UMASS EXTENSION

Vegetable Notes

For Vegetable Farmers in Massachusetts

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ATLAS FARM CORN BOILER CASE STUDY

Atlas Farm is a small family farm in South Deerfield, MA. They grow a wide diversity of certified organic vegetables, herbs, and flowers, with many gourmet, heirloom and specialty varieties in addition to all the standard varieties. Owners Sara and Gideon Porth have been working in agriculture since 1996 and share a deep commitment to sustainable farming.

Their farm is dedicated to producing food in a way that will maintain biological diversity, support natural ecosystems, and keep the land productive for future generations.One of their major goals is to minimize the impact of the farm on the surrounding ecosystem. For these reasons, they add fertility to their fields by cover cropping and using organic, naturally occurring fertilizers, manage pests by crop rotation and cultivar selection, and use organic pesticides only as a last resort. They strive to be efficient in their use of fossil fuels and are constantly trying new approaches to farming to become less wasteful.

This commitment to environmental stewardship is part of what led Atlas Farm to take part in the UMass Extension project, 'Building Model Networks to Use Shelled Corn for Greenhouse Heat Corn'. Insulating themselves from the recent volatility in fossil fuel prices was another motivating factor.

Atlas Farm initially installed a 160,000 btu Amaizeing Heat furnace built by KC Manufacturing. The unit was purchased from Frier's Electric & Heating in Ellsworth, WI for the sale price of $2,000, which included delivery. This price is about 50% of what a comparable unit would cost today. The furnace was adequate for keeping the 18' x 96' hoop house at 65 degree night temperatures. There were some initial problems with getting this furnace up and running that gave the impression that the manufacturing and dealer support could use improvement. The furnace arrived somewhat beat up, and a number of parts needed to be replaced, which the dealer was unhelpful with. Once the initial issues were sorted out it ran fine, and it's still in use.

In 2008 Atlas Farm built a new 35'x144' gothic style ridge vent greenhouse with 6mm double poly glazing. This house is primarily used for greenhouse tomatoes (most of which are grafted - see article below on grafting tomatos). Night temperatures are maintained at 62 degrees. The greenhouse starts up at the beginning of March and runs right through summer and hopefully into September. There are six horizontal airflow fans in two rows of three for air mixing. The tomatoes are grown in a compost mix in trenches on the floor.

The greenhouse in action

To provide heat to the tomato crop in the new greenhouse, they purchased an LDJ corn fired 165,000 btu Amaizeing Heat boiler. The burner was purchased from Yellows Green, a local dealer in Fitchburg, MA for about $6,000. This included the boiler, a standard hopper, and freight. They paid an additional $800 for a 165,000 btu water to air heat exchanger, $400 for a 250 gallon storage

Corn boiler with storage tank on the left

tank for the heated water, and $150 in tubing – they used 3/4" black poly pipe for the heating tubes, which seems to work fine. Plumbing parts and labor ran an additional $3,000.

The corn boiler serves two purposes. One is to run a root zone radiant heating system for the tomato troughs. The troughs are 132' long by 2' wide with one loop of heat tubing in each. They keep the root zone of the tomatoes at 70 degrees, or maybe a little less when it's cloudy and cool and the plants aren't growing as fast. To reach this temperature they keep the 250 gallons of water in the storage tank at 140 degrees, and have plumbed the system so that the 140 degree water coming from the tank is mixed with cooler return water so that the water in the heating tubes at the root zone is 90 degrees - that keeps the soil in the root zone at the target temperature of 70 degrees. The water to air heat exchanger also uses hot water from the boiler to help keep the greenhouse air temps at 62 degrees. There is a 225,000btu propane burner in the house for backup and to assist the corn boiler, but it was used very little in the 2009 season. The boiler uses a domestic hot water coil to heat the water for the radiant tubes in the planting troughs, and requires a heated return in the primary loop, so between the radiant heat, the heat exchanger, and the need for a heated return the plumbing gets a bit complicated.

A water to air heat exchanger runs in a separate loop

We're collected data on the maintenance time and costs associated with running this system over the 2009 and 2010 heating season. We'll post the second part of this case study as soon as all those numbers are in. In the meantime, you can read other case studies and follow the details of the project online at www.umass-vegetable.org – click on the Corn Heat Project for Greenhouses link. If you're interested in talking with growers who have experience with these systems, or other forms of renewable energy, see the following announcement about the New England Farm Energy Conference.

NEW ENGLAND FARM ENERGY CONFERENCE

March 15-16, 2010

Radisson Hotel

Manchester, New Hampshire

Keynote Speaker: Dr. Mike Morris, National Center for Appropriate Technology (NCAT)

Mike Morris works with farmers, ranchers, and communities on more sustainable ways of using energy and water. He is especially interested in irrigation, solar energy, and small-scale biofuels. He holds a Ph.D. in Philosophy from the University of Pittsburgh, and has taught at colleges and universities in Michigan, Montana, Ohio, Pennsylvania, and Wisconsin, specializing in ethics, technology, and the environment. Mike's keynote address will focus on assessing on-farm energy options.

There will be Two Concurrent Tracks of Presentations over Two Days of the Conference.

I) Track 1: Oilseeeds and Biodiesel

* Oilseed agronomics
* Equipment for oilseed production and seed handling
* Biodiesel processing: quality and safety
* Harvesting and storing oilseed crops

* Modifying tractors and equipment for vegetable oil
* Community-based biodiesel production

II) Track 2: Greenhouse Efficiency and Renewable Energy

* Greenhouse efficiency and conservation
* Solar PV and hot water systems
* Heating with shell corn
* Heating with waste vegetable oil
* Logwood systems
* Wood pellet use

Registration information coming soon - see www.umassvegetable.org for the latest details.

Hosted by: Cooperative Extension of Maine, Massachusetts, New Hampshire, and Vermont; and the Vermont Sustainable Jobs Fund.

GRAFTING GREENHOUSE TOMATOES

Grafting of vegetable seedlings is a common practice – in Asian countries. Here in North America, the practice is just getting a foothold, mainly for greenhouse production.

Why graft? The idea behind grafting is to take a variety with desirable above-ground horticultural characteristics (like fruit size, flavor, etc.) and connect it to the roots of a variety with desirable under-ground characteristics (like resistance to soil-borne diseases and vigorous root growth.) Grafting vegetables follows the same principle as grafting fruit trees, which has been done for a long time. In both cases the crop-producing shoot is called the scion, which is removed from its original roots and placed onto a new plant, called the rootstock.

Among greenhouse tomato growers, grafting is quickly being adopted as a way to manage root diseases and increase fruit production. Organic growers in particular can gain from grafting because growing tomatoes in soil and compost rather than in sterile media often leads to problems with weak roots, as a result of soil-borne pathogens.

Varieties for grafting. In my neck of the woods, growers have a wide range of preferences for varieties of greenhouse tomatoes, depending on their markets and production systems. Popular greenhouse varieties include Trust, Cobra, Buffalo, as well as cherry, cluster and even heirloom-types. All of these have been used as scions. There are far fewer tomato varieties that make sense to use for rootstock. The two most common are 'Maxifort' and 'Beaufort'. Both of these have tolerance to some common soil-borne diseases. 'Maxifort' also results in very vigorous growth while 'Beaufort' leads to a more moderate increase in plant vigor. These increases in vigor can be seen in both above ground-ground and below-ground growth.

Types of grafts. Two common grating techniques are top grafting and side grafting. With top grafting the scion is completely cut off from its roots and placed on top of the rootstock stem. Side grafting involves making a partial cut into the stem of the scion plant and then inserting the cut-off stem of the rootstock into that cut. The seedling is then allowed to retain both set of roots until the graft with the new rootstock heals.

Top grafting relies on a tiny plastic tube or sleeve to hold the scion and rootstock together until the graft heals. Top grafting is quicker and bit less complicated to do than side grafting because it requires only a single complete cut through both the root and shoot portions of the graft. This technique can be used on very small seedlings.

Side grafting takes a little longer but is preferred by some tomato growers because it is a bit more forgiving. If greenhouse conditions for graft healing are less than ideal, the grafted seedling still has its original set of roots to help during the transition. Side grafting can also be done with seedlings that have become larger than is ideal for top grafting. And, side grafting seems to accommodate a bit less uniformity between scion and rootstock stem diameters than is the case with top grafting, where the two stems must be almost exactly the same size. A small clip, much like an office binder clip, is used to hold side-grafted plants together until they heal.

Starting the plants. Rootstock varieties tend to have long thin stems so they are often sown a few days earlier than seed for the scions. Some growers will make sequential seedlings of the rootstock over several days to assure that they have the right selection of plants size to choose from when grafting. There is a narrow range of plant size for grafting. The ideal is when the stems are about 2 mm in diameter for top grafting, and 2 to 3 mm for side grafting. (Depending on conditions, plants this size usually have 4 or 5 true leaves showing.) It's physically difficult to graft plants that are thinner than this, and the success rate declines rapidly as the stem diameter increases.

Top grafting. Start by selecting healthy scion and rootstock plants that have the same stem diameter. Then remove the first set of true leaves on the scion to reduce transpiration during the healing process, leaving only the uppermost couple of leaves. Leave the cotyledons in place. Next, cut off the scion from its roots just below the cotyledons, at about a 60 degree angle.

Now take the rootstock, and cut off the top just below the cotyledons, at exactly the same angle as the scion was cut. (If the plants are too small the cut can be made above the cotyledon but be sure to prevent these suckers from growing later.) Slip the grafting sleeve onto the rootstock stem and gently push in the scion stem so that the cut surfaces make full contact. Wiggle gently if needed. Place transplant into a large cell tray (72s) or small individual pot and water promptly.

Side grafting. With this method, larger seedlings are used, typically two to three weeks old, since the stem diameter must be large enough to perform the graft. First, select a pair of healthy plants with similar stem diameter. Then remove the cotyledons and the first true leaves on the scion. Make an upward cut that goes two-thirds of the way through the scion stem at a 60 degree angle, about an inch below where the cotyledons were.

Then take the rootstock, and cut off the top just below the cotyledons. About an inch below that make a downward cut in the remaining stem that matches the cut in the scion: two-thirds of the way through, at a 60 degree angle.

After the matching cuts are made insert the rootstock stem up into the scion stem, and clip the plants together using the small side grafting clip. Hold the two root balls together and transplant into a small pot, watering promptly.

The side-grafted roots of the scion are left intact for 4 to 5 days while the graft union heals. Then it's time to sever the stem connecting to the original scion roots, so that the plant will rely only on the desired rootstock. An initial cut should be made part way through the stem to 'wean' the plant and reduce the shock of removing the original roots all at once. At this time it helps to stabilize the plants by attaching them to small stakes. After 2 more days, the stem to the scion root is cut all the way through. Leaving both root systems in place, rather than removing the scion roots, is not recommended as that may enhance the population of root pathogens which can thrive on the more susceptible roots.

Post-operative care. After grafting keep the plants where it's warm (80-85 degrees F) and at least 95% relative humidity while the grafts heal. They should be held in a heavily shaded area, like under a bench, and misted enough to maintain the humidity, but not more. The leaves don't need to be wet all the time, this will reduce success.

It takes about 4 to 5 days for top grafts to heal, and 6 to 7 days for side grafts. Placing plastic domes over trays of top-grafted plants appears to enhance success. For a couple of days before setting the grafted plants out, gradually increase their exposure to direct light by pulling them out from under benches or removing any covering for a few hours early or late in the day. If using plastic domes, prop them open during this time.

When you eventually move the plants completely out of cover mist them if needed to prevent wilting. Finally, when setting plants in the production house be sure that the graft union is above the soil line. If the scion roots into the soil, the plant will be susceptible to soil-borne diseases.

Managing plant vigor. Because grafted plants are more vigorous, they will produce a lot of vegetative growth at the expense of reproductive growth, in other words, too much foliage and not enough fruit. So, you have to take steps to reduce plant vigor. This may take some getting used to, especially if you've previously been trying to promote vigor in your un-grafted plants.

Leaf removal is one way to reduce plant vigor. Removing leaves may feel counter-intuitive, but apparently only 10 to 12 fully expanded leaves are needed to do the job of capturing sunlight to feed a grafted greenhouse tomato plant, at least in the Northeast. Allowing more leaves than that sure looks nice and lush, but it seems to suppress fruiting.

Another way to suppress the vigor of grafted plants is to let them develop two leaders, or main stems, rather than the single stem that's customary in greenhouse production. This also reduces the number of grafted plants that you'll need by half. The double-leader system adds a 'load' to the roots, and that suppresses vigor sufficiently so that only 'normal' leaf removal is needed. By that I mean taking off all the leaves below the lowest cluster with maturing fruit.

There are a couple of ways to get a double leader. One is to cut off the top of the plant soon after the graft heals so that two equal-sized leaders will be produced from the buds at the base of the cotyledons. This technique works well with top grafted plants. Of course, it will set back the plant, delaying first fruit harvest date by about a week. Alternatively, you can allow the main stem to grow normally, but then let the sucker below the first fruit cluster develop to become the second leader. Since this leader develops later, it will be shorter than the main stem, which can lead to shading. To prevent that from happening, when trellising the crop the main stem can be angled to the side to allow the sucker to grow straight up and eventually catch up, resulting in double leaders of equal size and competitiveness.

With 'Maxifort' rootstock a double leader is recommended. 'Beaufort' is a good rootstock for a single leader plant because it is not as vigorous. When using the double leader system don't forget to adjust plant spacing accordingly, so that each grafted plant has the growing area of two ungrafted or single leader plants.

Tips for success. Expose seedlings to full sun and some water stress before grafting to keep the plants short and increase tolerance to water stress. Avoid excess fertility in your potting mix so that plants are not too lush. Shortly before grafting, make sure plants have been watered and are not wilted. Make grafts early or late in the day to avoid water stress. If you can, do your grafting on cloudy days. Graft in a location that's protected from direct sunlight and away from greenhouse heater discharge. Don't cut more plants than you can graft together in a few minutes, so the cut surfaces do not dry out. Always match scions and rootstocks of equal stem diameter, cut them at exactly the same angle, and make sure the cut surfaces make good contact when the plants are clipped together so that they have the best chance of successfully connecting to each other.

For more information you can order a CD with a 20-minute video featuring Mike Collins, an organic grower who's been grafting for 15 years. Send your request with $10 payable to UVM to: University of Vermont Extension, 11 University Way, Brattleboro VT 05301. Also see articles on grafting greenhouse tomatoes by Richard McAvoy, Univ. of Connecticut at:http://www.hort.uconn.edu/ipm/veg/croptalk/croptalkpdfs/croptalk1.3.pdf and by Jack Manix, of Walker Farm at: www.nevbc.org/sessions_03/tomato/tomato_grafting.pdf.

Grafting clips and rootstock varieties are available from: Johnny's Selected Seeds www.johnnyseeds.com and Hydrogardens www.hydro-gardens.com.

- Vern Grubinger, Vegetable and Berry Specialist, University of Vermont Extension

MANAGEMENT STRATEGIES FOR IMPROVED SOIL QUALITY WITH EMPHASIS ON SOIL COMPACTION

A three-year multi-site field study was conducted to evaluate various cover crops, rotation cycles, compost, and deep tillage (subsoiling) for their impact on soil compaction, soil quality (including the soil pest/disease complex), and cash crop yield. Mechanical deep tillage (12-16 inch depths) on compacted sites had significant beneficial effects on soil quality parameters in the first year. Soil penetrometer resistance and bulk density were lower on deep-tilled compared to non deep-tilled (i.e., compacted) plots, and porosity, water infiltration rate, time-to-ponding, and water holding capacity were significantly increased by deep tillage.

Direct-seeded cabbage and snap beans were the crops most negatively affected by compaction of those we evaluated, followed by cucumber, table beets, sweet corn and transplanted cabbage. Not surprisingly, deep tillage of compacted sites led to 10 - 70% increases in crop yields in the first summer after tillage. Part of the benefit of deep tillage on snap bean yields was associated with less root disease. Of the five cash crops that we evaluated, sweet corn was best at producing roots that could penetrate into (shallow) compacted soil layers. Sweet corn often produced substantial biomass on compacted soils, even when ear yields were reduced. These results suggest that sweet corn can be a good rotation crop to include on fields with shallow compacted layers, although it was not as beneficial as some non-cash cover crops evaluated.

Sudangrass (as a summer crop) and perennial ryegrass (as a fall/winter crop) ranked highest among the 14 cover crops we evaluated with regard to remediation of soil compaction, ease of crop establishment, and year-to-year and site-to-site stability of performance. Sudangrass had the deepest root system and generally ranked highest for root growth into compacted soil layers. Sudangrass also ranked high with regard to organic matter contribution, weed suppression, and suppression of parasitic nematodes and root diseases of subsequent snap bean crops. Hubam sweet clover was another cover crop that consistently performed well, including growth on compacted soils. However, Hubam sweet clover did not produce as much below-ground biomass as sudangrass or perennial ryegrass. Yellow blossom sweet clover (grown as a two-year crop) produces deep roots, but we did not have the opportunity to fully evaluate its performance on a compacted soil in our trials. Grain rye, hairy vetch, and grain rye + hairy vetch mixtures are fall cover crops that frequently performed well, but they were not particularly effective at compaction remediation. Also, hairy vetch did not grow well on poorly drained, compacted soils, did not overwinter in some trials, and was associated with higher populations of parasitic root lesion nematodes in subsequent bean crops. Our results indicated that yellow mustard, and other cover crops in the Brassica genus, are potential soil compaction remediators because they produce deep, penetrating tap roots. However, we encountered some problems in establishing a good stand in some sites in some years. More research is needed to determine optimum management practices under Northeast conditions for all of these cover crops.

Table beets responded very positively to addition of composted chicken manure applied at rates between 2 to 5 tons/acre. Snap beans and sweet corn response to this compost were more variable, slightly increasing yields at one site, while having little effect or even a negative effect (on sweet corn) at the other site.

Our results indicated that snap bean monoculture without rotation to other cash or cover crops led to a decline in yield associated with an increase in root disease severity. Our data also suggested that rotation, particularly sequences that included sweet corn and sudangrass, enhanced and prolonged the beneficial effects of deep tillage on soil physical and biological properties. If you would like to receive a copy of the complete report on 'Management Strategies for Improved Soil Quality with Emphasis on Soil Compaction', please contact Dr. David Wolfe at (607) 255-7888.

- David W. Wolfe, Cornell Horticulture. Reprinted from TheVegetable & Small Fruit Gazette, Volume 14, No. 1

HOW TO PROFIT FROM INSTITUTIONAL DEMAND FOR LOCALLY GROWN PRODUCE

Workshop & Round Table Discussion.

February 3: 101 University Drive Amherst (the northeast Chartwells/Foodbuy buyer will attend this session only)

February 9: Devens Common Center *

February 17: Pittsfield Athenaeum*

February 25: Wrentham Town Hall*

At each meeting we will discuss:

- The increased value of "local" to distributors who sell to schools.
- When direct sales to schools or other institutions are profitable.
- New ways of distributing produce to institutions.
- Materials the Project could develop for wholesale farms to promote their products to distributors.

Start time is 10:30 a.m. and lunch will be provided.

R.S.V.P. to mafarmtoschool@gmail.com, or call 413-253-3844.

**School food service directors who received Fresh Fruits and Vegetable grants have been invited to join us at these meetings to discuss their increased needs for local produce.*

LATE BLIGHT PRESENTATIONS FROM NOFA WINTER CONFERENCE

On Saturday, January 16, 2010 at the NOFA/Mass Winter Conference in Worcester, MA, a panel was held on dealing with Late Blight. An audio transcript of the program is available at http://www.box.net/shared/hxu071pfzu, and many of the

presentation files are available through the links below.

David Fisher of Natural Roots in Conway, MA reported on his record tomato success in 2009. Despite some late blight infestation, using both copper and biological fertility practices, he achieved yields that were 238% of the average of the previous 5 years. Presentation available at http://www.nofamass.org/reference/pp/David%20FisherNatural%20Roots%20Tomato%20Culture%20Log%202009.ppt

Ben Grosscup of NOFA/Mass presented preliminary results of the NOFA/Mass' Northeast Organic Grower Survey on the 2009 Late Blight Pandemic including graphs on the differences in late blight infestation by greenhouse use, mulching, pruning, and treatments used. Presentation available at http://www.nofamass.org/reference/pp/Ben%20Grosscup%20-%20Northeast%20Organic%20Grower%20Survey%20on%202009%20Late%20Blight.ppt

Ruth Hazzard of UMass Extension explained the biology of the late blight pathogen, how the disease overwinters, where it could possibly originate in 2010, the use of copper controls, and greenhouse management issues. Presentation available at http://www.nofamass.org/reference/pp/Ruth%20Hazzard-Late%20blight%20for%202010c.ppt

OTHER MEETINGS & EVENTS

Holistic Sustainable Agriculture from the Soil Up

February 2 & 3 Barre, MA

Veterinarian and biological agriculture expert, Paul Dettloff, will give the 2nd annual NOFA/Mass Advanced Grower's Winter Seminar. He'll address soil fertility, raising forage nutritional quality, alternative veterinary tools, managing livestock, and growing fruits and vegetables. Registration:$165. NOFA membership discount: $15. Early registration (by Jan. 16) discount: $10. nofamass.org/seminars/winterseminar.php. Also from the Winter 2009-2010 edition of The Natural Farmer is an interview with Dr. Paul Dettloff about his approach to crop nutrition and what's in store for the seminar, available here.

For info, contact Ben Grosscup: 413-658-5374, ben.grosscup@nofamass.org.

Greenfield Winter Fare

Feburary 6, 10am-2pm

Greenfield High School Come to the third annual Greenfield Winter Fare for an incredible variety of locally grown food from 30 vendors. Workshops, a barter fair, and hot soup round out this educational, festive, mid-winter celebration of local food. http://www.winterfare.org

PASA'S 19th Annual Farming for the Fuure COnference

February 4-6 2010

Penn Starter Confernece Center Hotel, State College, Pennsylvania

Pre-register by January 31. For confernece details schedule and registration information visit http://www.pasafarming.org/conference2010/index.cfm

Mid-Atlantic Fruit & Vegetable Convention

February 2-4, 2010

Hershey Lodge and Convention Center

The Mid-Atlantic Fruit and Vegetable Convention has become the premier grower meeting in the Northeast combining three days of six or more concurrent educational sessions with a large industry trade show and numerous networking opportunities - all designed to enable fruit, vegetable and berry growers as well as direct marketers to stay on the cutting edge of their industries. About 1,800 persons from throughout the mid-Atlantic region and beyond gather each year at the Hershey Lodge and Convention Center. Registration is open to all interested commercial fruit, vegetable and berry growers, direct marketers and allied industry personnel.

The 2010 Convention will feature several new sessions.

For more information visit http://www.mafvc.org/html/

NEW HAMPSHIRE COOPERATIVE EXTENSION MEETINGS

Intermediate Winemaking Seminar

co-sponsored by UNH Cooperative Extension and the NH Winery Association

Saturday, Feb 6, 2010

Radisson Hotel Manchester, Manchester NH

9:00am – Noon

$20 registration. Register online at: http://www.events.unh.edu/RegistrationForm.pm?event_id=6727

For more information call Becky Sideman or Suzanne Hebert at 603-862-3200

Organic Producers? Workshop: Season Extension Focus

co-sponsored by UNH Cooperative Extension, NOFA-NH, NH Department of Agriculture, Markets & Food, and the USDA Risk Management Agency

Wednesday, Feb 10, 2010

Common Man Restaurant, Plymouth NH

10:00am-3:30pm

$20 registration includes Lunch. Register online at: http://www.events.unh.edu/RegistrationForm.pm?event_id=6521

For more information call UNH Cooperative Extension Educator Heather Bryant, 603-787-6944

Opportunities with Ethnic Crops

co-sponsored by UNH Cooperative Extension and the USDA Risk Management Agency

Wednesday, Feb 17, 2010

Unitarian Universalist Church , Concord NH

10:00am-3:30pm.

Registration starts at 9:30. $20 registration includes Lunch. Register online at:

http://www.events.unh.edu/RegistrationForm.pm?event_id=6741

For more information call Becky Sideman or Suzanne Hebert at 603-862-3200

If you would like to become a Vegetable notes sponsor, please contact Jessica Dizek at jdizek@outreach.umass.edu or 413 545 1445

Vegetable Notes. Ruth Hazzard, editor and Amanda Brown and Andrew Cavanagh, assistant editors. Vegetable Notes is published weekly from May to September and at intervals during the off-season, and includes contributions from the faculty and staff of the UMass Extension Vegetable Program, other universities and USDA agencies, growers, and private IPM consultants. Authors of articles are noted; author and photographer is R. Hazzard if none is cited.