

Frozen Ground Summary from 24 Top Winter Growers in US/Canada

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On August 10-11, 2014 in Fairlee, VT, 24 top growers with experience in winter production, along with ten others representing seed companies, extension programs, and universities, met to discuss the best practices for how to grow greens in colder regions. The idea to pull together such a group came from Eliot Coleman, farmer in Maine, author, and long-time advocate of winter growing, and Sandy Arnold, farmer and owner of Pleasant Valley Farm in Argyle, NY, who has been doing winter growing since 1992 with her husband, Paul. Eliot's daughter, Clara Coleman, also helped organize the gathering, which was named Frozen Ground. The participating growers were from all northern regions of the U.S. as well as some from Canada.

At the cutting edge of the local food movement is the challenge of providing fresh, local food greens in the middle of winter and this group spent two days unraveling what in the past years has worked well, what hasn't, and where we all need to spend more effort researching and experimenting. The group discussed in one huge roundtable setup six major topics for high tunnel production in the winter: Greenhouse design, inner covers, crops, temperature, fertilization, and new developments.

Greenhouse design covered different types and brands of tunnels, which sizes of tunnels were best, orientation (E-W is the preferred for winter), types of external coverings, ground insulation, drainage, moveable tunnels pros and cons, and venting. All agreed that venting is a critical factor in winter production in order to prevent diseases and have healthy crops.

Inner covers session reviewed the types of inside covers folks preferred (Typar, Covertan, and Agri-bon most common but Typar should not be the layer closest to greens), height of covers suspended above crops (the lower the better for heat retention), types of support structures, and the use of plastic on beds. The plastic on beds was shown through the use of data-loggers to increase both the day and night soil temperature, which is critical to growth on the cold days as plants won't grow to any degree with soil temps below 42 degrees. It was agreed that taking covers off as much as possible, especially on sunny days, and 2 to 3 days each week minimum was very beneficial to production.

The crops grown by most growers with success and that showed hardiness include arugula, spinach, Asian Greens (baby and full size), mustards, kale, swiss chard, salad mix, mache, minors lettuce, and parsley, though other greens are certainly out there! Some growers took fresh greenhouse radishes, turnips, carrots, leeks and other hardy crops to winter markets, while others said they preferred growing these in the field in the Fall and cold storing them for winter sales. These growers saved the greenhouses for higher-dollar-value greens. Baby lettuce and head lettuce is less hardy, but with good management, it is possible to grow, especially the Salanova varieties when placed in the center of larger tunnels.

Choosing what to grow and when to seed it is extremely important for winter growing, and requires careful planning. The dates of seedings are variable depending on zone and whether farmers have no heat, ground heat or air heat. Successive sowings of all crops over a 2 to 3-week period gives a better insurance of having success rather than one specific date to seed due to the variability of each winter season's weather. Just as important though is practicing sound greenhouse management during harsh winter weather. Farmers are a creative lot, and every farmer at Frozen Ground seemed to have a unique management approach to the common problems of cold temperature and low light levels.

The Temperature session covered thoughts on differing systems such as temporary heating, ground heating, air heating, geothermal (one farmer from MN), ventilation, and value of HAF fans. The past two winters have been much colder than normal so systems to have some type of heat are one way farmers were combatting the weather to get good yields, but many with no heat still have had reasonable production despite below zero temperatures. The value of winter greens in tunnels were shown to be in the ranges of \$2 to over \$10 per square foot or \$90,000 to \$400,000 per acre. Well worth the time! Hardening off the greens in the fall is critical to having them survive the depths of winter so that there are not extreme fluctuations in temperature.

Fertilization session reviewed soil tests, crop needs for trace minerals, nitrates (and are they a problem?), the use of extra CO₂, as well as winter irrigation systems. Farmers use a range of different methods for irrigation, including overhead and drip, with some being used to reduce salts and nitrates. Nitrates are inorganic ions that occur naturally as part of the nitrogen cycle. When microbes break down animal wastes, ammonia is created, which then oxidizes into nitrates. Nitrates are required for plant growth, but excess nitrates can be a problem for plants. While leaves might be nice and green, root growth is often stunted and leaf edges can become yellow or wilt. Excess nitrogen is famous for inviting pests like aphids. Best practice is to not use animal-based manures and take soil tests regularly to determine any issues.

Maintenance of the crops inside the tunnels include not only fertilization, pest control, and irrigation but also weed control...yes, even in January! Chickweed is by far the worse weed and many systems prove helpful in controlling it, including

flame-weeding, “cooking” it with clear plastic, stale-seed bedding in early fall before planting (if the weather is cool enough to have it germinate), use plastic mulch, and use wire-weeders, with a new design of wire-weeder being invented this year. Another new technique that will be shown is steam-sterilizing beds, which has been amazingly effective.

Many New Developments in technology and biology are happening all the time, and there will be some information on a bubble wrap greenhouse plastic that Eliot Coleman put on a tunnel (SolaWrap from Germany), as well as heat storage systems, and breeding for hardier crops.

Winter production is definitely out of its infancy and this Frozen Ground meeting gave a tremendous amount of practical information from the experienced growers that shared their knowledge during the two days of non-stop networking. This information is being used by the experienced growers to tweak their techniques and it will help new growers be able to grow in the winter more productively. However, there is still much to be learned.

For additional resources, many of the power points from this conference, as well as notes taken by the extension folks who attended are posted at: <http://www.uvm.edu/vtvegandberry/WinterGrowingConference2014.html> and many of the farmers would be glad to give more information, including the presenters, Sandy/Paul Arnold (farm tours welcome also) and Michael Kilpatrick.