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Proceedings of the Northeast Farmer to Farmer Information Exchange

Greenhouse Meeting

1992 and 1993

edited by Alex Stone

Northeast Organic Farming Association
University of Massachusetts Cooperative Extension System

with the support of the
Northeast Region Sustainable Agriculture
Research and Education (SARE) Program

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Introduction

The Northeast Farmer to Farmer Information Exchange

The Northeast Farmer to Farmer Information Exchange, a project of the Northeast Organic Farming Association and the University of Massachusetts, held two-day meetings of small groups of farmers in the winters of 1992 and 1993 with the support of the USDA's Sustainable Agriculture Research and Education Program. Each group focused on one of five commodities for which there are significant barriers to organic production in the Northeast: apples, sweet corn, greenhouse bedding plants, livestock herd health, or strawberries. All of the participating farmers were interested in management methods which can be used on organic farms, but many of them are not organic growers and do not intend to use only organic methods.

At the request of the farmer participants, resource people were also invited to attend. These included researchers, faculty, IPM specialists and Extension agents from land grant universities, professional organic farming technical advisors, representatives of state departments of agriculture, and farmers recommended by others because of their experience and knowledge. Each meeting had a facilitator who assisted farmers in setting and following an agenda and moderated the discussions. Resource people sometimes made informal presentations but primarily were participants in discussions.

The Farmer to Farmer Information Exchange gave participating growers, and others reading these proceedings, a chance to become very familiar with the farming practices of a group of farmers. Farmers have an enormous amount of experiential knowledge about growing crops, raising livestock, marketing, managing labor, and all other aspects of running their farms. Farmers trying to grow crops using new or unusual methods may have experimented with techniques that few others have tried. In most cases, the results of these informal experiments never leave the farm to be shared with the larger agricultural community. Through these meetings and the written proceedings, the experiences of both farmers and researchers working on these crops can build upon each other.

A wide variety of activities has been generated by the meetings. Several growers in the sweet corn group set up trials in insect and weed control on their farms, with the help of Ruth Hazzard, Vegetable IPM Specialist at the University of Massachusetts and co-coordinator of the Farmer to Farmer project. At the urging of growers in the strawberry meeting, the Strawberry IPM Program at the University of Massachusetts did a scouting workshop in Vermont, at the farm of one of the Farmer to Farmer growers. Due to the interest of many of the livestock producers in alternative herd health remedies, a two-day homeopathy workshop was organized in Vermont. Several of the groups are continuing to meet in 1994, although the funding support from the USDA has ended.

These proceedings are a summary of the information provided by growers and resource people at the 1992 and 1993 meetings. They include discussion of specific production methods, marketing, and philosophy, and are intended to make available the expertise that was shared at the meetings to a wider group of farmers, researchers, and other interested people. They are not intended to provide complete information on how to produce these crops, nor to discuss only those production practices which have been verified by the research community. Additional sources of information on production and research-based information can be found in the list of sources at the back of the proceedings.

Participating Institutions

The Northeast Organic Farming Association

The Northeast Organic Farming Association (NOFA, formerly the Natural Organic Farmers Association) provides education and services for farmers, gardeners, consumers, and others interested in organic agriculture. NOFA has chapters in seven states: Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. The activities of state chapters vary, and include such things as organic certification, conferences, farm field days, country fairs, and cooperative purchase of farm and gardening supplies. Together, the state chapters hold an annual summer conference, publish a bimonthly newsletter, *The Natural Farmer*, and engage in regional projects such as this one. Information on becoming a NOFA member is provided on the inside back cover.

University of Massachusetts Vegetable IPM Program

The University of Massachusetts Cooperative Extension System conducts Integrated Pest Management (IPM) Programs in many commodities, including three that were part of this project: vegetables (including sweet corn), strawberries and apples. The purpose of these programs is to assist farmers in reducing pesticide use in their crops, and to develop alternative pest management methods such as biological and cultural controls. Increasingly, IPM programs seek to integrate all aspects of crop and pest management into whole systems, and to direct research efforts into "bio-intensive" methods, many of which are compatible with organic farming practices. Farmers have always played a key role in using, evaluating and helping to develop IPM methods; this project provided further opportunities to build links between IPM programs and organic farmers across New England, and to understand how both researchers and farmers can benefit from direct information exchange.

Sustainable Agriculture Research and Education Program

Mandated by Congress in the 1985 Farm Bill and first funded in 1988, the Sustainable Agriculture Research and Education Program (SARE, formerly LISA) funds research in sustainable agriculture. The program encourages projects in which several institutions cooperate, including non-profit groups and other non-university institutions. In addition, the program promotes farmer involvement in planning and carrying out research, and in 1993 began giving "mini-grants" directly to farmers. In 1993, the Northeast Region SARE Program awarded grants to 35 farmers, totalling $94,347, and 13 projects of research and education institutions, totalling $1.3 million. Further information about the Northeast Region SARE Program can be obtained from:

Northeast Region SARE
Hills Building
University of Vermont
Burlington, VT 05405-0082
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Acknowledgments

The proposal for the Northeast Farmer to Farmer Information Exchange was developed by Margaret Christie, Alex Stone, and Enid Wonnacott at the request of the Northeast Organic Farming Association (NOFA) Interstate Council. Input for the proposal came from a range of farmers and researchers who attended planning meetings and a pilot meeting of the Apple Growers Group organized by Alex Stone. Several Extension personnel, including Ruth Hazzard of the University of Massachusetts Vegetable IPM Program, Dan Cooley, Sonia Schloemann, and Arthur Tuttle of the University of Massachusetts Apple and Strawberry IPM Programs, and Vern Grubinger of University of Vermont Cooperative Extension, provided input and agreed to help with the project.

Funding from the Northeast Sustainable Agriculture Research and Education program allowed the project to begin in 1991. Meetings were held in the winters of 1992 and 1993. Margaret Christie and Ruth Hazzard coordinated the project, while Enid Wonnacott and Alex Stone acted as workshop coordinators and helped to provide project direction. Ed McGlew managed the money and complicated billing procedures, and the NOFA Council, under the leadership of Bill Duesing, provided valuable oversight. Margaret Christie did the final editing and layout of the proceedings, and Jack Kittredge accomplished their printing and distribution.

A number of additional people helped to make the project successful. Thanks are due to the researchers who agreed to attend the meetings, particularly to those noted above, who helped to plan and facilitate the sessions and provide research and training help requested by growers between meetings. The cooks at Rowe Camp and Conference Center kept us exceptionally well fed at our meetings. Most especially, we want to thank the participating growers, who were willing to share both their successes and failures. Not only did they supply the bulk of the information presented here, review the proceedings, and provide useful editing suggestions and corrections, but their enthusiasm and humor made for wonderful meetings. Although much of the information presented at the meetings is available here, the pleasure of the company of the grower groups is impossible to reproduce on paper.

Organic Container Plant Production in the Northeast

The certification guidelines in most states in the northeast required or were gearing up towards the requirement of the use of only certified organic vegetable transplants for field vegetable production during the period 1992-93. This policy put tremendous pressure on vegetable growers to learn to produce their vegetable seedlings organically or find a commercial source of organic seedlings. In addition, there is a growing consumer demand for organic bedding plants, and many organic greenhouse plant growers are looking for organic cuttings or other propagative materials. The container plant meeting was convened to bring together the most experienced container plant growers in the region to share and compile information relevant to organic production. All but two of the farmers were currently growing organically; the conventional growers participated due to their many years of experience in the bedding plant business and their interest in and experimentation with organic production. Both the conventional growers grow organically in the field.

The experienced organic farmers in this group felt that they were in general satisfied with their abilities to grow container plants organically. They have developed reliable compost-based soil mixes and experience few pest problems. However, most growers would like to make organic plant production more profitable. All the growers were interested in ideas that would make their businesses more efficient, profitable, and enjoyable--from new bedding plant varieties, to marketing techniques and record-keeping and planning methods, to new ways to work with employees.

Participants in the Greenhouse Farmer to Farmer Group

The growers in this group wish to remain anonymous. Several of them were already overwhelmed with requests for advice on farming practices, and were willing to offer information to one another and for the proceedings, but did not want their names or addresses published.

The 9 growers farm in Rhode Island, New Hampshire, Vermont, New York, and Massachusetts, and include mail-order and retail perennial and herb growers, wholesale and retail bedding plant growers, and vegetable growers growing vegetable transplants. The size of operation ranges from 1200 to 34,500 square feet of greenhouse space. Only one of the growers operates a year-round greenhouse (growing herbs, perennials and bedding plants). All the growers are full-time farmers.

Resource People

Alex Stone initiated a pilot farmer-to-farmer meeting of apple growers interested in organic production practices at the New England Small Farm Institute in 1991. She was one of the designers of the Northeast Farmer to Farmer Information Exchange, and facilitated the greenhouse grower group in 1992 and 1993. Alex managed an organic market garden in Belchertown, MA for 5 years, growing vegetables and annual and perennial bedding plants. She is now studying organic matter quality and decomposition and its relationship to disease suppression in the Plant Pathology and Environmental Science programs at Ohio State University.

Tina Smith is the Extension Specialist for Floriculture in the University of Massachusetts Cooperative Extension System. She spent an afternoon at the first meeting discussing greenhouse pest control. She can be reached at Room 212B, Stockbridge Hall, University of Massachusetts, Amherst, MA 01003.

David Holm is currently the farm manager and agricultural education coordinator at Hampshire College. He previously was farm manager at Maplewood Farm in Amherst, MA, and holds a Master's Degree in agricultural economics from the University of Massachusetts. David also chairs the Massachusetts NOFA Certification Committee. He joined the Farmer to Farmer group in 1993 to discuss record-keeping.

Ruth Hazzard facilitated the greenhouse meeting in 1992. She works as Vegetable IPM Specialist in the University of Massachusetts Cooperative Extension System, coordinating IPM programs in sweet corn, tomato, potato and crucifers. This project grew out of collaboration with NOFA on the Massachusetts NOFA organic certification committee and other NOFA projects, and out of contacts with farmers from her IPM work in Massachusetts and former farming days in Vermont. Ruth is co-coordinator of the Northeast Farmer to Farmer Information Exchange.

Margaret Christie, a coordinator and designer of the Northeast Farmer to Farmer Information Exchange, organized and facilitated the strawberry and apple grower meetings, and facilitated the greenhouse meeting in 1993. She was coordinator of the Second-level Apple IPM Project at the University of Massachusetts from 1989 to 1993, and is currently a student in the Rural Sociology Department at the University of Wisconsin at Madison.

Potting Soil Mixes

POTTING SOIL MIX	COMPOST INGREDIENTS	COMPOST MANAGEMENT
40% Moody Hill[1] potting soil or haylage compost 40% peat 20% vermiculite (sometimes added fertilizer, e.g. pelletized composted poultry manure) (this mix is used entirely for soil blocks made with mechanical blocker)	Homemade: greenchop haylage	turned 3 times once/month with loader and manure spreader used at two years old
Germinating: 4 parts brown peat 1 part black peat 1 part compost 1/4 part greensand 1/4 part colloidal phosphate 1 part perlite 1 part vermiculite **Growing on:** delete greensand and colloidal phosphate, add 1/4 part fertilizer 3-4-3 and 1/16 part lime		turned every 3-4 weeks with fork used at 1-1.5 years old pH 6-6.5
20 gallons Moody Hill[1] potting soil 1 cup bloodmeal 1 cup bonemeal 1 cup greensand 2.5 gallon vermiculite or 10 gallon screened brown peat 1/2 cup lime 1 cup bloodmeal 1 cup bonemeal 1 cup greensand 2.5 gallon vermiculite 5 gallon compost	dairy manure bedded in sawdust	turned 2-3 times with spreader and bucket loader used at one year pH 6.5

4 bushel brown peat 4 bushel compost 1 quart bloodmeal 1 quart bonemeal 1 quart greensand 1 quart colloidal phosphate 1 pint lime 1 bushel perlite	spoiled haylage/silage lightly bedded dairy manure added at one year: colloidal phosphate additional carbonaceous material if needed	turned 2-3 times with skid steer loader stored outside under plastic
10 yards compost 11 bales peat 11 bales perlite and/or vermiculite 50 lb. bonemeal 50 lb. bloodmeal 200 lb. greensand 50 lb. rock phosphate 90 lb. lime or 4 parts compost 1 part peat 1 part vermiculite	Ideal Compost Co.[2]	
5 gallons Moody Hill[1] potting soil 5 gallons peat 1 gallon vermiculite 1 gallon perlite 1 cup lime 1 quart: 2 part bonemeal 1 part sul-po-mag 1 part bloodmeal		
manure compost vegetative compost sand peat	manure compost: cow manure and bedding vegetative compost: garden, greenhouse and dried flower waste	turn 2 times/year by hand or with loader covered in winter

[1] Moody Hill is a commercially available compost and potting soil made by Moody Hill Farms in Armenia, New York.
[2] Ideal Compost is made by Ideal Compost Co. in Peterborough, NH.

Feeding Plants

Fertilization (topdressing)

Two growers topdressed potted herbs and perennials with new soil or 5-3-4 or 3-4-3 (commercial bagged composted hen manure) by hand every three to four weeks or as needed. These growers also fertigated.

Fertigation

Several growers applied fish emulsion and or liquid seaweed. One grower made manure tea by soaking a burlap bag of cow manure in a 50 gallon drum for 4-8 weeks. Some fertigated on a regular schedule and others only irregularly or very rarely. Some growers felt that their potting soil provided sufficient nutrition throughout the growth cycle of their plants, and that fertigation was only necessary when holding plants in extreme circumstances. Others felt that a regular fertigation after 4 or more weeks' growth was imperative for vigorous growth. The need for fertigation would vary depending on the nutrient content of the soil mix, the needs of the crop, the leaching of nutrients as a result of watering, the soil volume, the growth period of the crop, and general growing conditions.

Growers apply liquid nutrients either through the watering system through a hozon or from tanks or drums with a sump pump and hose.

One grower sprayed liquid seaweed on potted herbs; this grower no longer applied fish emulsion this way because she felt it attracted fungus gnats.

Insect Problems

In general, no grower felt that insects were an important problem on container plants (several growers had problems in their tomato greenhouses, addressed below).

Aphids

The most commonly encountered insect problem was aphids. Most growers felt that alternately heating and freezing the greenhouse in the winter and removing debris offered the best control of aphids. Several growers have applied insecticidal soap to control occasional aphid problems. Two growers released ladybugs but found that they fly away. One grower applied rotenone/pyrethrum. Tina Smith suggests monitoring growing tips of plants for aphids; relying on sticky cards is not effective because by the time you see them on the cards the population is already out of control.

Fungus Gnats

Several growers had experienced problems with fungus gnats. One grower vacuumed the gnats off the inside peak of the roof of the greenhouse; one grower applied Gnatrol (a *B.t.* for fungus gnats); another kept the top layer of soil dry by watering only early in the day if possible. Tina Smith says that there is a new biological product called "Exhibit,"

a beneficial nematode, which can be used to control fungus gnats. She has not worked with this product and doesn't know whether it is effective.

Whitefly

Several growers had experienced problems with whitefly. Most controlled them with insecticidal soap. One grower had released *Encarsia formosa* in a year-round greenhouse. She was not convinced that they helped control the problem and felt that they were expensive.

Tina Smith says that horticultural oils are very effective against whitefly. Oils smother insects and can be very effective pesticides. There are no vegetable oils labelled for use in greenhouses yet (and horticultural oils labelled currently are petroleum-based and not permitted for use in organic greenhouse production–only as dormant oils on trees). A problem with horticultural oils is their phytotoxicity; if using them, don't spray when sunny, and use them experimentally on small areas before applying them throughout your greenhouse. Some plants are more sensitive than others.

Whitefly problems in tomato greenhouses

Tina Smith spent some time discussing insect control in tomato greenhouses. She has worked with several growers on using *Encarsia formosa* as a biological control for whitefly. She and other researchers have found that *Encarsia* works fairly well to control greenhouse whitefly but not sweet potato whitefly. *Encarsia* are purchased for about $15/1000, and packaged 50 per card. She scattered them throughout the greenhouse by releasing them on individual plants which she tagged. She applied 1000 every week for seven weeks. She thinks that this may be more releases than was absolutely necessary, but says that it is hard to judge how many releases are enough. She looks for parasitism first on the tagged plants. Parasitized insects look black, so they are fairly easy to see, while greenhouse whitefly aren't easily seen as they blend in with tomato hairs. She stands under the tomato plants and looks up into the light to see parasitism. During the slower growing, lower temperature periods in the late winter, it may take three weeks before parasitism is noticeable. As the temperature increases, lifecycles speed up, and parasitism is noticeable earlier. *Encarsia* like the heat and longer days, and are most effective at temperatures around 80°F. You can use insecticidal soap while using *Encarsia*, but don't use pyrethrum or pyrethroids.

Tina notes that many growers bring whitefly in on plants bought from other growers. It is probably not a good idea to grow bedding plants and hangers in your tomato greenhouses. Whitefly, although unable to survive northeast U.S. winters, can move out of your summer greenhouse into the surrounding area, and then move back into your greenhouse in the fall when temperatures fall to freezing. One grower said that he thinks he should start releasing *Encarsia* in his tomato greenhouse in August (or two weeks before a frost) because he gets an influx of whitefly in September.

Leafhopper

Only one grower experienced problems with leafhopper and controlled them with insecticidal soap and rotenone/pyrethrum.

Thrips

Tina has found that many greenhouses do have thrips although many growers are unaware of the problem. Thrips rasp plant tissue, causing a silvery mottle and stippling on new growth and flowers. Necrotic spots appear on leaves, while the tissue inside remains green. New Guinea impatiens are very susceptible to thrips. Some growers use white petunias (particularly the variety "Calypso") as indicator plants, as lesions appear on the plants immediately after feeding. Tina Smith reports that some growers use impatiens or fava beans as indicators, but that they require more skilled eyes. Thrips are of concern as they can carry tomato spotted wilt virus, which can seriously damage vegetable crops. Thrips caught on sticky traps can be tested for the virus. Removal of all plant debris and then alternate heating and freezing of the greenhouse can eradicate thrips. Heat the greenhouse for a week to hatch out the eggs and then freeze the house and repeat that cycle.

Screens

Tina discussed the use of screens to keep insect pests from entering greenhouses. Researchers have demonstrated that the use of screens, particularly of small hole size, require that growers install much larger ventilation systems to compensate for the decreased air intake. This makes the use of screens more expensive, but Tina reports that growers are beginning to use them.

General Cultural Tips

Tina advises growers to keep greenhouses clean of all dead plant material. Don't let weeds grow in or around greenhouse as they can be hosts for both insect pests and disease organisms. Tina has found diseases and aphids on weeds directly outside greenhouse intake vents. Freeze the greenhouse in winter. Heat and freeze alternately for even better winterkill. Ventilate and circulate air for disease prevention. Tina highly recommends the book *Biological Pest Management for Interior Plantscapes* by Steiner and Elliot (see references).

Disease Problems

The only disease growers had encountered was damping-off and only in certain crops (early spring basil, snapdragons, pansies, vinca) or during cloudy periods. Most growers felt that bottom heat and adequate temperatures, spacing, control of watering and adequate air movement decreased or prevented the incidence of damping off. One grower stopped using humidity domes because they increased disease incidence. One grower applied perlite to the surface of seed flats and also applied chamomile tea. Another removed seed flats from the germination chamber immediately upon germination to decrease incidence of damping off. Properly composted mature compost in a soil mix should help suppress the various damping-off and root rot fungal diseases.

Cuttings

Neither herb grower used a mist system or rooting hormone to root cuttings. For *scented geraniums,* they cut only semi-hard growing tips and allow them to air dry in the shade. One grower roots them in 1/2 sand : 1/2 sphagnum. One grower uses humidity domes over trays in the shade on bottom heat. For *tarragon,* they use only firm stems. Beginners must experiment to learn what type of cutting to take.

One grower takes *rosemary* cuttings in August from field stock. Field plants are overwintered in the greenhouse; they are set into cold frames in March and into the field in mid-May. The cuttings are rooted at 65°F on heating cables in 6-pack cells (half sand, half sphagnum). These are sold in 10" pots for $20 or 12" for $26. She wholesales them at Christmas if there are too many left over. Rosemary plants can be overwintered in a greenhouse kept at 30-35°F. She only digs rosemary field plants after several hard frosts because they wilt if they are still growing.

Special Crops

Geraniums

One grower was having trouble getting his seed geraniums to bloom in time for Memorial Day. Others suggested that he try growing cutting geraniums, as they may be a easier crop to grow and also to make money growing. A rooted cutting transplanted in the third week in March should bloom by Memorial Day.

Miniature roses

An herb and perennial grower buys miniature rose plugs in February to sell in 4" fiber pots for Mother's Day. They are very hardy and look best if grown fairly cold in a cold frame. Customers buy them to grow in their herb and perennial borders.

Fall pansies

One grower seeds variety "Springtime" in 1020's in September. He transplants them into 806's in October and grows them on benches in an unheated greenhouse. The temperature ranges from 20°-60°F (he keeps fans running). He waters every few weeks. He moves them out to cold frames in the late winter/early spring and sells them in April (southern Vermont). Another grower seeds them August 15th and transplants them outside into the field September 15th, then digs them in the spring. Another grower grows them in packs but winters them in a cold frame. He takes the plastic off, allowing snow to accumulate as insulation, and then puts the plastic back on (northern Vermont).

Hibiscus

One grower grows Southern Belle and Disco Belle in an 8" mum pan, starting the seed on February 1.

Patio tomatoes

One grower grows "Patio" from Stokes, selling them in 6" or 8" perennial pots for Mother's Day for $4.75 (with green fruit). The plants will produce red tomatoes by Memorial Day.

Germination Systems

Several growers started their earliest crops in the house or basement, using lights and a heating tape or mat. One grower heated a basement room with a wood stove in addition to heat tapes. Most growers devised some sort of in-greenhouse germination system. Some built shelf-type germination chambers separated from the rest of the greenhouse by plastic sheeting and heated to 80°F with an electric heater. These can be made smaller or larger by removing or adding plastic, so they are very adaptable to changing germination space requirements. Several growers used heated benches, heated either by heat tape or by forcing hot air under the benches. One grower used heat cable on the floor of the greenhouse. Several growers used plastic tray domes to maintain humidity in flats, and some growers used inverted seed flats to exclude light for seeds requiring dark.

The largest grower has two 20x100 germination greenhouses. In each house there is a middle bench with bottom heat. After seeds germinate, the flats are moved to non-heated benches in the same house until ready to be transplanted. In one of these houses he has hot water tubing for bottom heat, and this grows better plants than the forced air system. He places either a screen or capillary mats over the tubing; the mats work best for growing plugs because the plugs, which often remain too wet, dry out faster. He uses a 288 plug tray because it is more forgiving.

Equipment Innovations

Watering

Two growers had installed elevated hoses. One of these advocates buying the commercially available ones, as he has so far been unsuccessful in fabricating an effective version of the piece which keeps the hose from kinking. One grower successfully watered his perennials with a whirlybird sprinkler. He also plans to install spaghetti-tube irrigation for his mums. One large grower did have automatic overhead irrigation in one greenhouse, but other growers noted that in a very diverse greenhouse operation, automation would probably not be feasible due to the very different watering requirements and pack and pot sizes of different crops.

Seeding

Several growers used an innovative handmade plexiglass seeder used to seed *Brassica* or pelletized lettuce seed into plug trays. A top sheet slides over a fixed bottom sheet with small holes in it, dropping seed into plugs. Others used some type of hand seeder. One grower used a vacuum seeder.

Germination

One grower places a porous plastic cloth (commercially available for this use, also marketed as a row cover) over his small-seeded seed trays. The material prevents seed from being washed down into the soil when watered and has dramatically increased his germination rate.

Soil mixing

One grower borrows a neighbor's mixer wagon, which makes mixing a soil mix much easier and more efficient. Others have used cement mixers.

Soil blocks

Several growers use soil blocks, primarily for growing vegetable transplants. One grower has purchased a mechanical blocker, greatly facilitating the blocking process, and is growing vegetable blocks for himself and other commercial vegetable growers.

Greenhouse plastic

One grower is installing quick locking systems (which attach plastic to frame) on his greenhouses as he replaces plastic because it makes removing and putting up plastic so much faster and easier.

Greenhouse heating

One grower has constructed a large horse manure pile outside his tomato greenhouse with 3/4 inch pipe running through it. This pipe runs through the soil of 10 tomato beds in the greenhouse and into a water tank which provides irrigation water. The water leaves the compost pile at 94°F and the water tank at 80°F. He feels that this heating system will heat the tomato beds and watering system effectively throughout the winter. A new compost pile will be made early the next winter. The greenhouse also has a gas hot air heating system.

Another grower has a solar wood-framed attached greenhouse which does not require backup heating after the end of March (southern Vermont). The greenhouse benches sit on 50 gallon drums filled with water. The water does not get above 58°F, so when a higher temperature is required backup heat is necessary. This greenhouse is used as a germination/starter greenhouse. Both endwalls are insulated, and he does have problems getting adequate light during cloudy periods. This greenhouse also works well for growing summer flowers, as it begins to be partially shaded in mid-May.

Greenhouse circulation/ventilation

One grower built a wide door on an endwall which has a horizontal hinge; the top half of the door can be unhooked and folded down, thereby ventilating without directly exposing plants on the floor to cold drafts. Many growers had removable endwalls and removable or roll-up kneewalls. Two growers have recently constructed Poly-Tex XA 300 A-frame houses (for greenhouse tomatoes) with blower-controlled collapsible top vent and

walls. These can be sequenced, so different sections open at different temperatures, providing excellent temperature control.

One grower uses jet fans for heating in his bedding plant houses as they give the best distribution of heat. He uses horizontal air flow in all greenhouses which don't have jet fans. He installs two 20" fans in 14 ft. greenhouses and four 20" fans in his larger houses.

Bench structures

One grower is using conduit on top of steel shipping boxes (used to ship small Kubota and John Deere garden tractors--given to him by local dealer) as benches. Another uses irrigation pipe to support field flats on the floor of a greenhouse as they are so easy to move. One grower has a house with rolling steel benches to maximize bench space. Because the benches are so expensive, he feels that this is only economically viable for a year-round greenhouse.

Potting

A grower built some portable potting benches which can be moved anywhere in his greenhouses. The benches raise the flat to a height comfortable for transplanting. Workers are able to comfortably transplant flats at the location where they will be grown-on, minimizing flat moving and back problems.

Greenhouse floor groundcover

In a retail greenhouse, a grower has a self-seeding *Polygonum* "Magic Carpet" growing around the benches and walkways. It flowers and self sows about three times a season and flourishes despite trampling. Customers love it. Tina Smith pointed out that it could harbor fungus gnats, but that has not seemed to be a problem in this greenhouse.

Marketing

A grower who sells at farmers markets recently started using a little white picket fence as part of her display and found that it is a great way to attract customers. She displays her herbs at different levels on the fence.

A grower who has a large retail stand has put together a haunted house in one of his greenhouses for the last three Halloween seasons. By the third year, it was definitely attracting new customers.

Growers who do have display greenhouses at their stands often don't like them, while growers who don't have them wish they did. Display greenhouses require careful management. One grower says that people don't like to take the time to walk through the greenhouse attached to his stand. He prefers to display his plants on benches outside his stand. One grower displays her basil at the far end of her retail greenhouse to force people to walk to the end so they will see all the plants.

A retail herb grower manages display gardens around her greenhouse. The herbs are all labelled so people can walk around and see what the various plants actually look like in the garden. She collects seed and everlastings from this garden, and digs up self-sown plants to sell (e.g. plantain, chamomile, stinging nettle). These gardens require a lot of upkeep, and she feels that she never has the time to make them look their best.

Record keeping

Most of the growers use some form of paper record-keeping for planting schedules and labor accounting, although few of them are satisfied with their current system. Several growers with many years experience are able to manage their operations from memory. One grower has a large, inexpensive plastic-coated wipe-off poster on which workers record how much time they spent on each crop each week; the numbers are tabulated at the end of the year.

Several growers have labor time sheets of varying degrees of complexity. Some use the numbers collected from these sheets to make crop budgets and for other planning purposes and to determine where their labor inefficiencies are.

David Holm uses computer-generated charts, with columns headed: *seed type, date to be seeded, # plug trays to seed, # flats to be transplanted from seed flats, flat type.* These charts can be sorted by date, crop, or other category for different uses. For example, sorting by date provides a list which can be posted for employees of what needs to be seeded or transplanted that day. David keeps a copy in the greenhouse, and employees cross off items as they are seeded or transplanted. Seed germination failure, or early or late maturation of greenhouse crops is noted on a sheet in the greenhouse. David takes an inventory June 15th, and puts all bedding plants on sale at that time. He takes another inventory in July before he throws plants away. These inventories are used to plan for next year.

Computers

David advises that it is generally a good idea to buy a computer locally, so you have the benefit of the local store's knowledge, support, and repair and replacement services. Computers can come with defects, and they will often show up in the first year. The first year you are working with a computer system, you should keep paper printouts of all your work in case you lose information by mistake. No computer method is of any value if you are not collecting good numbers to plug into it (e.g. time it takes to do certain tasks, labor hours, number of plants sold and thrown away, etc.). Good record-keeping is very important.

Spreadsheets

Lotus and Quattro are two standard spreadsheets which can be used to generate planting schedules, accounts, seeding schedules, budgets, and basic accounting. Quattro allows you to link spreadsheets. You can have a spreadsheet for equipment use and single crops, and can call up information from one to use in the other (e.g. cost per square foot greenhouse space in March can be inserted into geranium budget).

Quicken

Quicken is a fairly simple software package which can be used for balance sheets, bookkeeping, check-writing, payroll, tax preparation and invoices.

Managing employees

Most growers agreed that this is one of their most important and difficult jobs. Farmers have to ask a lot from employees but can't pay them very much money. Although some growers have people who work for them for many years successfully, others feel that employees often slow down after a few years. One grower gives people a half-paid vacation in August so they get a break and don't burn out. He also will hire a big crew to do a big job so it gets done quickly and is more fun. He tries to maintain more of a friendship with employees, by eating dinner with them and going swimming. He also hires people based on how they might all work as a group. Another large grower tries to give his employees flexibility in hours and in what they do. One grower has a suggestion box next to the time cards in her greenhouse.

Some growers have weekly or bi-weekly meetings to discuss how things are going, to plan, to do time sheets, etc. These growers feel that they could not run their farms without regularly scheduled meetings. Not only do the meetings help them become more organized, but they were able to deal with small problems before they became big problems. One grower asks his employees for feedback about how he is doing as an employer; he asks them specific questions, like "How does it make you feel when I am not in the field two days a week?" Other growers have tried to have meetings but they fizzle out as the season progresses and gets busier.

Several growers were trying different ways to give themselves and their employees more space. Some have constructed employee "lounges" in barns or sheds. Others have set up picnic areas outside where workers can eat lunch or sit while on breaks. They generally allow people in the house for lunch during wet weather. Several growers felt that it was important to give themselves and workers full hour lunches.

One grower has each employee, or one person on a team, wear a watch and keep track of how long it takes to do a certain job. He has a book of standards which contains a list of jobs and how long it should take to do them. Most of his workers like to have an achievable standard to beat. It seems to help some workers remain motivated if they understand that job X must be completed in time Y or the farmer cannot make money on the crop.

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Greenhouse

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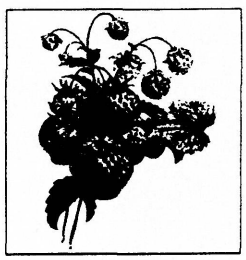

Strawberries