Sustaining the Pacific Northwest

Food, Farm, & Natural Resource Systems

Winter 2008 Volume 5, No. 3

Washington State University Extension
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In This Issue

Articles

Winter Wheat Growers Meeting

March 21, 9:30 – noon at WSU Mount Vernon Northestern Washington Research and Extension Center. This meeting will overview WSU's winter wheat breeding and testing program and new opportunities in western Washington. Provide input critical to establish research priorities. For more information, contact Jonathan Roozen at.edu or 360-848-6135.

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Storing Winter Vegetables

Carol Miles, Tracy Smith, & Erin Klingler, WSU Mount Vernon NWREC

Introduction

Good storage practices enable farmers to market crops for longer periods of time, attain higher market values later in the year, and increase total sales. Effective storage starts in the field with crop cultural management strategies and continues in storage with temperature and humidity control. This article provides an overview of storage recommendations for vegetable crops. It also includes field cultural practices and storage conditions for a few selected crops, such as onions, potatoes, and winter squash.

While it may not be possible to provide ideal storage conditions for all crops, growers can provide the best possible conditions and recognize the limitations. In areas, such as in much of Western Washington, where winter day temperatures generally remain above freezing and humidity stays high, many vegetables may be stored in an unheated outbuilding. Ventilation during the night may provide cooler temperatures needed for good storage, while ventilation during the day may provide warm temperatures. Outside ventilation also provides high humidity conditions. For low humidity conditions, it may be necessary to circulate and ventilate air or install dehumidifiers.

Freeze definitions:

- Light freeze – 28 to 31 °F
- Moderate freeze – 24 to 28 °F
- Severe or heavy freeze – below 24 °F

Crops Stored Under Cool Dry Conditions

Dry beans, dry peas, and popcorn should be stored in an unheated shed or room. Storing in un-perforated plastic bags, plastic tubs, or glass jars will keep moisture out. These crops can easily be stored for one year or more.

Onions. Growers should plant a storage variety with good scale cover and early maturity. Onions should be fully mature in the field for several weeks prior to onset of winter rains. If weather conditions do not permit proper field drying, then drying must take place within storage. If harvested onions are immature (thick necks), they are susceptible to neck rot and other diseases and will not store well. Market these quickly to avoid heavy storage losses.

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WASHINGTON STATE UNIVERSITY EXTENSION

Small Farms Team

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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Manage onion field crops so necks dry down in the field. Thick necks and split scales will result in poor storability. Over-fertilization results in thick, green necks. Once bulbs attain full size and the tops just begin to fall over, stop irrigating. Bulb yield increases incrementally until 100% tops-down, however maximum storage life is attained when onions are harvested with 60-70% tops down. Excessive field-drying increases scale splitting and 'baldness'. In conventional production, growers apply sprout inhibitors to storage onions in the field at 50% tops down.

In the field, undercut onions and leave for approximately one week. Lift onions and windrow with tops on to protect from sunscald and lay tops over bulbs. When tops become totally dry after one to two weeks, top onions about one inch above the bulb, although thicker necks should be cut longer to enable bulbs to seal during the drying process. Open necks are the primary point of entry of Botrytis neck rot in storage. Onions may be topped by hand or by machine; Vegi-Vac, Top-Air perform lifting, topping, and windrowing operations at the same time.

Table 1: Reccomended Storage Conditions

Crop	Temp. (°F)	Relative Humidity (%)	Storage Time
Asparagus	32-36	95-100	3 weeks
Beans: green or snap	40-45	95	7-10 days
lima - shelled	37-40	95	1 week
unshelled	41-43	95	5 days
Beets: bunched	32	98-100	10 - 14 days
topped	32	98-100	4-6 months
Broccoli: Italian or sprouting	32	95-100	10-14 days
Brussels sprouts	32	95-100	3 - 5 weeks
Cabbage: early	32	98-100	3 - 6 weeks
late	32	98-100	3 - 6 weeks
Carrots: bunched	32	95-100	2 weeks
topped	32	98-100	7-9 months
Cauliflower	32	95	3-4 weeks
Celery	32	98-100	2-3 weeks
Corn, sweet	32	95-100	0-3 days
Cucumbers	50-55	95	10 - 14 days
Eggplants	46-54	90-95	10 days
Endive or escarole	32	95-100	2 - 3 weeks
Garlic, dry	32	65-70	6 - 7 months
Horseradish	30 - 32	98-100	12 months
Kohlrabi	32	98-100	2-3 months
Leeks, green	32	95-100	2 -3 months
Lettuce, head	32	98-100	2 - 3 weeks
Melons: cantaloupe or muskmelon	36-45	90-95	2 weeks
honeydew	45 - 50	90	2 weeks
watermelon	50-60	90	2 - 3 weeks
Mushrooms: cultivated	32	95	5 days
Onions: set	32	65-70	6-8 months
dry	32	65-70	5 - 9 months
Parsnips	32	98-100	4-6 months
Peas, green	32	95-98	1 -2 weeks
Peppers, sweet	45 - 55	90-95	2-3 weeks
Potatoes: early	40	90-95	4-5 months
late	32	90-95	3-4 months
Pumpkins	50-55	50-70	2 -3 months
Radish: spring, bunch	32	95	1-2 weeks
winter	32	95-100	2 - 4 months
Rhubarb	32	95-100	2 - 4 weeks
Rutabega or turnip	32	98-100	4-6 months
Salsify	32	95-98	2-4 months
Spinach	32	95-100	14 days
Squash: summer	41-50	95	1-2 weeks
winter	50-55	50-70	2-3 months
Tomatoes: ripe	50	90-95	1 week
mature green	55 - 70	90-95	1-2 weeks

Sources: Lockhart, C. L., and P. D. Lidster, 1985; and Porritt, S.W., 1974

Harvest onions into crates and then stack in a warm (75-85 °F), dry (65-70 % humidity), and well-ventilated location. Cure onions for several weeks. It may be necessary to blow air through the bottom of the onion pile at a rate of one to two cubic feet of air per minute for each cubic foot of onions, with the higher rate used initially to remove surface moisture and seal necks. If the onions are wet, use forced air at 85 °F and 25-35% relative humidity for the first week. Continue blown air until the outer skins and necks are dry. Cool onions gradually by drawing in outside air. Onions are cured when the

Continued on next page

neck is tight and the outer scales are dry and will rustle. Excessive drying cracks the outer bulb scales and causes bald onions. Poorly cured onions decay in storage, most often from Botrytis neck rot.

Use nets, perforated bags, crates, pallet boxes, or bulk bins for dry storage. Bags can be stacked on pallets but should allow good air circulation. Onions in bins can be piled 10 to 15 feet deep. Store onions in an unheated building or location with 60% to 70% humidity, but do not allow them to freeze. During dry, cold weather (above 32 °F), open doors or use fans to circulate cold air throughout the storage area. Do not allow water to condense on the onions. During wet or very cold weather (below 32 °F), keep the building closed and recirculate the air periodically to keep onions cool and dry.

Onions do not sprout and are not susceptible to decay when in their resting stage, which generally lasts 30 to 60 days after curing and can be prolonged by cold storage temperatures. Sprout growth indicates too high a storage temperature (above 50 °F), poorly cured bulbs, or immature bulbs. Root growth indicates too high a relative humidity.

Cold storage allows longer term storage. Place onions in cold storage (32 °F) immediately after curing and provide air circulation to prevent heating and remove moisture. Globe onions last six to eight months in cold storage while mild types, such as Walla Walla sweets, only last one to two months.

When removing onions from storage, gradually increase temperatures to 50 °F over a period of 24 to 36 hours and provide good air movement. This avoids sweating from moisture condensation, which leads to decay.

Crops Stored Under Cool Moist Conditions

Long season crops, such as beets, cabbage, carrots, celery, parsnips, potatoes, and rutabagas, store best under these cool, moist conditions. Only place well developed, mature, undamaged vegetables into storage and discard those with injuries or decay. Root crop leaves are a primary route for moisture loss in storage, resulting in shrinkage, weight loss, and smaller roots which may reduce marketability. Cut root crop tops about one inch above root at harvest. Place only dry root crops in storage to minimize rot.

Beets. Do not store beets in bulk bins since crushing and heat build up will occur. Store beets in crates or totes with good ventilation at temperatures of 32-45 °F and at 98-100 % humidity. Beets store for four to six months.

Cabbage. For the longest storage life, choose late season Danish-type cabbage varieties. Trim all loose leaves (leave only three to six tight wrapper leaves) and only place undamaged, healthy cabbage heads directly in pallet boxes, bulk bins, or perforated plastic bags. Use plastic liners to retain moisture. Store under dark conditions or use black plastic to help retain moisture and color. Store at temperatures of 32-34 °F and at 95-100 % humidity. Slight freezing is harmless, but heavy freezing results in large losses. Cabbage stores for five to six months. Before marketing, trim loose and damaged wrapper leaves.

Carrots, Parsnips, and Rutabagas. When harvesting, top carrots, parsnips, and rutabagas to within one inch and cool immediately to 45 °F. Clean crops prior to storage if harvested under muddy conditions. Store in crates, bulk bins, or pallet boxes at temperatures of 32-34 °F and at 95-100% humidity. Good ventilation and air circulation removes respiratory heat, prevents condensation, and helps maintain uniform temperatures. Parsnips cooled to 32 °F immediately after harvest and held for two weeks will become sweet, similar to being kept in the field for two months under frosty conditions. Parsnips are more susceptible to moisture loss and should be stored with plastic crate liners. Do not wax rutabagas for storage; waxing is often used prior to marketing for appearance. Carrots will store for seven to nine months while parsnips and rutabagas will last four to six months.

Celery. Wilting causes the primary losses of celery in storage. Harvest plants before outer stalks become pithy and leave some root intact. Cool immediately after harvest to 35-40 oF. Store in perforated plastic bags, crates, bins, or boxes and use plastic liners to retain moisture. Do not stack plants more than four high in bulk bins, and do not stack bags or crates more than four high or overheating may occur. Store at temperatures of 32-34 °F and at 98-100% humidity. Provide good air circulation or ventilation to keep temperatures uniform Can be stored for two to three months.

Potatoes. Killing vines two to three weeks prior to harvest produces good tuber separation from stolons, skin set, and efficient harvest. Potatoes with intact vines reduce quality (low starch and high sugar concentrations) and become more susceptible to skinning, mechanical injury during harvest, and storage decay. Vines can be killed using chemical sprays (common conventional method), chopping, rotobeating, flaming, and sometimes frost (below freezing temperatures can kill vines but will not harm tubers). For chopping, adjust the blade height to remove tops, leaving tubers uncovered and uninjured. Flail-type shredders generally work better than rotary blades since they adjust more easily.

Immediately after harvest, place potatoes in bulk bins, pallet boxes, or piles of eight to 20 feet deep. Cure potatoes at 50-60 °F and high humidity (90-95%) for 10 to 14 days in the dark (light induces greening). Curing heals bruises and cuts.

For long-term storage, when curing is complete, reduce temperatures to 38-40 °F. Lower temperatures cause sweetening and chilling injury. Correctly stored healthy potatoes may be kept for up to four to five months. Recondition potatoes by placing them at room temperature for one to two weeks prior to sale.

Crops Stored Under Warm Dry Conditions

Tomatoes. Mature-green (breaker point) tomatoes store up to two weeks at 55-60 °F. Light red or pink fruit

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Table 2: Storage Compatability of Fruits & Vegetables

	Apples	Apricots	Asparagus	Beans, Green	Beans, Lima	Beets, Bunched	Beets, Topped	Blackberries	Broccoli	Brussels Sprouts	Cabbage	Carrots	Cauliflower	Celery	Cherries, Sweet	Cherries, Sour	Corn, Sweet	Cranberries	Cucumbers	Eggplant	Endive (escarole)	Garlic, Dry	Grapes	Horseradish	Kohlrabi	Leeks, Green	Lettuce	Melon, Cantaloupe	Melon, Honeydew	Melon, Watermelon	Mushrooms	Onions, Green	Onions, dry	Parsnips	Peaches	Pears, Bartlett	Pears, Winter	Peas, Green	Peppers, Sweet	Plums, Early	Plums, Late	Potatoes, Early	Potatoes, Late	Pumpkins	Radish, Spring	Radish, Late	Raspberries	Rhubarb	Rutabaga (turnip)	Salsify	Spinach	Squash, Summer	Squash, Winter	Sweet Potatoes	Tomatoes, Ripe
Apples																																																						
Apricots																																																						
Asparagus																																																						
Beans, Green																																																						
Beans, Lima	1	1	1																																																				
Beets, Bunched				1																																																			
Beets, Topped	2			1																																																			
Blackberries	2			1																																																			
Broccoli				1		2	2																																																
Brussels Sprouts				1																																																			
Cabbage	3			1																																																			
Carrots	3			1																																																			
Cauliflower	3			1																																																			
Celery				1																																																			
Cherries, Sweet	0	0	0	1	0																																																		
Cherries, Sour				1		2	2																																																
Corn, Sweet				1		2	2																																																
Cranberries				1																																																			
Cucumbers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																																						
Eggplant	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1																																					
Endive (escarole)	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	0																																				
Garlic, Dry				1														1	1	1																																				
Grapes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0																																	
Horseradish				1		2	2											1	1	1		0																																
Kohlrabi				1														1	1	1		0																																
Leeks, Green				1														1	1	1		0																																
Lettuce				1														1	1	1		0																																
Melon, Cantaloupe																						0																																
Melon, Honeydew	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1																												
Melon, Watermelon	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1		1																									
Mushrooms				1														1				0							1	1																								
Onions, Green	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		2		2	2	2	2	2	2	2																							
Onions, dry	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		2		2	2	2	2	2	2	2	2																						
Parsnips	2	2	2	2	2													1	1	1		0							1	1		2	2																					
Peaches				1		2	2											1	1	1		0							1	1		2	2																					
Pears, Bartlett				1		2	2			3	3	3						1	1	1		0							1	1		2	2																					
Pears, Winter				1		2	2			3	3	3						1	1	1		0							1	1		2	2																					
Peas, Green				1														1	1	1		0							1	1		2	2																					
Peppers, Sweet	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1			1		2	2	1	1	1	1	1																
Plums, Early	1	1		1		2	2	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1		1		1	2	2	1	1	1	1	1	1															
Plums, Late	1	1		1		2	2											1	1	1		0							1	1		2	2						1	1															
Potatoes, Early	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	2	2	1	1	2	2	1	1	1	1	1		1	1													
Potatoes, Late	2			1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	2	1	2	1	2	2	1	1	1	1	1	1		1	1												
Pumpkins	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1			1	1	2	2	1	1	1	1	1		1	1		1											
Radish, Spring				1														1	1	1		0							1	1											1	1		1	1	1										
Radish, Late				1														1	1	1		0							1	1											1	1		1	1	1										
Raspberries				1		2	2											1	1	1		0							1	1		2	2						1	1		1	1	1										
Rhubarb				1														1	1	1		0							1	1		2	2						1	1		1	1	1										
Rutabaga (turnip)	2	2		2	2			2						2	2	2	2	1	1	1		0	2						2	2		2	2		2	2	2	1	1	2	2		1	1			2	2							
Salsify				1														1	1	1		0							1	1		2	2						1	1		1	1	1										
Spinach				1														1	1	1		0							1	1		2	2						1	1		1	1	1										
Squash, Summer	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1			1	1	2	2	1	1	1	1	1		1	1		1		1	1	1	1	1	1	1				
Squash, Winter	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1			1	1	2	2	1	1	1	1	1		1	1		1		1	1	1	1	1	1	1				
Sweet Potatoes	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Tomatoes, Ripe																																2	2															2							
Tomatoes, Mature Green	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1

☐ Compatible

0 Compatible if commodity requiring high humidity is enclosed in plastic liner.

1 Undesirable for optimal storage quality due to differing temperature requirements. Short term holding may be possible by maintaining storage temperature at the minimum allowable for the low-temperature sensitive commodity.

2 Undesirable flavor transfer may develop in storage. This can be reduced by storing one of the commodities in perforated polyethylene garbage bag.

3 Incompatible for long storage due to cross-commodity deterioration of produce quality.

(Source: Lockhart, C. L., and P. D. Lidster, 1985).

store for up to one week at 50 to 55 °F. Firm red tomatoes store for up to one week at 45-50 °F, or up to three weeks at 32 °F, but quality declines. Mature green and light red fruit should be ripened at 70 °F for one to three days prior to marketing to improve eating quality. For all types, place tomatoes one layer deep in shallow trays. Inspect trays every week and discard decayed fruit and market ripe fruit.

Pumpkins and Winter Squash. Harvest pumpkins and winter squash when mature and handle with care to avoid puncturing the skin or bruising the flesh before placing in storage. Harvest when night temperatures reach 50 °F for more than a week and before a hard freeze since freezing damage causes decay in storage. Place dry pumpkins and squash

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onto storage racks or into bulk bins or crates. Store in a well ventilated area at 50 °F with 50-70% humidity. Hard shelled winter squashes, such as Turban and Buttercup, will store for three months or more, while Hubbard squash stores up to six months. Most pumpkins and Butternut squash store for two to three months while Acorn-type squash only storse for five to eight weeks. Flesh becomes stringy and flavor declines after optimum storage time passes.

Fruit may be cured prior to long-term storage, but research studies are inconclusive regarding advantages. To cure pumpkins and winter squash, store fruit under dry conditions (50-70% humidity) at 80-85 °F for two to three weeks.

References

Bartsch, J.A., G.D. Blanpied, and R.J. Krizek. 1990. *Refrigeration and Controlled Atmosphere Storage for Horticultural Crops*. Northeast Regional Agricultural Engineering Service Publication No. NRAES-22. http://www.nraes.org/

Butkus, S. 1978. *Storing Vegetables and Fruit at Home*. Washington State University Extension Publication. EB1326. http://cru84.cahe.wsu.edu/cgi-bin/pubs/EB1326.html

Gaus, A.E, H. DiCarlo, and R. Zuroweste. Undated. *Vegetable Harvest and Storage*. USDA Agricultural Fact Sheet for Part-time Farmers and Gardeners, AFS-8-13-1. http://www.usda.gov/wps/portal/usdahome

Hardenburg, R.E., Al E. Watada, and C.Y. Wang. 1986. *The Commercial Storage of Fruits, Vegetables, and Florist and Nursery Stock*. USDA ARS Agricultural Handbook Number 66. Reprinted 1995 by Washington State University, Publication No. AH0066. http://cru84.cahe.wsu.edu/cgi-bin/pubs/AH0066.html

Iritani, W.M. and W.C. Sparks. 1985. *Potatoes: Storage and Quality Maintenance in the Pacific Northwest.* Pacific Northwest Extension Bulletin. PNW 257. http://cru84.cahe.wsu.edu/cgi-bin/pubs/PNW0257.html

Lockhart, C. L., and P. D. Lidster. 1985. *Home Storage for Fruits and Vegetables: Construction and Operation.* Agriculture Canada. Publication 1478/E. Communication Branch, Ottawa K1A 0C7.

Hardenburg, R. E., A. E. Watada, C. Y. Wang. 1995. *The Commercial Storage of Fruits, Vegetables, and Florist and Nursery Stocks*. USDA. Agriculture handbook number 66.)

Matson, W.E., N.S. Monsour, D.G. Richardson. 1985. *Onion Storage – Guidelines for Commercial Growers*. Pacific Northwest Extension Bulletin. PNW 277. http://cru84.cahe.wsu.edu/cgi-bin/pubs/PNW0277.html

PNW Commercial Vegetable Production Guides. Oregon State University. http://hort-devel-nwrec.hort.oregonstate.edu/vegindex.html

Porritt, S.W. 1974. *Commercial Storage of Fruits and Vegetables* by *S.W*. Agric. Can. Publ. 1532.

Thompson, J.F., F.G. Mitchell, T.R. Rumsey, R.F. Kasmire, and C.H. Crisosto. 1998. *Commercial Cooling of Fruits, Vegetables, and Flowers*. University of California Publication No. 21567. http://danrcs.ucdavis.edu/

Wilson, E.B. 1971. *Cooling Potatoes with Night Air Evaporation and Refrigeration*. Washington State University Extension Publication. EB3463.

Wilson, E.B. 1993. *Potato Storage and Ventilation*. Washington State University Extension Publication. EB2799.

Soil Amendment with Limestone for Management of Fusarium Wilt in Spinach Seed Crops in the Pacific Northwest

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Introduction

Spinach is an important leafy vegetable grown on more than 55,000 acres in the U.S. annually for fresh and processed markets [USDA National Agricultural Statistics Service, (NASS)]. Spinach crops are planted at populations ranging from 32,000 to more than 2 million seed/acre, with the higher populations used for the expanding 'baby leaf' bagged spinach market (10,13). The dense populations, particularly for 'baby leaf' crops harvested 30-45 days after planting, necessitate production of high quality spinach seed, and have increased the demand for spinach seed.

Spinach seed crops grown on 2,000 to 4,000 acres in the mild maritime region of western Washington and western Oregon produce up to 50% of the U.S. and up to 25% of the world supply of spinach seed, at an annual value of $1,000 to $1,200/acre (8) (Photo 1). Few areas of the world experience the climatic conditions of the coastal PNW required to produce high-quality spinach seed. The long summer days trigger uniform flowering of this day length-sensitive species, dry summers minimize pathogens infecting developing seed, and mild summer temperatures are necessary for uniform flowering of this heat-sensitive species (14). However, Fusarium wilt, caused by the soilborne fungus F. oxysporum f. sp. spinaciae, has become the limiting factor for high-yielding spinach seed crop production in the maritime PNW (8) (Photos 2 and 3). The pathogen may also be seedborne (2). While growers in the U.S. used to treat spinach seeds with benomyl to minimize seed transmission of the fungus and infection of seedlings by soilborne inoculum, all registrations for benomyl in the U.S. were cancelled by the EPA in the last three to four years. This has created a need for alternative seed treatments, and increased the importance of identifying fields with low populations of the pathogen for planting spinach seed crops.

Photo 1 - A hybrid spinach seed crop in Skagit Co., Washington.

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Photo 2 - Above-ground symptoms of Fusarium wilt in a spinach seed crop.

Efforts to manage spinach Fusarium wilt in the PNW include planting resistant cultivars and using extensive crop rotations (8). Spinach cultivars with partial resistance are available, but many popular cultivars carry little resistance to the pathogen (3). In addition, seed crops are grown on a contract basis, which leaves growers with little choice of the parent (inbred) lines they grow. Once introduced into soil, F. oxysporum f. sp. spinaciae can survive many years as a saprophyte or a pathogen on spinach and related asymptomatic crops, such as beets and chard (asymptomatic means the plants can be infected but do not develop symptoms of Fusarium wilt) (1,15). When the disease was first identified in the PNW in the 1960s, producers managed spinach Fusarium wilt by growing seed crops in fields not previously planted to spinach.

Photo 3 - Internal vascular discoloration of the roots and crown of a spinach plant infected with Fusarium oxysporum f. sp. spinaciae (top) vs. a healthy plant (lower).

Subsequent depletion of virgin ground for spinach led to Fusarium wilt becoming the main factor limiting production of high yielding spinach seed crops in the region (8). Losses to Fusarium wilt now necessitate rotation intervals of 6 to 10 years for partially resistant spinach lines, and 12 to 15 years for susceptible lines. Synthetic fumigants, such as methyl bromide, chloropicrin, and/or metam sodium, are cost-prohibitive for control of spinach Fusarium wilt, except in production of foundation and stock seed. Furthermore, the need to isolate seed crops to avoid unwanted cross pollination of this wind-pollinated species complicates control of Fusarium wilt and makes field selection for spinach seed production a limiting factor for seed growers.

In contrast to Western Washington and Oregon, up to 15,000 acres of spinach seed crops are grown in Denmark annually with no Fusarium wilt, despite rotation intervals of only 3-5 years (5). Alkaline (pH 7.5-8.5) and high calcium soils in Denmark may account, in part, for the lack of Fusarium wilt. Research in Florida demonstrated that limestone (calcium carbonate) applications suppressed Fusarium wilt of tomatos caused by F. oxysporum f. sp. lycopersici (11,12). Limestone elevated soil and plant calcium, enhancing crop resistance. Liming also raised soil pH, which reduced aggressiveness of the fungus by making some micronutrients (e.g., Zn) unavailable to the pathogen.

In 2006, the Vegetable Seed Pathology program at the WSU Mount Vernon NWREC started investigating the potential to suppress spinach Fusarium wilt by applying limestone to Western Washington's acid soils. Although dolomitic lime, a combination of calcium carbonate and magnesium carbonate, commonly is used to raise soil pH above 6.0, effects of agricultural limestone as well as high rates of limestone application on Fusarium wilt and the nutrient status of spinach seed crops need to be investigated.

Objective

This research was initiated to assess the potential efficacy of limestone applications to suppress Fusarium wilt of spinach and enable spinach seed growers in the maritime PNW to reduce crop rotation intervals from 6-15 years to 5-8 years without increasing losses to Fusarium wilt. This article draws from research described by du Toit et al. in their report titled *Evaluation of Limestone Amendments for Control of Fusarium Wilt in a Spinach Seed Crop, 2006* (6).

Materials and Methods

The limestone amendment field trial comprised a randomized complete block design with five replications of a factorial combination of six rates of limestone amendment and two proprietary female spinach inbred lines, one highly susceptible and one moderately susceptible to Fusarium wilt. A soil testing lab determined the pH and nutrient status of soil samples collected in March 2006 from each of six fields in Skagit County that had been planted to spinach four or five years previously (thus assuring the presence of F. oxysporum f. sp. spinaciae). The field selected for the trial had an initial pH of 5.5. The soil testing lab calculated the amount of agricultural limestone (TexLime General Purpose Limestone Flour, Oregon Lime Score = 96, CCE = 98.3%, 97% $CaCO_3$, and 38.8% Ca) needed to raise soil pH to approximately 6.0, 6.5, 7.0, 7.5, and 8.0 to be 0, 1.4, 2.1, 2.8, 3.5, and 4.2 tons/acre. The lime was applied onto the appropriate 35 feet x 35 feet plots on April 4 and 5 using a drop spreader, and incorporated six inches deep on April 5 using a rototiller. The plots were mulched on April 28. On May 2, the herbicide RoNeet was broadcast and incorporated with a mulcher-packer. Spinach seed was planted 0.5 inches deep using a Monosem planter, with a 22-inch spacing between rows and two inch spacing within rows. Six rows of each female line were planted in each plot, along with one row of a proprietary male line on each side of the six female rows. Fertilizer (11-52-0) was applied in-furrow at 350 lb/acre at planting. Soil samples were collected from each plot (eight cores/lime plot) on May 11, dried, and tested for pH. Plant stand and incidence of wilted seedlings were counted in 20 ft of row/spinach line on May 30, June

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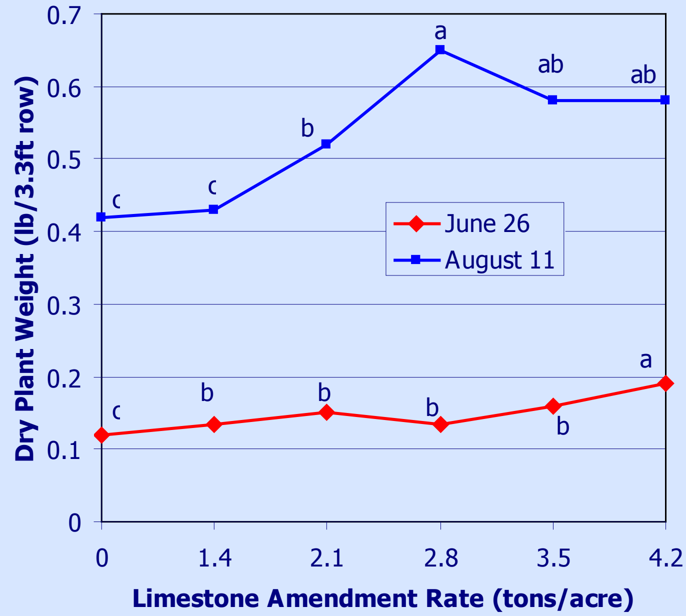
21, and July 11. Isolations were carried out from a sample of wilting seedlings from all three spinach lines on May 31. The herbicide Spin-Aid was broadcast on June 6. Plots were also weeded manually. Fertilizer (27-0-0) was applied at 130 lb/acre on June 12 with a single-shank applicator. On June 26, plants were sampled from 3.3 feet of row/parent line, dried, and weighed. Soil cores (20/lime plot) were also collected on June 26, dried, and soil nutrient analyses completed by a soil testing lab. Plant biomass samples were collected again on August 11, dried, and weighed. Plants in the middle 10 feet of the center four rows/female line were windrowed on August 16 and 18, dried, and hand-threshed. Twenty soil cores/plot were collected on August 22 within the rows, dried, and pH determined. Soil dilution assays were completed to quantify populations of F. oxysporum using a semi-selective agar medium. The harvested seed was cleaned and sized. Seed was then tested for germination using the Association of Offical Seed Analysts' spinach germination assay, and for seedborne necrotrophic fungi using a freeze-blotter seed health assay (7). Data were subjected to analyses of variance (ANOVAs) and means separation using Fisher's protected least significant difference (LSD).

Results

The moderately-susceptible female spinach inbred line exhibited significantly higher stand counts, lower incidence of wilt, greater plant biomass, and eight-fold greater seed yields than the susceptible female line (Figures 1 and 2). The male line was the most susceptible of the three lines to Fusarium wilt. F. oxysporum f. sp. spinaciae was the primary organism isolated from wilting seedlings of the susceptible female and male lines on May 31, but Pythium spp. and Rhizoctonia spp. were primarily isolated from the few wilting plants of the moderately-susceptible female.

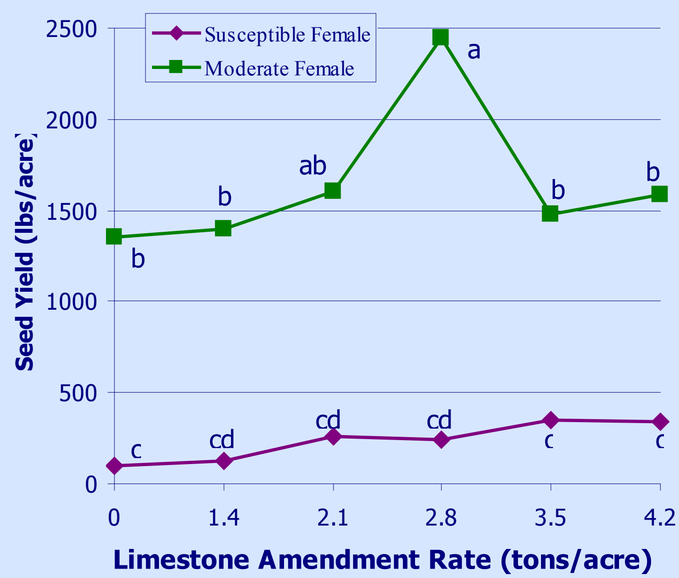
Limestone treatments did not significantly affect stand counts on May 30, June 21, and July 11, nor the incidence of wilted plants on May 30 and June 21. However, by July 11, limestone applications over 1.4 tons/acre significantly suppressed Fusarium wilt. Plant biomass on June 26 was significantly greater in all plots treated with limestone compared to the control plots. The largest plants were measured from plots treated with 4.2 tons/acre (Figure 1). By August 11, plots with limestone applications of 2.1 tons/acre or greater had significantly larger plants than plots treated with 1.4 tons/acre or no lime (Figure 1). The suppressive effect of limestone on Fusarium wilt was significant for the susceptible female, reducing the incidence of wilted plants by 45%, and increasing seed yield 318% on plots amended with 3.5 or 4.2 tons limestone/acre compared to plots receiving no limestone (Figure 2). Limestone applications did not decrease the incidence of wilt significantly for the moderate female, although seed yield was highest (2,468 lb seed/acre) on plots amended with 2.8 tons limestone/acre, and decreased on plots with higher and lower rates of amendment (Figure 2).

Figure 1: Spinach Plants



For each date of assessment, data points with the same letter are not significantly different based on Fisher's protected least significant difference (P < 0.05).

Figure 2: Marketable Spinach Seed Yield From Female Inbred Lines Susceptible or Moderately Susceptible to Fusarium Wilt



Data points with the same letter are not significantly different based on Fisher's protected least significant difference (P < 0.05).

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Limestone amendments increased soil pH significantly on May 15, June 26, and August 18, although the highest pH was measured on June 26, approximately two months after application. Applying 4.2 tons limestone/acre increased soil pH from a mean of 5.4, 5.7, and 5.5 for non-limed plots to a mean of 6.2, 6.9, and 6.7 on May 15, June 26, and August 18, respectively. Higher rates were needed to render the soil alkaline (a pH over 7.0). Nonetheless, soil and plant tissue analyses demonstrated that both soil and plant calcium (Ca) concentrations increased significantly with increasing rates of limestone application. In addition, rates greater than 1.4 tons/acre significantly reduced the concentration of available zinc (Zn) and manganese (Mn) in the soil and plants, but did not affect other micro- or macronutrients measured. The moderate female spinach line showed significantly lower concentrations of potassium (K), magnesium (Mg), sulfur (S), boron (B), zinc (Zn), and copper (Cu) than the susceptible female, reflecting the stunted growth of the susceptible female compared to the moderate female. Conversely, Ca was significantly higher in the moderate female than the susceptible female. Ca is important in host resistance, while Zn and Mn may promote aggressiveness of some Fusarium wilt pathogens (4). Mn and Zn are also essential for plant growth, so the decrease in seed yields observed at applications greater than 2.8 tons limestone/acre for the moderate female may be associated with inadequate Zn and/or Mn available for seed production at the higher rates of limestone amendment.

Limestone amendments did not affect germination of the harvested spinach seed, but germination was significantly greater for the moderate female than the susceptible female (62% vs. 21%, respectively). Seed health assays showed the incidence of harvested seed infected with Fusarium spp. was less than 1%, regardless of the female line or rate of limestone amendment, and despite significant differences in incidence of Fusarium wilt observed in July. In contrast, the incidence of seed infected with Verticillium dahliae, which causes Verticillium wilt in spinach seed crops (7), increased with increasing application rates for both females, from 11.2% for non-limed plots to 35.7% for plots treated with 3.5 tons/acre. The moderate female had significantly more seed infected with V. dahliae (39%) than the susceptible female (9%). The incidences of seedborne Stemphylium botryosum and Cladosporium variabile, which cause leaf spots of spinach (9), were not affected by spinach line or rate of limestone.

The population of F. oxysporum in soil sampled within rows at harvest was significantly lower for the moderately-susceptible female (2,027 cfu/g soil) than the susceptible female (3,852 cfu/g), but was not affected by limestone application rates. This suggests the minimum rotation interval needed between spinach seed crops to avoid losses to Fusarium wilt is longer following seed crops with parent lines susceptible to Fusarium wilt than for more resistant parent lines.

Conclusions

This research demonstrated that limestone amendments may effectively suppress Fusarium wilt in spinach seed crops on acid soils in the maritime PNW. However, the results also suggest that limestone amendments may promote infection of harvested seed by V. dahliae, another wilt pathogen of spinach (7). This supports results of Jones and Wolz (12) and others (4) who showed an inverse relationship between soil pH and susceptibility of certain crops to Fusarium wilt vs. Verticillium wilt. Further research is needed to optimize rates of limestone amendment that enable rotation intervals between spinach seed crops to be reduced without increasing losses to Fusarium wilt or Verticillium wilt. Future research should also assess foliar micronutrient applications necessary to counteract reduced micronutrient availability resulting from increased soil pH caused by limestone amendments, which may affect seed development. The limestone amendment trial described in this article was repeated in 2007 with modifications (rates of 0, 2, 4, 6, and 8 tons limestone/acre were assessed). Contact Lindsey du Toit (dutoit@wsu.edu) for 2007 trial results or a copy of the original report.

Acknowledgements

We thank the Puget Sound Seed Growers' Association, WA State Commission for Pesticide Registration, and Alfred Christianson Endowment for financial support. In addition, this research would not be possible without in-kind support from the Western WA Vegetable Seed Advisory Committee and seed companies, and excellent technical support from Mike Derie, Louise Brissey, Ron Dralle, Kerri Brooks, Ashley Bentley, Jaime Cummings, Coen de Jong, Gabby Freier, and Leya Wilhoit.

References

1. Armstrong, G.M., and Armstrong, J.K. 1976. *Common Hosts for Fusarium Oxysporum Formae Speciales Spinaciae and Betae.* Phytopathology 66:542-545.

2. Bassi, A., Jr., and Goode, M.J. 1978. *Fusarium oxysporum f. sp. spinaciae seedborne in spinach.* Plant Dis. Rep. 62:203-205.

3. Correll, J.C., Morelock, T.E., Black, M.C., Koike, S.T., Brandenberger, L.P., and Dainello, F.J. 1994. *Economically Important diseases of spinach.* Plant Dis. 78:653-660.

4. Datnoff, L.E., Elmer, W.H., and Huber, D.M. 2007. *Mineral Nutrition and Plant Disease.* APS Press, St. Paul, MN.

5. Deleuran, L.C., and Boelt, B. 2006. *Spinach seed production in Denmark.* Pages 13-15, in: Proc. 2006 Int. Spinach Conf., 13-14 July 2006, La Conner, WA.

6. du Toit, L.J., Derie, M.L., Brissey, L.M., and Cummings, J.A. 2007. *Evaluation of Limestone Amendments for Control of Fusarium Wilt in a Spinach Seed Crop, 2006.* Plant Disease Management Reports 1:V091.

7. du Toit, L.J., Derie, M.L., and Hernandez-Perez, P. 2005. *Verticillium Wilt in Spinach Seed Production.* Plant Dis. 89:4-11.

8. Foss, C.R., and Jones, L.J. 2005. *Crop Profile for Spinach Seed in Washington.* U.S. Dep. Agric. National Pest Management Centers.

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9. Hernandez-Perez, P., and du Toit, L.J. 2006. *Seedborne Cladosporium Variabile and Stemphylium Botryosum in spinach.* Plant Disease 90:137-145.

10. Holloway, R.L., Hall, K.D., and Smith, D.T. 2003. *Crop Profile for Spinach in Texas.* U.S. Dep. Agric. National Pest Management Centers. http://www.ipmcenters.org/cropprofiles/docs/txspinach.html

11. Jones, J.P., and Wolz, S.S. 1970. *Fusarium Wilt of Tomato: Interaction of Soil Liming and Micronutrient Amendments on Disease Development.* Phytopathology 60:812-813.

12. Jones, J.P., and Wolz, S.S. 1972. *Effect of Soil pH and Micronutrient Amendments on Verticillium and Fusarium Wilt of Tomato.* Plant Dis. Rep. 56:151-153.

13. LeStrange, M., Koike, S.T., Valencia, J., and Chaney, W. 1996. *Spinach Production in California.* Vegetable Research and Information Center, Vegetable Production Series. University of California DANR Publication No. 7212, Sacramento, CA.

14. Metzger, J.D., and Zeevaart, J.A.D. 1985. *Spinacia Oleracea.* Pages 384-392, in: CRC Handbook of Flowering, Volume IV. A.H. Halevy, Editor. CRC Press, Boca Raton, FL.

15. Reyes, A.A. 1979. *Populations of the Spinach Wilt Pathogen, Fusarium Oxysporum f. sp. Spinaciae, in the Root TissuesR rhizosphere, and Soil in the Field.* Can. J. Microbiol. 25:227-229.

Material Registration for Organic Production

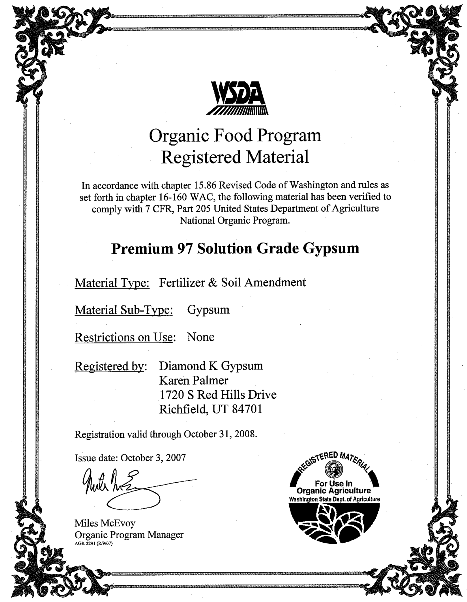
Lisa M. Brines, WSDA Organic Food Program

The National Organic Standards allow certification of producers and handlers by accredited certifying agencies, but these standards do not allow certification of materials. Although they are unable to be certified, all materials used in organic food production must comply with the National List of Allowed and Prohibited Substances which specifies which synthetic substances are allowed and which nonsynthetic (i.e. natural) substances are prohibited for use in crop production. Unless specifically prohibited, all natural substances are permitted.

How do certified organic operators determine if their material inputs comply with the standards? Growers must ensure that all of a product's ingredients comply with the criteria given on the National List in order to use the product in organic production. Determining the full list of ingredients present in a product is often difficult since many product labels only list their active ingredients. Inert ingredients, such as solvents and other intentionally added substances other than the active ingredient, are not always disclosed. Some products also contain confidential formulations which manufacturers will not disclose to the public. In addition, some products advertised as organic may not be compliant with the National List. Determining whether a product complies with National Organic Standards can be time consuming for certified operators, so many refer to product lists generated by material review organizations.

Lists of Registered Materials

In order to make it easier for certified organic operators to determine whether materials are allowed for use in organic production, some organizations maintain lists of products which are known to be compliant with the National Organic Standards. Manufacturers or distributors may apply to register products by completing an application and paying a fee. Some of these organizations, such as the WSDA Organic Food Program, issue registration certificates indicating products approved for use in organic agriculture. However, a certificate does not certify these products as organic since the National Organic Program does not allow certifying materials, instead, these inputs are simply registered for use in organic food production. This registration does not equate to EPA pesticide registration and all pesticide products must also be registered for use in Washington State.


WSDA

Organic Food Program
Registered Material

In accordance with chapter 15.86 Revised Code of Washington and rules as set forth in chapter 16-160 WAC, the following material has been verified to comply with 7 CFR, Part 205 United States Department of Agriculture National Organic Program.

Premium 97 Solution Grade Gypsum

Material Type: Fertilizer & Soil Amendment

Material Sub-Type: Gypsum

Restrictions on Use: None

Registered by: Diamond K Gypsum
Karen Palmer
1720 S Red Hills Drive
Richfield, UT 84701

Registration valid through October 31, 2008.

Issue date: October 3, 2007

Miles McEvoy
Organic Program Manager
AGR 2291 (R/9/07)

REGISTERED MATERIAL
For Use In Organic Agriculture
Washington State Dept. of Agriculture

Material registration issued by the WSDA Organic Food Program.

WSDA Brand Name Material List

The WSDA Organic Food Program maintains a Brand Name Material List of WSDA registered materials that are approved for use in organic agriculture. The list is provided to all of its certified producers, handlers, and processors, and may be downloaded from WSDA Organic Food Program. The most recent list contains over 500 registered products. To become registered on the WSDA Brand Name Material List, applicants must fully disclose the ingredients and manufacturing process for each product. Registrations expire October 31 and must be renewed annually by completing a renewal application and paying a renewal fee. The WSDA provides list updates quarterly to WSDA certified operators and their website. The WSDA Organic Food Program thoroughly evaluates the ingredients and manufacturing processes of all listed products to ensure compliance with National Organic Standards. The WSDA Organic Food Program logo may also be used on the product labels and marketing information of WSDA registered materials. Operations certified by any agency other than the WSDA should refer to their certification agency prior to the use of any WSDA registered material to ensure that their agency

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recognizes the WSDA list or allows the product under its certification program.

WSDA Organic Food Program logo for materials registered for use in organic agriculture.

OMRI

The non-profit, Organic Material Review Institute (OMRI), determines which input products are allowed for use in organic production and processing. OMRI maintains lists of both products and generic materials suitable for use in certified organic production. The 2007 edition of the OMRI Products List contains over 1,400 products, many of which display the OMRI logo on their packaging. Certified operators should check with their certifying agency to ensure their agency recognizes the OMRI list or allows the product under its certification program.

OMRI logo for listed materials.

EPA Pesticide Registration

The EPA may also approve pesticides for use in organic production. To use the EPA logo, registrants must demonstrate that all ingredients in their product comply with the National Organic Standards. This includes both active pesticide ingredients and inert substances. This program is voluntary for EPA registered pesticides. The WSDA and many other certifying agencies recognize and accept EPA registration for materials.

EPA logo for pesticides approved for use in organic production.

Can Certified Organic Operators Use a Product that is Not Registered?

All registration lists are voluntary and certified organic operators may use any material whose ingredients are allowed under the criteria of the National List. In order to use a product, operators need a complete disclosure of ingredients from the manufacturer. Each ingredient in the product formulation, including any carriers, preservatives, and wetting agents, must be compliant with National Organic Standards. The information from the manufacturer must be kept on file and available during inspections.

Certifying agencies such as the WSDA Organic Food Program also assist its operators in determining whether a product meets National Organic Standards. In situations where manufacturers do not want to disclose their complete product formulation, product registration is a useful way for them to maintain market access to organic operations. Even though material inputs are not "certified organic," any product may be allowed for use in organic food production as long as all of its ingredients meet the criteria of the National List.

Resources:

National List of Allowed and Prohibited Substances

WSDA Brand Name Material List

Organic Material Review Institute (OMRI) http://www.omri.org/

Environmental Protection Agency – Labeling of Pesticides under the National Organic Program (NOP)

International Exchange: Agriculture, Forestry, Fisheries, & Natural Resource Management

Experience International (EI) , located in Bellingham, WA, has been bringing together international trainees and U.S. hosts for 20 years in the Pacific Northwest. Trainees have come from over 15 countries. Trainees come to the U.S. with the motivation and expectation to work hard, get involved in the daily activities of farming, research, cooperatives, and special projects, as well as to enjoy a cross-cultural exchange.

U.S. hosts from both private and public sectors in agriculture, forestry, fisheries, or natural resource management may be qualified. Hosts provide on-the-job training opportunities while EI provides support and resources for the host and trainee to accomplish their goals.

A sample of trainees placed in 2007 and currently working in our area include:

1) Ecuadorian trainees are enjoying their time living on a farm just outside of Seattle, WA. Trainee activities include: vegetable production, sustainable agriculture practices, and weekly trips to farmers' markets.

2) French trainees are doing agricultural research in Oregon and working in established nurseries for the production and sale of a variety of fruits, vegetables, trees, and shrubs.

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A sample of trainees and their interests available to be placed in 2008 include:

1) Graduates of Agricultural Engineering in Ecuador with over two years combined experience are seeking training in agriculture, horticulture, nurseries, livestock, fruit orchards, crop production, food processing techniques, and/or fertilization techniques.

2) Professionals from Cameroon are seeking training in urban forestry, beekeeping, and land-use management planning.

3) Students from Ecuador are seeking internships in vegetable production and horticulture practices.

The above trainee examples only show a small slice of what EI can offer hosts. For more information about trainees that may fit your business needs, or if you would like to expand or develop your program into one that is international, please contact our offices or visit us. Contact Experience International, PO Box 680, Everson, WA 98247, 360-966-3876.

Events

Food Product Development Short Course

OSU Department of Food Science & Technology Extension Service will hold this short course **March 10-12**, 2008, 8:00 am – 5:00 pm at the Food Innovation Center (FIC), 1207 NW Naito Parkway, Portland, OR 97209.

This short course provides attendees a "throughout" exercise in food product development with emphasis on the technical aspects of product development. Participants will work from product concepts to processing in a pilot plant; from product ideal (based on provided raw materials), formulation, equipment, processing procedures, packaging design and labeling to hands-on pilot plant processing and quality analysis of the final products.

Early registration by March 3 costs $485, after which registration costs $550. Register on-line and contact Debby Yacas (800-823-2357) for more information.

Announcements

Western Regional Excellence in Extension Award

WSU Today announced that WSU's Marcy Ostrom received the 2007 Western Regional Excellence in Extension Award at the annual November meeting of NASULGC (National Association of State University and Land Grant Colleges) meeting. Ostrom directs the WSU Small Farms Program and is a member of the WSU Community and Rural Sociology Department.

Tidbits

Harnessing Farms and Forests to Provide Climate Change Solutions

AFT. The nation's working lands increasingly are being viewed as a critical asset in the fight to reduce global warming. Farms and forests act as natural "sinks," absorbing vast amounts of the greenhouse gas carbon dioxide from the atmosphere and storing it in plants and soil. One study from the Pew Center on Global Climate Change found that changes in agricultural practices, paired with the foresting of marginal agricultural lands, could offset up to one fifth of current U.S. greenhouse gas emissions. Another recent report noted that land management projects could, by 2025, provide around two-thirds of the reduction that climate models predict will be needed to avoid dangerous climate change. The Presidential Climate Action Project released a comprehensive new plan for fighting climate change, with AFT drafting the detailed recommendations related to agriculture.

Harmful Pesticides Found in Everyday Food Products

Seattle Post-Intelligencer, January 30, 2008. This Seattle P-I article by Andrew Scneider outlines a study by Chensheng Lu in a recent issue of Environmental Health Perspectives. The study looked at 21 children, ages 3 to 11, from two elementary schools and a Montessori preschool on Mercer Island, WA.

"The peer-reviewed study found that the urine and saliva of children eating a variety of conventional foods from area groceries contained biological markers of organophosphates, the family of pesticides spawned by the creation of nerve gas agents in World War II. When the same children ate organic fruits, vegetables and juices, signs of pesticides were not found."

For the full story, see the Seattle P-I article or look at the original study.

Draft Sustainable Agriculture Standard to be Introduced

ATTRA. An effort to develop a sustainable agriculture ANSI (American National Standards Institute) standard Projects/ansi-SustainAg.htm launched in October. The Leonardo Academy, an ANSI-accredited Standards Development Organization, is working to ascertain stakeholder group participation in this process.

Washington County Creating Business Plan for Agriculture

ATTRA. The Seattle Times reports on Snohomish County's (WA) Agriculture Sustainability Project, a grass-roots effort to grow the county's agricultural economy, ensure a local food supplies, and support existing

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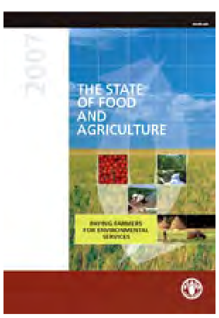
farming operations. The project inventories agricultural lands and identifies policies necessary to promote economic growth in agriculture.

New Study Reveals Benefits of Switchgrass-based Ethanol

ATTRA. Nebraska Ag Connection published an article describing how Switchgrass grown for biofuel production produced 540% more energy than needed to grow, harvest, and process it into cellulosic ethanol. A large on-farm study by researchers at the University of Nebraska-Lincoln. shows results from the five-year study involving fields on farms in three states highlights the prairie grass' potential as a biomass fuel source that yields significantly more energy than is consumed in production and conversion into cellulosic ethanol.

UN Says Paying Farmers Could Protect Environment

FAO. Carefully targeted payments to farmers could serve as an approach to protect the environment and to address growing concerns about climate change, biodiversity loss, and water supply, according to a news release by the Food and Agriculture Organization of the United Nations about its annual publication, *The State of Food and Agriculture*. The report cautions that payments for environmental services are not the best solution in all situations, and that significant implementation challenges remain.



Long-term Study Shows Organic Practices Outpacing Conventional Crop Production

Leopold Center. The Leopold Center for Sustainable Agriculture reports that after nine years of comparison, the clear differences between organic and conventional crop production systems are emerging: the longer rotations and careful management of the organic system show greater yields, increased profitability, and steadily improved soil quality over conventional practices.

Those are the conclusions drawn from experimental plots set up at the Iowa State University Neely-Kinyon Research Farm near Greenfield. The plots are part of the Long-Term Agro-ecological Research (LTAR) initiative led by Kathleen Delate of the ISU agronomy and horticulture departments and supported by the Leopold Center for Sustainable Agriculture since 1997. The study is believed to be the largest randomized, replicated comparison of organic and conventional crops in the nation.

Edible Schoolyard Program

AFT. The Edible Schoolyard program at Martin Luther King Junior Middle School in Berkeley, California, provides urban public school students with a one-acre organic garden and a kitchen classroom. Using food systems as a unifying concept, students learn how to grow, harvest, and prepare nutritious seasonal produce. The program site also contains resources for others interested in starting similar programs.

Washington State Farmland Preservation Task Force Appointed

ATTRA. Washington State appointed an 18-member task force in October 2007 to provide the first statewide guidance for farmland preservation in Washington. Formed in response to a bill passed in the last legislative session, the Farmland Preservation Task Force consists of six farmer representatives from around the state along with legislators, county commissioners, and key officials from local, state, and federal agencies. The legislation also created the Office of Farmland Preservation within the State Conservation Commission.

Organic Fraud Protection Program Underway

The National Cooperative Grocers Association (NCGA) announced its partnership with Hanover Co-op Food Stores, PCC Natural Markets, and Unified Grocers on a pilot program exploring the implementation of the organic industry's first system-wide, retailer-based organic fraud detection and prevention program. NCGA has contracted with the International Organic Accreditation Service (IOAS) to determine appropriate methods retailers could undertake to limit the incidence of fraudulently traded organic products and to increase the chances of early detection when it takes place within the retail supply chain. Based on the pilot's findings, NCGA and IOAS plan to develop a recommended retailer-based fraud prevention program, offering it to not only NCGA's members but all organic retailers nationwide and throughout the world as early as mid-2008.

Resources – Agriculture

USDA Value-Added Producer Grants Available

USDA. Grants may be used for planning activities and for working capital for marketing value-added agricultural products and for farm-based renewable energy. Eligible applicants are independent producers, farmer and rancher cooperatives, agricultural producer groups, and majority-controlled producer-based business ventures. Applications are now being accepted through March 31, 2008. For more details on application requirements, see the Rural Development website, the Federal Register notice, or contact your local/state office. In Washington, contact Carlotta Donisi at (360) 704-7724.

Database of State Incentives for Renewables Efficiency

EnergyAg Newsbriefs. The Database of State Incentives for Renewables Efficiency is a state-by-state listing of information on state, local, utility, and federal incentives to promote renewable energy and energy efficiency. The resources listed include the agricultural sector.

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Energy Farm Audit Form

Freeborn Mower Cooperative Services offers a Farm Audit Form on their website to use as an analysis tool for determining farm energy usage. In addition, the National Sustainable Agricultural Information Service lists a selection of farm energy calculators designed to help producers save electrical energy, fuel or fossil-fuel-based fertilizers.

How Do We Open the Farm Gate of Local Food Systems?

AFT. Consumers increasingly ask for food with the farmer's face on it, from nearby farms they know, at fair prices. Local foods can spark economic development, foster health, sustain community values, and reduce food miles. But how do we address the long-term needs of farmers so that local food systems can flourish? Take a look at AFT's website for discussion of growth management and local food system planning, as well as insights about the economics of urban edge agriculture and the impact of local food movements like Slow Food.

How Do We Open the Farm Publication Aids Producers with Selling Strategies

ATTRA. The University of Missouri Extension released Selling Strategies for Local Producers, a publication designed to help farmers improve sales skills, with an emphasis on building customer relationships, advocating the product, and providing quality service. See related ATTRA publication on direct marketing.

Biological Control Brochure & Pocket Guide

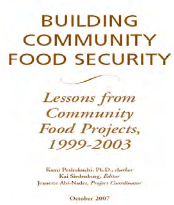
IPPC. The Integrated Plant Protection Center and the Xerces Society published a brochure on conservation biological control brochure. Check out the IPPC's Natural Enemies PocketGuide as well.

Western Sustainable Agriculture Working Group

Visit the WSAWG web site and peruse their electronic newsletter and sign up for email notification.

New Community Food Security Publication Available

ATTRA. The Community Food Security Coalition released a new publication, Building Community Food Security: Lessons Learned from Community Food Projects, 1999-2003.



Based on analysis of Community Food Project (CFP) narrative reports from 1999-2003, CFP focus groups, and relevant literature, it outlines characteristics of successful projects, success factors, challenges, and lessons learned.

Healthy Food in Healthcare Roundtable Presentations

The healthy food in healthcare roundtable "Redefining healthy food in hospitals: pathways to sustainability," held in November 2007 in Seattle, WA posted presentations. Co-hosted by Health Care Without Harm, Seattle Children's Hospital, and Washington's Physicians for Social Responsibility (WPSR).

Approaches for Supporting the Success of Limited Resource Farmers

Community Food Security Coalition. A recent report, Food and Agriculture Related Policies and Practices to Benefit Limited Resource Farmers by Martin Bailkey, highlights a variety of approaches for supporting the success of limited resource farmers and ranchers. It uses examples from the work of 14 organizations directly supporting limited resource producers along with summaries of 36 state and local government policies and practices. The report was produced by the Food Policy Council Program of the Community Food Security Coalition, with support from the USDA Risk Management Agency.

Resources – Forestry

USDA National Agroforestry Center

USDA. The National Agroforestry site contains information on a variety of agroforestry topics. A section on riparian forest buffers talks about natural or re-established streamside forests made up of tree, shrub, and grass plantings. They buffer non-point source pollution of waterways from adjacent land, reduce bank erosion, protect aquatic environments, enhance wildlife, and increase biodiversity. The windbreaks page discusses windbreaks for a variety of uses.

2007 North American Agroforestry Conference Proceedings

AFTA. Proceedings for the 10th North American Agroforestry Conference: When trees and Crops Get Together - Economic Opportunities and Environmental Benefits of Agroforestry are now available for purchase on-line for $15 (Canadian). Topics included windbreaks, shelterbelts, riparian buffers, intercropping systems, short-rotation forestry and forest farming. The conference program and abstracts can be downloaded for free.

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