)
- Helps to better manage watering to crop usage, preventing over watering and reducing leaching. Using soil moisture sensors unifies subjective choices, everyone is on the same page allowing others to make the same moisture judgment call as anyone else.
- Moisture sensors may be more useful later in the growing season and on heavier soils. Sandy soils require more frequent and regular watering naturally.

In summary, grower participants learned that using moisture sensors can help better manage soil moisture but do not necessarily save water. However, better management leads to fewer leaching events reducing the negative environmental effects of crop production. I wrote an article for the CWAS newsletter, “*Irrigation Management Using Portable Soil Moisture Sensors*,” April, 2010 (**Exhibit 4**) to inform other growers about the benefits of using a “checkbook”-based irrigation management system along with electronic soil moisture sensors to ground truth their system helping them make better decisions on when and how much irrigation water to apply. This article also explained the different types of sensors available and the estimated costs of each. Other irrigation related newsletter articles I authored include: “*Fine Tune Your Irrigation System*” and “*Energy Saving Opportunities for Irrigation Systems*.”

I developed a presentation “*Irrigation for Small-Scale Market Growers*” which I presented at two Fresh Market Vegetable Grower workshops in Central Wisconsin to 25 attendees in March 2010 (**Exhibit 13**). I also gave this presentation to 20 participants of a beginning farmer workshop put on by the Central Rivers Farmshed, a Stevens Point, WI local foods group in 2010 and 2011. Fresh market vegetable growers and beginning farmers were educated about irrigation management and water conservation.

Because irrigation water is vital to much of agriculture and the agricultural processing industry in Portage County, I developed a presentation, “*Portage County Agribusiness*” (**Exhibit 9**) that I present annually to the Leadership Portage County group of about 25 participants creating awareness of the importance of agriculture and water to a broader audience. This is a diverse group in occupation, age, sex, and place of residence. Participants acquire leadership skills plus an in-depth knowledge of community issues to prepare them for greater leadership roles in their workplace and community.

I serve on the Central Wisconsin Groundwater Task Force — a group comprised of over 30 concerned citizens, farmers, industry leaders, municipalities, and scientists. The Task Force meets each month to discuss, fund and implement a range of practices that will improve the efficiency of water use. Questions surfaced about the value of water. Jennifer Stewart, Portage County Community Development Agent and I, with the help of Steve Deller, UW-Madison Department of Agricultural and Applied Economics researched the economics of water dependent industries in Portage County to respond to the questions about water’s value to the area. I worked with Stewart organizing a workgroup consisting of representatives from production agriculture, agribusiness, local paper mills, municipalities, and economic development organizations to frame the study and gather data. I co-authored and published a paper, “*Economics of Water Dependent Industries in Portage County*” which is posted on the Ag and Applied Economics website as Staff Paper No. 555 <http://www.aae.wisc.edu/pubs/sps/pdf/stpap555.pdf> (**Exhibit 3**) to explain the study results. I developed a presentation “*The Role of Water in the Economy of Central Wisconsin*” (**Exhibit 5**) which I co-presented at a water forum sponsored by the

Irrigation Management, Water Quantity, and Water Quality Issues (continued)

League-of-Women Voters. One hundred fifty area residents attended including local legislators, public agencies, and agribusiness leaders. Attendees gained knowledge of the local economy and the important role water plays. The County Executive for Portage County was in attendance and pledged to include \$10,000 in the next budget to work toward solutions to the water quantity concerns after learning how important having an adequate water supply is to the economy of the County. Portage County's water dependent industries account for 19 percent of employment and 32 percent of industry sales in the County. I also gave this presentation to the Portage County Groundwater Citizens Advisory Committee, consisting of one representative appointed from each of the 28 municipalities in Portage County. The committee's role is to gather views and concerns regarding groundwater protection and management in Portage County from individual citizens and municipal governing boards and present recommendations to the Planning and Zoning Committee for consideration by the County Board. I designed a poster describing the economic impact model we used in doing the research for this paper that I shared with colleagues at the 2011 JCEP conference. Executive summaries of the paper were distributed at all the above presentations with the web address for accessing the entire paper.

Throughout the process of gathering stakeholder information for the economics of water study and presenting findings to a wide array of local citizens, discussions brought out time after time the need to get representatives from all sides of the water quantity issue together to work toward solutions to the water shortage problem. Without timely development of a broad platform that gathers all stakeholders together to examine and address issues related to water use, the potential for conflict between those who depend on these resources is likely to intensify, adversely affecting the economy of Central Wisconsin. This prompted me to write a Wisconsin Sustainable Agriculture Research and Education mini-grant to bring stakeholders together at a nonthreatening location to begin the process of developing solutions that everyone can take ownership of (**Exhibit 23**). I was awarded \$2,000 for this project. Funding was used to bring a unique coalition of basic, applied, and Extension scientists together with the expertise and experience of farmers, vegetable processors, industry, and local communities for a one day conference in Central Wisconsin in August 2011. The conference brought together 25 invited representatives, equal numbers from all areas of interest, to begin an open discussion on how to protect the area's water supply for everyone in the future. Also in attendance were 35 scientists and field experts to answer questions as needed. After much good, open discussion from all sides of the issue, consensus was reached by stakeholders that collaboration is key and they agreed to meet again. I worked with several specialists from UW-Madison to hold a science of water and agriculture field tour at the Hancock Research Station, the day prior to this gathering, to inform Central Wisconsin stakeholders about how agriculture is currently addressing groundwater issues. I developed a flipchart presentation and gave a talk about my perennial cover crop project to the 75 people in attendance.

I designed this on-farm research project, "*Using Perennial Cover Crops in Commercial Vegetable Production Systems*" (**Exhibit 11**) for the U.S. Department of Agriculture (USDA)/ Natural Resources Conservation Services (NRCS), Conservation Stewardship Program (CSP). CSP is a voluntary program that encourages agricultural producers to address soil, water, air, and related natural resources concerns by undertaking additional conservation activities and improving and maintaining existing conservation practices. In 2011, 590 Wisconsin farmers and forest landowners enrolled in CSP and received an average payment of \$7,244 per participant in return for improving conservation practices on their operation. Payment is based on the type and number of program enhancement credits a participant is involved with. Participating in my project qualifies for enhancement credits. My project stems from small plot research at the Hancock Agriculture Research Station on using perennial legumes inter-seeded in green beans and sweet corn. Legumes are known to scavenge N and other nutrients left behind by crops after harvest and release them for the growing crop the following season. Legumes can provide N credits of 80 to 110 lbs./ac for the growing vegetable crop reducing the need to apply commercial nitrogen and possibly in turn reduce nitrates entering the groundwater. Currently I have three growers participating in on-farm strip trials and one coming on board in spring of 2012. These trials will be used to collect production data and as demonstration plots for field days to educate growers about this new cropping system. Potential benefits of participation in the project include, saving money on purchased N, helping improve groundwater quality through use of slow-release organic N from legumes versus commercial fertilizers, and getting first-hand experience with a new innovative, sustainable vegetable production system.

Preliminary results from my cover crops project and my sweet corn study served as background information helping Dr. A.J. Bussan, vegetable crop production specialist from UW-Madison get a USDA/NRCS \$700,000 Conservation Innovation Grant "Preserving Water Resources in Central Wisconsin". I will be coordinating on-farm activities for two of the four objectives of the grant, implementing perennial cover crops in vegetable cropping systems and a new irrigation scheduling program.

Responding to Unforeseen Events

Vegetable growers experienced one of the coolest growing seasons on record along with sporadic rainfall throughout Central Wisconsin in 2009. This extended cool wet weather was ideal for proliferation of many plant diseases. Late blight, a fungal-like disease caused by a pathogen *Phytophthora infestans*, is one of the most devastating diseases of potato and tomato world-wide and the cause of the great Irish Potato Famine, showed up in Wisconsin in late July. It reappeared after a seven

Responding to Unforeseen Events (continued)

year absence and was confirmed on tomatoes in 21 Wisconsin counties. This is a very rapidly spreading and potentially disastrous tomato and potato disease requiring a rapid response to minimize the spread. At the first report of late blight in Wisconsin on garden tomatoes, I immediately wrote an article on late blight; how to identify the disease, and how to differentiate it from some commonly occurring look-alikes. Unlike other information available, this article gets right to the important point of how to identify the disease which is a critical first step in reducing its spread. I distributed this article to the UW-Extension Ag All email list (**Exhibit 24**). Brian Hudelson, UW-Madison plant pathologist, confirmed the value of the article. I utilized my contacts in media to more widely disseminate this information by sending my article to State agriculture newspapers and Central Wisconsin's local papers. After reading my article, The Country Today and Stevens Point Journal interviewed me prior to writing articles for publication (**Exhibit 25**). Late blight was also confirmed on potatoes in Dane, Columbia, Portage, and Marathon counties. When late blight was found on potatoes, I forwarded the new information to the newspapers and was subsequently interviewed by reporter Cara Spoto of the Stevens Point Journal. I also utilized my contacts with local TV news media to disseminate information and create awareness about late blight. I was interviewed by two Wausau TV stations, Channels 7 and 9 with interviews airing during their evening and 10:00 p.m. news casts (about 14,000 viewers for each station and each news cast). I took several photos from a local late blight outbreak and sent them to all county agriculture agents along with my article sent out previously (**Exhibit 24**) to help them correctly identify the disease. Joe Bollman, Jason Fischbach, and Vijai Pandian, UW-Extension agents, responded to the photos and article indicating they were useful and that they would be using them in their efforts to control the spread of late blight. I wrote another article, "*Check Tomato and Potato Plants for Late Blight In Your Fields and Gardens*" for the CWAS newsletter (**Exhibit 26**) to further advance awareness of this potentially devastating disease and reduce its spread to more commercial potato fields in Central Wisconsin's potato country. It is extremely important for homeowners to be able to detect late blight and know what to do if found in their gardens. A single potato plant unprotected and undetected can produce 100,000 to 300,000 spores. Each spore can move to other vulnerable plants within a 40 mile radius. This disease is capable of completely destroying a field in 3 weeks. Immediate response is needed to protect the large economically important 62,500 acres of potatoes in Wisconsin that annually adds \$350 million to our State's economy and supports 2,800 jobs (Keene and Mitchell 2010). Through my awareness building and efforts of the Fresh Market and Commercial Vegetable team, potato acreage infected in 2009 was kept to less than 200 in Central Wisconsin. The Fresh Market and Commercial Vegetable Team, of which I am co-leader, was awarded the 2011 Agriculture and Natural Resources program area Cooperative Extension Team/Workgroup Leadership Responsiveness Award. This award recognizes the team for effectively working together to identify important needs of producers, industry, university, and the community, and for responding to clientele needs through the development of dynamic research and Cooperative Extension programming.

Late blight returned to Central Wisconsin in 2010 with even heavier infection of potatoes. I scouted potato fields extensively during the growing season. Based on the extent of the disease, I felt it necessary to gather potato growers in early August for an informational meeting on the progress of late blight and update them on recommended control methods. I organized a meeting of 35 growers and crop consultants and presented an update on locations and spread of late blight in Wisconsin, the life cycle of this disease, and key identifying symptoms (**Exhibit 27**). It suddenly occurred to me that potato growers had experience and information on reducing tuber infection upon harvest but our home gardeners had little information to help them reduce tuber infection so I co-authored and assembled a factsheet "*Late Blight Infection of Potato Tubers*" (**Exhibit 2**). This factsheet was sent out to the UWEX Ag All list, posted to the UW Vegetable Pathology website <http://www.plantpath.wisc.edu/wivegdis/> and referenced in subsequent Vegetable Crop Update newsletters. It is important for potato growers to understand that putting late blight-infected tubers on the compost pile is not a good idea because tubers may survive the winter and sprout in spring with inoculum onsite to immediately begin the disease cycle over again (see **Exhibit 2**). Infected tubers surviving in the field as volunteers or in cull piles also serve as overwintering sites for the late blight pathogen. Through my continued awareness building efforts the disease was kept to less than 500 acres in 2010. With potato producers, commercial and backyard alike familiar with the late blight disease, potato acres infected in 2011 were kept to less than 50, thus protecting the \$350 million Wisconsin crop.

Program Title: Developing and Serving Urban Agriculture (horticulture)**Introduction**

At the National level, U.S. household participation in lawn and garden activities increased from 68 million households in 1997 to 85 million in 2002, an increase of 25 percent and a compound growth rate of 5 percent per year. During this same period lawn and garden sales increased from \$26.6 billion to \$39.6 billion, an overall increase of 49 percent (Statewide Horticulture team plan of work 2005 to 2009). Home horticulture is expanding in Portage County as homeowners are looking to improve their vegetable gardens and surrounding landscape. Many more people are enjoying gardening and generating many questions and concerns about plant growth and development, insects, diseases, and environmental sustainability. In any given gardening season, the Portage County Extension office receives 400 or more calls requesting

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horticulture related information or assistance. To expand the education and outreach capacity of our office, I train Master Gardener Volunteers (MGV) and supervise the Portage County MGV association.

MGV general training classes are often taught via distance learning using Wisline teleconferencing and Power Point presentations. It has been my experience that many people learn more effectively through interaction with instructors. With my horticulture education and background, I chose to personally teach the Portage County MGV training classes and taught several of the classes in neighboring counties. This provides our MGVS an opportunity to learn from the local experts familiar with specific environmental conditions of our area in a more personal situation. I taught; Woody Landscape Plants and developed a Power Point presentation “*Woody Ornamentals*” (**Exhibit 7**), in Portage, Juneau and Adams Counties; Growing Vegetables in Wisconsin using a Power Point I developed “*Getting Started in the Vegetable Garden*” (**Exhibit 8**) in Portage, Marathon, and Waushara; Fruit Production for Home Gardeners (Juneau); Plant Pathology in Portage and Adams Counties; Plant Growth and Development, and Plant Propagation in Portage County. I trained 52 new people in 2007, 13 in 2008, and 24 in 2010 in Portage County. During the time I’ve been teaching and supervising the Portage County MGVS, the average annual number of certified Master Gardeners increased 26 percent and total volunteer hours contributed to Portage County in youth education, community education and support services increased 37 percent (total hours increased, 5,040). The increased value of their volunteer services at \$10.00 per hour is worth \$50,400 to Portage County over a three year period. Further education of Master Gardeners and garden enthusiasts was provided at the annual Garden Inspirations conference, a day-long program organized by Portage County MGVS held in March with attendance around 100 people. I was invited to give a talk about vegetable gardening and developed and presented “*Vegetable Gardening: Everyone Can Do It*” (**Exhibit 6**).

Instilling Confidence in Home Gardeners to Grow and Store Vegetables

In summer 2009 I organized and facilitated eight vegetable garden walks at the request of our local foods group, the Central Rivers Farmshed to provide mentorship for beginning vegetable gardeners. Objectives of these vegetable garden walks were: to support and encourage new and experienced gardeners alike to grow vegetables, to provide opportunities for people to learn new gardening techniques as well as tried-and-true methods, to learn about the host’s successes and challenges. Guests were given tours of the gardens with hosts talking about their gardening techniques and the crops they grow. Featured gardening techniques included conventional and organic, raised beds, square-foot, and ridge planting. The atmosphere was informal. I encouraged attendees to share their gardening experiences and to ask questions of the hosts and myself. I encouraged discussion and provided research-based input as needed. The Country Today newspaper and The Stevens Point Journal printed stories on the program in 2009 (**Exhibit 28**). Over 230 people attended one or more of the 2009 evening garden walks.

My project was so well accepted that upon the request of many I decided to hold garden walks in 2010. Follow-up evaluations/surveys were sent out in November 2010 to 126 attendees to document program effectiveness and gather information for follow-up programming (**Exhibit 29**). Seventy five surveys were returned for a 60 percent response. Ninety three percent rated the Portage County Vegetable Garden Walks very good to excellent and 93 percent also indicated the garden walks are a very good to excellent method of learning. Fifty-three percent of respondents indicated this program increased their confidence in their ability to grow their own vegetables greatly to quite a bit. Sixty percent indicated they were very likely to use information learned. Many beneficial ideas learned were incorporated into attendees’ gardens including mulching, composting, crop rotation, drip irrigation, rain barrel water collecting, and soil testing. Gardening techniques incorporated included using raised beds, square foot gardening, lasagna composting, trellising, seed saving, and staking tomatoes. When asked what they liked most about the programming, respondents said: opportunities to ask questions, visual examples, idea exchange, and new ideas shared. Several answers focused on the philosophical benefits such as the casual atmosphere, networking opportunities, and inspiration from other gardeners. Ninety six percent agreed this type of program should be repeated. I organized and held six vegetable garden walks in 2011 with over 200 attendees. In 2011, I added an update on current issues and concerns for vegetable gardeners including insect and disease information. This platform provided a great opportunity to let gardeners know about the challenges associated with late blight and encourage them to keep up on garden cleanliness to reduce disease inoculum thus reducing the risk of disease spread.

High demand for petroleum and concern about global climate change brought about renewed interest in home gardening, buying local, and conserving energy. People became interested in root cellars, but had little knowledge on how to manage a root cellar or possible alternatives to the traditional root cellar. I researched and developed a root cellar seminar which I presented to the general public, and presented to the Portage County Master Gardeners in fall of 2008 (**Exhibit 10**). I also worked with Anne Strainchamps, producer and interviewer for National Public Radio’s program “*To the Best of Our Knowledge*” to produce an article on root cellars. Using the information and knowledge she gained from my interview Anne wrote an article “*Taking Root: The Root Cellar Becomes Cool Again*,” published in the Wisconsin Trails magazine January/February 2009 issue (circulation 20,000). I presented my root cellar program to the North Central Wisconsin Master

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Gardeners in Wausau and others in fall of 2009 as popularity for the root cellar seminar grew. Evaluations from the North Central Wisconsin Master Gardeners root cellar seminar (n=39) indicate increased knowledge in four key focus areas of the presentation (**Exhibit 30**). Using a Likert Scale from one to five, 1= no understanding of topic, 5= complete understanding. Basic produce storage requirements 2.4 before 3.9 after; Root cellars 2.1 before 4.0 after; Methods for cold storage 2.1 before 3.7 after; Harvesting and handling of produce for longer storage 2.4 before 3.9 after. When asked, how likely is it that you will use information learned from this program, 67 percent responded, very likely. When asked what they liked most about the program, respondents indicated – “It was very informative, I learned tons, excellent instructor knowledge, good speaker, presentation and handout materials.”

When word got around about my gardening background and horticultural expertise, I was invited to be on Wisconsin Public Radio’s “*Garden Talk*” (50,000 listeners), hosted by Larry Meiller at the Midwest Renewable Energy Fair in July 2008 and 2009 providing additional opportunities for me to encourage gardening and assist home gardeners with their gardening challenges.

Programming Implications: Present and Future

Vegetable production and processing in Central Wisconsin are very important to our State and Nation. Wisconsin ranks 7th in the Nation for farm-gate vegetable sales. Wisconsin ranks 2nd in the U.S. for harvested acreage and total production of processing vegetables and 3rd for production value. Key processing crops include potatoes, sweet corn, green beans, green peas, carrots, cucumbers, and onions. Growers in Central Wisconsin produced 81 percent of Wisconsin’s potatoes, 67 percent of the green beans, 62 percent of the sweet corn, 40 percent of the green peas, and 76 percent of Wisconsin’s carrots. Nearly all of this vegetable production occurs on irrigated sandy cropland. The groundwater of Wisconsin’s Central Sands region is a valuable resource sustaining not only vegetable production but a large processing industry as well. Over the past decades, increasing business development, population growth, and an expanding regional market have led to concerns about the long-term quality and availability of our groundwater. Concerns were raised regarding how the agriculture industry affects the region’s groundwater (Central Sands Water Initiative. K-J Samuel Kung. 2011).

The need for environmentally and economically sustainable agricultural practices remains at the forefront of issues in Central Wisconsin. Projects I worked on and continue to be involved with are vital to addressing these challenges. My sweet corn N fertility project is wrapping up. A determination will need to be made whether or not more studies are needed. Additional fertility studies may include, sweet corn varietal effects on N requirements and implementation of on-farm studies researching effectiveness of slow-release fertilizer products on vegetable crops grown on sandy irrigated soils.

Continued emphasis will be placed on the following sustainability issues:

- Water quality and quantity – I will be coordinating on-farm activities to implement improved irrigation scheduling and to implement the use of perennial legume cover crops in vegetable cropping systems in accordance with a USDA/NRCS \$700,000 Conservation Innovation Grant with \$700,051 project match for Total Project Budget of \$1,400,051 for three years. Grant title, “Preserving Water Resources in Central Wisconsin”. UW-Madison Principal Investigator is A.J. Bussan. Known benefits of using perennial legume cover crops are: nitrogen and rotational benefits, providing perennial ground cover reducing soil erosion, retaining excess nutrients from crop production to be used by subsequent crops, and a very important benefit, decreasing the impacts of vegetable production systems on groundwater quality.
- Local foods – Currently, 108 farms generate \$825,000 in direct-marketing sales adding to the Portage County economy and growth in this area is expected to continue as more and more people are looking for locally grown foods (Portage County Agriculture: Value and Economic Impact. 2011). Locally sourced meats and seafood, and locally grown produce ranked one and two, respectively, as the top restaurant menu trends for 2012. This according to the National Restaurant Association fall 2011 survey of 1,791 professional chefs. The full report is available at www.restaurant.org/foodtrends. I plan to continue programming in this area to meet the needs of this underserved group of small fresh market vegetable producers and backyard gardeners.
- My recent bid to host Farm Technology Days in Portage County in 2014 was successful. This show is host to about 600 exhibitors and 60,000 to 90,000 attendees. I will serve as Executive Secretary, a position I am happy to have. I have always enjoyed and appreciated the state-wide event for its educational opportunities.

Economic viability of agriculture will remain at the forefront of issues facing the industry as world population increases and input costs increase with tightening input supplies. UWEX programming will be in high demand as producers struggle to remain current on new technologies and remain profitable. I look forward to meeting the future needs of Portage County and Central Wisconsin producers and gardeners in years to come.