Season Extension and Winter Harvest Quick Course

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Perspective: Season extension for warm season vegetables (tomato, pepper, squash, etc) and cool season leafy greens (kale, chard, collards, lettuce, BLSG, etc) has been practiced for centuries. Hightunnel production for winter harvest has been used for at least 15 years but is much less common than season extension. Winter growing and harvesting from passive solar greenhouses (PSGH) combined with the use of cold storage for vegetables (potatoes, onions, squash, carrots, cabbage) has been used for 6 years for a 48-week Community Supported Agriculture (CSA) program at the Michigan State University Student Organic Farm (MSU-SOF). The methods of Eliot Coleman and other farmers have been used to produce a wide range of winter crops in East Lansing, MI, zone 5 and one of the lowest winter sunlight areas of the northern US.

Season Extension protective structures can range from cold frames to row covers (low tunnels) to walk in structures (high tunnels) to full size unheated greenhouses (hoophouses). The structure is protecting plants from excessive wind and rain as well as providing protection from frost. A row cover or greenhouse cover can trap the warmth of the soil, which is normally lost to the atmosphere, in much the same way that cloud cover can keep the earth warmer at night.

There are four key aspects to the winter harvest in unheated passive solar greenhouses.

1. The first is the use of cold tolerant crops that can handle repeated freezing and thawing. Examples include baby and head lettuce for salad greens; spinach, chard, kale and other leafy salad greens as baby leaf for salad or for cooking greens, as well as root crops like carrot, radishes, turnips and beets. Leafy crops will "freeze" overnight so the leaves are rigid and if harvested early in the morning while still frozen will thaw and turn to unpalatable "mush". However, when the greenhouse warms up by late morning on sunny days, the leafy greens will thaw and have excellent sweet taste. Properly harvested and refrigerated the leafy greens can last 7 to 10 days. Examples of crops grown at the MSU-SOF are provided in a separate handout.
2. The second is that the crops must be planted and grown early enough in the fall season so that the majority of development has occurred before light and temperature conditions are too low for a reasonable rate of growth. Light available for growth and to warm the structure and soil declines dramatically at northern U.S. latitudes (40 to 45). For baby leaf salad greens the time from seed to harvest can go from 21-28 days to 60-80 days or more with sowing dates ranging from early to late September.
3. A third important factor is the use of crops that allow for multiple harvests either by removing outer, larger leaves at regular intervals (spinach, chard, kale, collards, komatsuna, etc) or for the case of baby leaf salad greens (lettuces, kale, mizuna, tatsoi, chard, spinach, etc) by cutting the entire plant back to within an inch or so above the soil so the growing point still remains. These leafy crops are able to regrow during the lower light and temperature winter conditions, particularly by early February.
4. The fourth factor is the protection of the crop by a passive solar greenhouse (PSGH) and internal layers of frost fabric or polyethylene. The protection from wind, rain and snow, and therefore excess moisture limits damage to the foliage. The protective layers, when covered by moisture as a result of condensation and or ice under freezing conditions, trap long wave radiant energy from the soil and plants in the greenhouse and prevent freezing of the soil. Minimum air temperature in the 15F range are maintained even when temperatures outside have dropped to -20F. The degree of protection is dependent on both the amount of sunlight during the cold weather, the outside temperature, the number of days of extreme low temperature and the amount of wind. Prolonged (>7days?) cloudy weather and outside air temperature below -10 to -20F can lead to frozen soil and damaged crops. Larger and taller structures likely provide more protection but many types and sizes of structures including cold frames can be used.

Additional References:

Eliot Coleman – *New Organic Grower, Four Season Harvest* and *Winter Harvest Handbook;*
High Tunnels Manual – www.uvm.edu/sustainableagriculture
High Tunnels web site and list serve: www.hightunnels.org
MSU Student Organic Farm www.msuorganicfarm.org at the resources tab;

Example Fall Planting Schedule for MSU Student Organic Farm in East Lansing, MI (Zone 5)

Crop	Cultivar	Direct Seed (DS) or Transplant (TP)	Scheduled Seed Date	Annual Week	Actual Date Seeded (for record keeping)	Scheduled Transplant Date	Annual Week	Actual Date Transplanted (for record keeping)
Baby Salad	Various- fast	DS	9/4 and 10/8	36 & 41		n/a		
Baby Salad	Various- slow	DS	8/27 and 10/1	35, & 40		n/a		
Beet	Chioggia	DS	13-Aug	33		n/a		n/a
Beet	Golden	DS	13-Aug	33		n/a		n/a
Carrot	Napoli	DS	6-Aug	32		n/a		n/a
Carrot	Sugar Snax	DS	6-Aug	32		n/a		n/a
Chinese Cabbage	Rubicon	TP	6-Aug	32		4-Sep	36	
Choi	Black Summer	TP	6-Aug	32		4-Sep	36	
Choi	Joi	TP	6-Aug	32		4-Sep	36	
Choi	Mei Quin	TP	6-Aug	32		4-Sep	36	
Cilantro	Santo	DS	4-Sep	36		n/a		n/a
Collards	Flash	TP	24-Jul	30		20-Aug	34	
Kale	Red Russian	TP	24-Jul	30		20-Aug	34	
Kale	Toscano	TP	24-Jul	30		20-Aug	34	
Kale	Winterbor	TP	24-Jul	30		20-Aug	34	
Lettuce	Aruba-Red Oakleaf	TP	13-Aug	33		18-Sep	38	
Lettuce	Ermosa-Green/Bibb	TP	13-Aug	33		18-Sep	38	
Lettuce	Winter Density-Rom	TP	13-Aug	33		18-Sep	38	
Parsley	Italian Dark Green	TP	6-Aug	32		4-Sep	36	
Raddichio	Indigo	TP	24-Jul	30		20-Aug	34	
Radish	D'avignon	DS	4-Sept and 18-Sept	36 and 38		n/a		n/a
Radish	Easter Egg	DS	4-Sept and 18-Sept	36 and 38		n/a		n/a
Scallion	Dp Purple, Hdy White	DS/TP	6-Aug	32		n/a		n/a
Spinach	Space	DS/TP	20-Aug	34		18-Sep	38	
Swiss Chard	Bright Lights	TP	24-Jul	30		20-Aug	34	
Tatsoi	N/A	TP	6-Aug	32		4-Sep	36	
Turnip	Hakurei	DS	13-Aug and 4-Sep	33 and 36		n/a		n/a
Turnip	Scarlett Queen	DS	13-Aug and 4-Sep	33 and 36		n/a		n/a

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