1981

The Solar Salad Bar

Guavas to garlic in the organic greenhouse

By Linda Gilkeson and Susan Mahoney

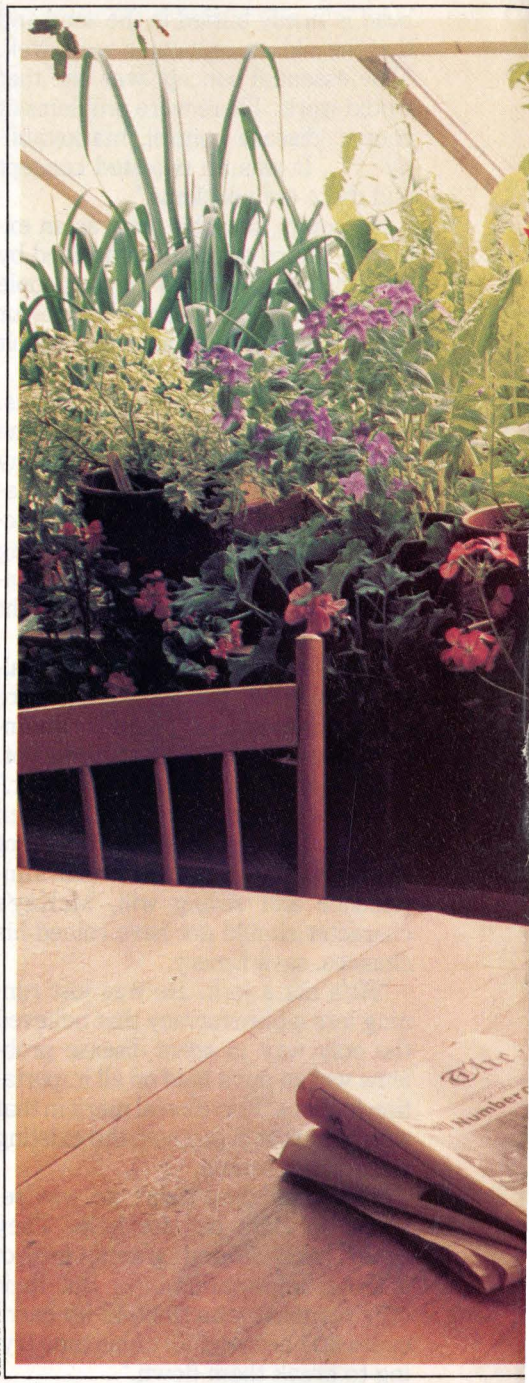
As the staff of the Ark assembles around the big dining table, one of us makes a head count and an entry on the kitchen clipboard: "Domestic greenhouse, lunch, February 9, 12 salad servings." Today's salad, freshly picked from the greenhouse beside the table, will include spinach, chard, several varieties of leaf lettuce and a few broccoli florets, a vine-ripened tomato, a few green onions, radishes and a handful of parsley.

Twelve fresh, organically raised salads in the dead of a Canadian winter. All of this bounty comes from a home addition whose popularity has burgeoned within the last few years, an attached solar greenhouse that, in this case, spans the south side of the research institute's "living area" (although no one actually lives here at the Ark). Behind an expanse of double acrylic glazing that slopes down to meet a kneewall of thermopane glass, the attractive 240-square-foot greenhouse is a jungle of plants; plants in beds, plants in pots and plants hanging from the ceiling. There are over 60 varieties of vegetables, 25 types of flowers, several dwarf citrus trees, strawberries, a dozen herb plants, a grape vine, a guava tree and a dwarf peach. This past summer, there were zucchini and crookneck squashes, beans, garlic, fennel and sweet potatoes – part of a demonstration to prove that, if necessary, a greenhouse could take the place of an outdoor garden.

The riot of greenery and colour created by the vegetables, fruit, herbs and flowers has been achieved through experimentation and careful observation over the years. The greenhouse is a showplace year-round, demonstrating the potential of intensive home-greenhouse horticulture to the 5,000 visitors who tour the Project annually. The scent of blossoming hyacinths in February and the sight of herb plants growing within easy reach of the kitchen counter excite the imagination far more than armchair gardening ever could.

Various insect species make their home amongst the vegetables, and the soil, which has never been steamed or sterilized (a process taken for granted in most commercial greenhouses), teems with life. Yields from the small area are very high; insect pests are controlled biologically; diseases are virtually unknown.

Our situation here at the Ark, a federally funded research and demonstration centre near Souris, Prince Edward Island, is, in an important sense, unique. One might expect that, with the help of a trained and dedicated staff, it would be easy to come up with the results we do. This attached home-style greenhouse represents, however, only a very small part of the work at the Ark and, as such, receives only about as much attention as an average home greenhouse would have.



Camera Art

While our jobs are certainly made easier by the resources we have available, our greenhouse success is not unique. For instance, Doug Miller and Denise Reiser of Melville, P.E.I., do not spend much time on the maintenance of their two-year-old attached solar greenhouse, but are still able to harvest fresh winter greens, grow their own transplants, and produce European cucumbers which they market in a local corner store.

Their neighbours Cef and Wendy

The Ark's solar greenhouse is a profusion of herbs, flowers and vegetables, a verdant Eden under glass.

Pobjoy are able to supply some of their own plant materials for Cef's work in landscape gardening, thanks to their attached solar greenhouse. Estimating that the greenhouse also produces about six salad servings a day, Wendy says that she "would find it really hard to live in a house without a greenhouse."

Stories like these are being told across the country with increasing frequency and, we hope, with increasing success. The experimentation that we are carrying out here at the Ark should be helpful not only in the Maritimes, but to all northerners who are interested in efficient, organic food production.

The attached solar greenhouse is a relatively uncomplicated structure. It can be inexpensive to build and, if designed for passive solar heat gain as ours is, relatively inexpensive to heat. There are several books available on the design of passive solar attached greenhouses, but most are geared to southern climes. The northern winter, with its short days, low sun angles and bitterly cold temperatures, forces the builders to utilize sound carpentry practices and proven greenhouse designs as much as possible. We have seen some wonderfully ingenious greenhouses that, unfortunately, do not support plants.

Like any greenhouse, ours is not simply an outdoor garden under glass. Enclosing the plants makes all the difference in the world. Fresh air, moisture, light, pollination and proper temperatures must all be regulated by the gardener, who must also attend to the regular chores of pest control, thinning, pruning and harvesting. While failure to take care of any of the plants' needs will limit or halt its growth, the atmospheric environment in the greenhouse is even more important but is often misunderstood or simply ignored.

In the solar greenhouse, temperatures are going to vary considerably with time of day, season and weather conditions on any particular day. Plants will grow best between the temperatures of 55 and 85 degrees F (13 and 30 degrees C). Some vegetables, such as tomatoes, will become unproductive and disease-susceptible at temperatures beyond these limits while others, such as lettuce, will tolerate slightly lower temperatures but growth will be very slow.

Fifty-five to 85 degrees F is not a very wide range, especially when contrasted with the extremes of temperatures that are possible within a glazed space. Even in weak winter sunlight, temperatures in a closed greenhouse can quickly soar to 105 degrees F or higher. In contrast, on winter nights, if no moderating influence exists (such as thermal mass, insulated shutters, a curtain, heat from the home – or, preferably, a combination of these), the temperature will drop rapidly to the freezing point or lower. Very few plants can tolerate conditions such as these. Moderate temperatures and only moderate temperature changes are required for healthy, vigorous plant growth.

During sunny days this means that the venting of excess heat is necessary, either by a small fan or by natural convection (hot air moves up – and out escape routes provided) that will direct heat into the home. In the summer, such ventilation must be exceptionally well designed to move air sufficiently. While some overheating can be prevented by shading, this limits light as well, and vegetables need as much light as possible. Besides, air in shade is not necessarily cool. Heat builds up even in a well-shaded place if the air is not moving.

At the Ark greenhouse, the lower vertical thermopane windows swing open to provide ventilation, and there is also a complete row of vents along the ridge above the glazing. If the openings at the ridge and along the kneewall and endwalls are large enough to ensure good natural convection, adequate ventilation can be achieved this way in a home greenhouse.

IN WITH THE GOOD AIR

A good guideline is to have the vents cover an area at least one-sixth as large as the floor area of the greenhouse; that is, if the greenhouse is 180 square feet, 30 square feet should open to the outside. This could include a side door. Vents for air entry should be low down, preferably along the kneewall, while those for air escape should be as high as possible. All vents and doors should be screened to prevent the entry of mice, flies and night-flying moths (which can produce some very destructive caterpillars on the greenhouse foliage).

Besides controlling temperatures, ventilation also replenishes carbon dioxide, essential in plant photosynthesis. Because carbon dioxide is not visible, its importance in the greenhouse is often overlooked – but not by commercial growers, who often find artificial carbon dioxide enrichment beneficial in their greenhouses.

Too, on most days, ventilation will dehumidify the greenhouse. The ideal relative humidity (R.H.) is about 60 per cent. Humidity higher than this – a problem especially in coastal greenhouses – can cause a number of problems including fungal diseases and condensation on wood and glazing, causing wood decay and the lessening of light transmission through the glazing. An R.H. lower than 60 per cent – a frequent winter problem in inland areas – causes soil to dry out excessively and encourages some insect pests such as spider mites. The humidity can be raised by watering the walkways or by spraying a very fine mist into the air. Do not wet foliage on bright, sunny days, however, as the sun's rays can be magnified through drops of water, causing leaf burn.

GREENHOUSE VACATIONS

Because of the plants' atmospheric environment requirements, it is not worthwhile to keep the greenhouse operational year-round in some cases. Those blessed with a long outdoor growing season may choose to empty the greenhouse for the summer, put a heavy, cooling mulch on the soil to keep it from drying out, open all the vents, and leave it that way until the fall. This is a good idea for those who like to take summer vacations. An outdoor garden may be able to take care of itself for a few weeks, but a greenhouse cannot.

On the other hand, those in very cold, northern areas may find that the operating summer greenhouse presents their only possibility of harvesting tender crops. In winter, though, they may find that the expense and effort necessary to keep the greenhouse going through the short, frigid days are not worthwhile. Plants need a certain amount of light as well as warmth. A greenhouse in such cold, low-light conditions will likely become an unproductive and hard-to-heat burden.

In such a situation, though, the greenhouse can still be used as a solarium, a sun room and a solar collector for the house. It can be opened to the house during sunny days, and closed off on overcast days or at night. While this greatly limits the greenhouse's horticultural possibilities, it does mean that it will contribute heat to the home without draining any away. Solar collection and good gardening are *not* always compatible. In the cool, cloudy climate of Prince Edward Island, we run the greenhouse year-round, with our usual priority as horticulture rather than solar collection.

MIXED MEDIA

The growing medium in the greenhouse has to be somewhat different from that in the garden. Most greenhouse soils are worked harder than garden soils, because they do not have the benefit of winter rest and the freezing and thawing that improve soil texture and help correct the results of overcultivation. A regular garden soil used on its own in the greenhouse will compact, becoming heavy and often impenetrable to plant roots.

Good topsoil is, however, the main ingredient in our greenhouse soil mix. Chunks of sod may be left in the soil to add to the organic matter content, which is further enhanced by the use of compost, an ideal soil amendment that supplies major and minor plant nutrients as well. A good substitute for compost is very well rotted manure. If there is no other source nearby, one may purchase it dried and bagged in garden centres.

Compost that has been further digested by worms is an ideal fertilizer in soil mixes. All winter long, we keep several two-by-three-foot wooden boxes filled with worms and compost and covered with a sheet of burlap under the greenhouse bench. In the summer, the worm beds are removed to a cooler place in the root cellar.

Behind a potted fig tree and under a blooming begonia, Maureen Sirois checks the greenhouse dill for the presence of beneficial insects.

Camera Art

A steel-framed attached solar greenhouse enables Doug Miller and Denise Reiser of P.E.I. to pick fresh salads all winter.

Conditioners such as vermiculite, sand and peat moss are used to lighten the soil texture, permitting good drainage and aeration in the root zone. If the mixture drains too quickly, more peat moss can be added to increase moisture retention; if it drains too slowly, add clean, coarse sand. Vermiculite is a good but expensive lightener that contributes calcium and magnesium to the soil, desirable in acid soils but not welcome in alkaline ones.

PARTS PER MILLION

A yearly soil test report will include recommendations for the application of lime or other nutrients. Be sure to request the test for an outdoor garden or field soil, *not* for greenhouse soil. The latter tests soluble nutrients in parts per million. Because of a mix-up, we once received the results of such a test and were thoroughly astonished to read that the nitrogen level in our soil was at the bottom of the measurable scale, even though enormous dark green broccoli plants and a profusion of leafy greens were living testament to an abundance of nitrogen in the greenhouse. In fact, there was plenty of nitrogen available to them, but it was held in the organic matter fraction of the soil and wasn't readily soluble and so didn't show up in the test.

Liming recommendations should be followed carefully. If too much lime is added, creating an alkaline soil, the condition can be difficult to correct. The usual recommendation in the Maritimes (our soils are very acidic) is to add 2,000 pounds of lime per acre. This may sound like a lot, but represents only about five pounds per 100 square feet – a very light dusting of the soil is all that is required. Other nutrient deficiencies can be remedied organically. For instance, bone meal supplies phosphorus, wood ashes supply potassium, and blood and fish meals supply nitrogen. Seaweed is an excellent addition, contributing a variety of micronutrients and plant hormones. It can be dug in raw or purchased as a dry powder – a good investment even for gardeners who live far from the coast.

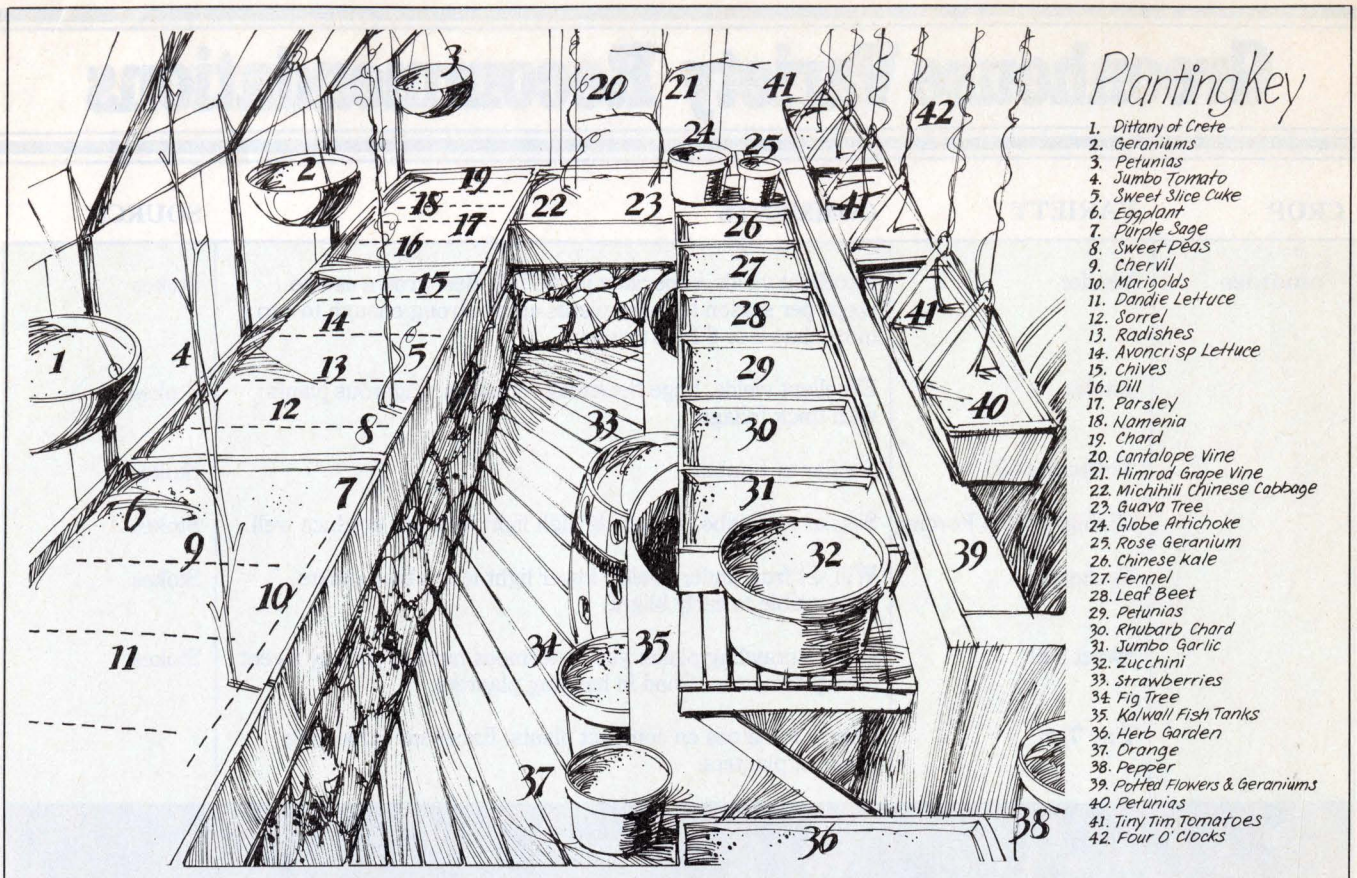
Denise Reiser's greenhouse fertility programme involves watering with compost and manure teas on a fairly random schedule – "I use manure tea whenever the plants look a bit pale and especially when fruits are setting. I also add rock phosphate, bone meal and use seaweed extract occasionally." The mainstay of the Pobjoys' fertility programme is composted chicken manure; the soil mix is equal parts garden soil, peat and vermiculite.

DEEP BEDS

Most of the soil mix, which should be tested and augmented from time to time, will be placed in the growing benches, the long beds that extend along the south wall of the greenhouse. The soil surface should be level with the bottom edge of the glazing. If it is even a couple of inches below the sill, it will be shaded, cold and unproductive for several months in the winter – the low winter sun casts very long shadows.

The soil should be at least a foot, and preferably 18 to 24 inches deep to minimize temperature fluctuations and maximize the root zone. At the Ark, space under the benches

Susan Mahoney



THE DOMESTIC GREENHOUSE: Schematic diagram of the plantings in the Ark's indoor kitchen garden, showing arrangement of vegetables, fruits, herbs and flowers.

was filled with field stones to increase the thermal mass in the root zone and to provide drainage from the soil above. Sheets of wire mesh were placed over the field stones, and a deep soil layer was piled on top of that. Gravel, containers of water, or any other material with good heat-storage capability could be used under the soil to achieve the same effect. If the bottom of the bed or planter is unavoidably solid – say, a concrete floor – leave at least a foot of gravel and stone between the floor and soil.

When building the benches, avoid wood preservatives, as they are harmful to plants. It is better to use inexpensive scrap wood which may need replacing in five years than to risk using a preservative such as pentachlorophenol or creosote inside a greenhouse. Though expensive, cedar is very attractive and resistant to decay, and lower grades can often be obtained at much less cost. Hemlock is also slow to rot. Denise Reiser is presently using hemlock boards to rebuild her soil beds, increasing their depth from 10 to 20 inches.

Ian Grainge

Greenhouse soil should be watered deeply and infrequently, whenever the soil surface is beginning to dry out, but before plants start to wilt. Overwatering is as harmful as underwatering, because roots will quickly rot in soggy and airless soil.

Because hard water may eventually cause the unhealthy build-up of mineral salts in the soil, a simple rainwater collection system is a good idea. In cities, allow chlorinated water to stand in an open container for a day or two, to allow chlorine gas to escape. In any case, drawing water into a holding tank is a good idea, because the water then has an opportunity to warm to room temperature before it is used. Because the routine of watering can become tedious, try to make it as simple as possible by providing easy access to the beds and a step stool for checking hanging plants.

CROP CHOICE

The temperature range that can be economically maintained in the greenhouse will be a major factor in one's choice of appropriate crops. While plants that set fruit, such as melons and tomatoes, require a great deal of light and predictable warmth to be productive, leafy greens will continue to grow, albeit slowly, even in a cool greenhouse. Some vegetables, such as radishes and onions, respond to day length and will not produce good roots in the short days of winter. We do, however, plant a small bed of radishes in midwinter, because a few always form good-sized roots and the rest can be eaten as salad greens.

Naturally, personal preferences will be important as well. Since space is very valuable, be realistic. Kale was planted once in the Ark greenhouse because it was well known as an indestructible, cold-hardy green, adaptable and prolific – but as it turned out, nobody really wanted to eat it when they could choose fresh chard, lettuce, celery or broccoli. We have learned to plant more parsley and chard in the greenhouse every year, but we don't plant kale now, though it is heartily recommended to anyone who truly likes it.

The size and success of an outdoor garden will also determine greenhouse crops. Peas provide relatively little harvest for the space they take up, and are best planted outdoors. It

Greenhouse Variety Recommendations

CROP	VARIETY	COMMENTS	SOURCE
Tomatoes	Vendor	Excellent yields, especially in the fall. Best grown as two crops per season because plants aren't strong enough to carry more than 5 or 6 fruit trusses.	Stokes
	Jumbo	Excellent yields, huge beefsteak tomatoes. Vigorous plants with thick foliage.	Stokes
	Tuckcross 533	Similar to Jumbo.	Stokes
	Michigan Ohio Forcing	Similar to Jumbo, but needs high light levels to produce well.	Stokes
	Tuckqueen	Will set fruit under cooler, lower light levels than others. Susceptible to early blight.	Stokes
	Sweet 100	Huge, sprawling plants yield enormous number of very sweet cherry tomatoes. Good in hanging planters.	Stokes
	Tiny Tim	Cherry tomatoes on compact plants. Excellent in hanging baskets, planters.	
Loose-Head Lettuce	Dandie	Excellent flavour and yield in the fall.	Suttons
	Ostinata	Most suitable for spring crop.	Stokes
	Deci-Minor	Suitable for fall and winter crop.	Stokes
	Winter Density	Romaine-type head; performed well in cold frames in early spring; very popular in salads. Worth a try in the greenhouse.	Suttons
Cos Lettuce	Ramcos	Good summer crop.	Thompson & Morgan
Cutting Lettuce	Avoncrisp "Cut and Come Again"	Sow thickly in beds and cut back completely instead of just the outer leaves. Crisp leaves grow back quickly and give exceptional yield per area.	Thompson & Morgan
Chards	Fordhook	Broad white-stemmed chard; slow in winter, excellent crop rest of year.	Vesey's
	Rhubarb	Slow in winter, not quite the yield of above but a favourite in flavour and appearance.	Vesey's
	Perpetual Spinach (Leaf Beet)	English variety similar to chard but has fine stems and smoother leaves. Excellent growth early spring through fall. Some people prefer the flavour to that of chard.	Suttons
Turnip Greens	Namenia	Smooth, serrated leaf; a favourite winter salad green, always mild and tender. For maximum yields, cut entire plant back to 1 inch above soil level. Plants regrow, and yield continuously for 6 months.	William Dam
Mustard	Green Wave	Good in cool weather for quick short crop. Gets hot and tough if left too long.	

Of the many varieties tried, these have performed particularly well in the Ark greenhouse, and are listed here as a general guideline. For the addresses of these and other seed sources, see *Seed Sources 1981,* page 86.

CROP	VARIETY	COMMENTS	SOURCE
Spinach	Giant Winter	The best yielding variety for fall and winter. Large, tender leaves.	William Dam
	New Zealand	Thrives in hot weather, fine in cool conditions. Has a high oxalic acid content and should only be eaten cooked. Self sows madly.	Stokes
Misc. Greens	Sorrel	Thrives year round in greenhouse from annual replanting. A treat in salads.	William Dam
	Rocket *(Brassica eruca)*	Hot, peanut-like flavour; great in salads. Sow at frequent short intervals.	William Dam
	Parsley	All varieties tried have done well.	
	Collards, Kale	Both are cold hardy, insect and disease resistant.	
Celery	Florimart Tendercrisp	Both grow slowly but tolerate continuous picking of outer stalks quite well.	Stokes
	Leaf Celery	Tender, light green foliage with narrow stalks; for flavouring in soups and salads.	William Dam
Broccoli	Cleopatra F_1	Takes up space but yields continuously all winter after main head is cut.	Stokes
Radishes	Scarlet Globe Forcing	Bred for greenhouse culture. Worth planting even in midwinter. Very quick crop in the spring; produces mild radishes of high quality.	Stokes
Cucumbers	Sweet Slice	Superior yield of dark green, smooth cucumbers; vines resist insect pests.	Stokes
Chinese Cabbages	Michihili	One of the best for continuous harvest.	Stokes
	Snow Mountain WR Crusader, Pai Tsai	Excellent growth under cool conditions characteristic of most Chinese greens.	Herbst Brothers
Herbs	Rosemary	Thrives in the cool, moist greenhouse over winter.	
	Sage, Thyme, Oregano	Dig from the summer garden and overwinter indoors in the brightest, warmest location.	
	Basil, Sweet Marjoram	Need very warm conditions, neither do well in the winter at the Ark. Fine spring to fall.	
	Chives, Mint, Lemon Balm	Dig from outdoor garden after a cold snap has frozen foliage. Cut back old tops and they will grow vigorously indoors.	
	Dill, Chervil	Sow seed directly in benches regularly throughout the year for fresh herbs.	

doesn't make much sense to grow carrots in the greenhouse if a garden crop is stored in the root cellar, but if the greenhouse is one's only garden, almost anything can be grown there. Some vegetable varieties are specifically selected for growing in greenhouses or cold frames. Check for the word "forcing" in the variety name; for example, *Scarlet Globe Forcing* radishes are a greenhouse selected strain of *Scarlet Globe.*

This doesn't mean that regular garden varieties won't do well in a greenhouse. Some do very well. Just remember that the most productive plants are those which tolerate continual harvesting, either growing back after being cut down completely, or growing near centre leaves as the outer ones are picked. Some vegetables such as cauliflower take up a lot of space and are harvested only once, whereas some broccoli varieties produce florets throughout the season.

SEEDING

We achieve maximum production by starting most seeds in wooden or fibre flats, recycled until they disintegrate, transplanting the seedlings later into the benches. A good mix for flats, whose soil should be lighter than the bench soil, is two parts topsoil, two parts peat, two parts vermiculite and one part screened compost.

As we mentioned earlier, the soil and compost are not sterilized, and yet in three years of use we have had little trouble with damping off, the fungal disease that causes seedlings to die before emergence or to shrivel and collapse at the soil line. Avoiding overwatering and providing warm germination temperatures, good light, fresh air and a light, compost-enriched soil mix are the best insurance against damping off.

The soil mixture is lightly pressed into the flat and watered sparingly. The seeds are placed on top of this, and a layer of vermiculite spread over the seeds to cover them. Seeds that require light to germinate are covered with a very thin layer of fine vermiculite, which allows light to reach the seeds while keeping them moist. The flats are then sprayed very gently with water – they are *not* watered from the bottom as some books recommend – and placed in a warm spot for germination. (A small area of one bench equipped with bottom heat and grow lights results in excellent germination, which usually proceeds best with a soil temperature of at least 60 degrees F.)

Once the seedlings have sent up a few leaves, they can be either transplanted to the benches or set in containers or flats at a greater spacing to allow them to grow more before they are set out. This system of seeding and transplanting maximizes the use of the space in the greenhouse, but it does require more labour than is involved in seeding directly into the benches.

A principle we follow as much as possible at the Ark is to leave no space in the bench empty for more than 24 hours. This takes some planning because seeds should be sown in flats three to eight weeks before they are set out, depending on variety and time of year. Because Chinese cabbage is one crop which does well at almost any season of the year in the greenhouse, a small flat of seedlings is kept ready year-round, so that there is always something to transplant into openings in the bench. Of course, some plants such as radishes, carrots, dill and chervil are difficult (if not impossible) to transplant, and are always sown in the bed where they are to remain.

BED LAYOUT

When laying out the planting beds, keep the relative heights of various vegetables in mind. The shortest ones should go closest to the glazing, with the taller ones behind. In deep soil, a mixture of species can be set quite close together if they occupy different root zones. For example, a strip of lettuce, then radishes, then Chinese cabbage makes better use of the whole soil depth than a solid planting of lettuce, all of whose roots reach to the same depth. Too, shallow-rooted vegetables such as cress or leaf lettuce can be set under large, deep-rooted plants such as tomatoes that have grown tall and been pruned.

Their vines, if unsupported, quickly form an inaccessible and space-wasting tangle in the greenhouse. We prune and support them so that they grow with two leaders and find that this method increases yields by at least one-third. As the plants grow, all the suckers in the axils of the leaves should be carefully snapped off except for the one strong sucker that develops below the first blossom cluster. Allow this sucker to become the second top. (Suckers should not be pinched or cut off as this could allow infected plant juices to spread from plant to plant. Hold the sucker firmly, and snap it downward so that it breaks cleanly.) To trellis the plants, tie the twine in a loose knot at the base of the plant, wind it gently around the main stem and tie it very securely to a strong overhead trellis six feet above the bed. When the second top grows sufficiently, string it up to the trellis also. Note that the string used must be very strong. The first year we used commercial "tomato string" which broke under the burden of 25-pound tomato vines, leaving Linda supporting a fragile vine in each hand, her frantic cries fortunately bringing help. All vines are now strung with sturdy nylon fishnet twine (although any other very strong twine will also do).

Once a week or so, the top of the plant stem is gently wrapped around the string, any suckers are pulled off and yellowing lower leaves removed. (This requires the use of late, indeterminate varieties of tomatoes. Early, determinate varieties should not be grown in the greenhouse.) Other plants such as dill or broccoli may need to be staked as well to prevent them from flopping over onto other plants in the crowded benches.

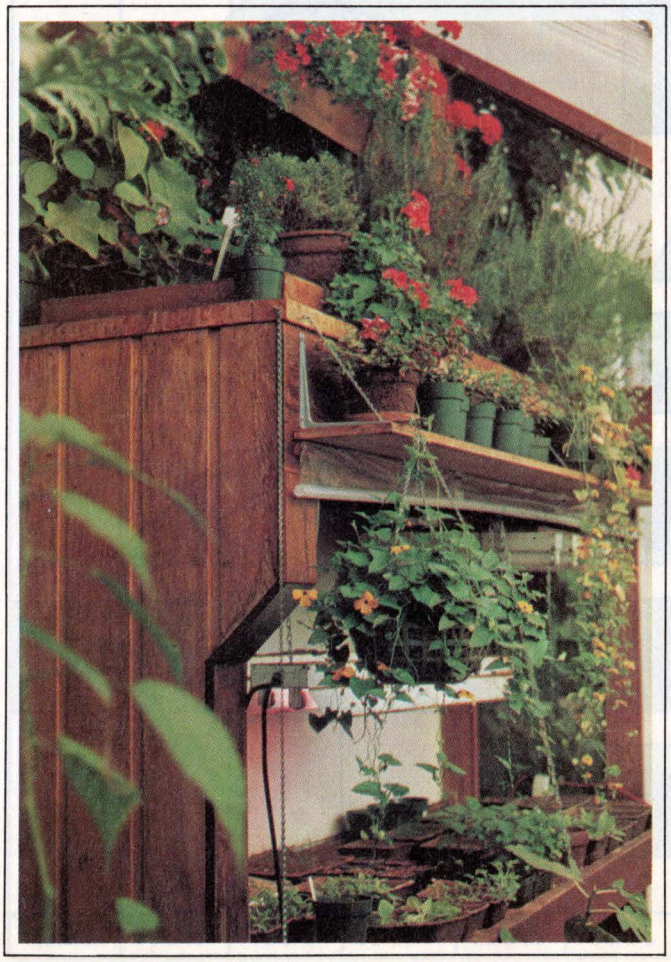
POLLINATION

All plants that form flowers will need to be pollinated. Tomatoes, peppers, eggplants and beans, all self-pollinating, can be assisted by a little shaking of the plant when it is in bloom, preferably at mid-day, as the flowers require several hours of bright sun before the pollen can be shed inside the flower. As the pollen in tomato flowers becomes sterile at temperatures below 55 degrees F and when light levels are low, fruit set is unlikely past September. Any fruit that is already present, however, will gradually ripen on the vine until well past December.

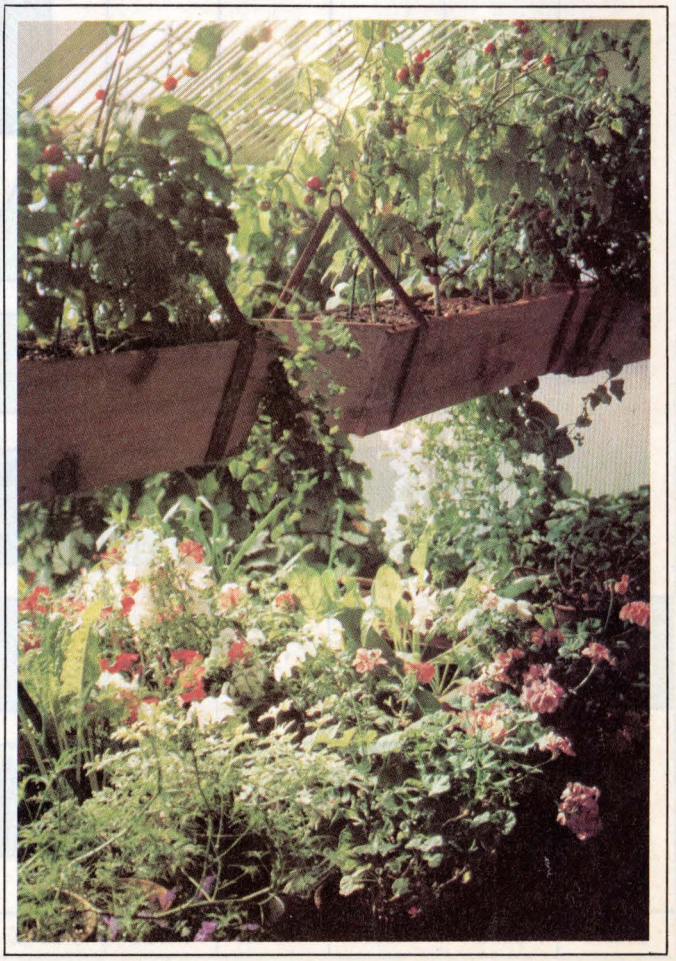
Melons, squash and cucumbers (except the European varieties, which must *not* be pollinated) are insect pollinated in the garden, so the gardener must perform this function by transferring pollen from the male flowers to the newly opened female

Top, *Leaf beet and* Dandie *lettuce.* **Bottom left,** *herbs, flowers and vegetables prosper above a seedling bench equipped with bottom heat and fluorescent lights.* **Right,** Tiny Tim *tomatoes in hanging pots, grape vine behind.*

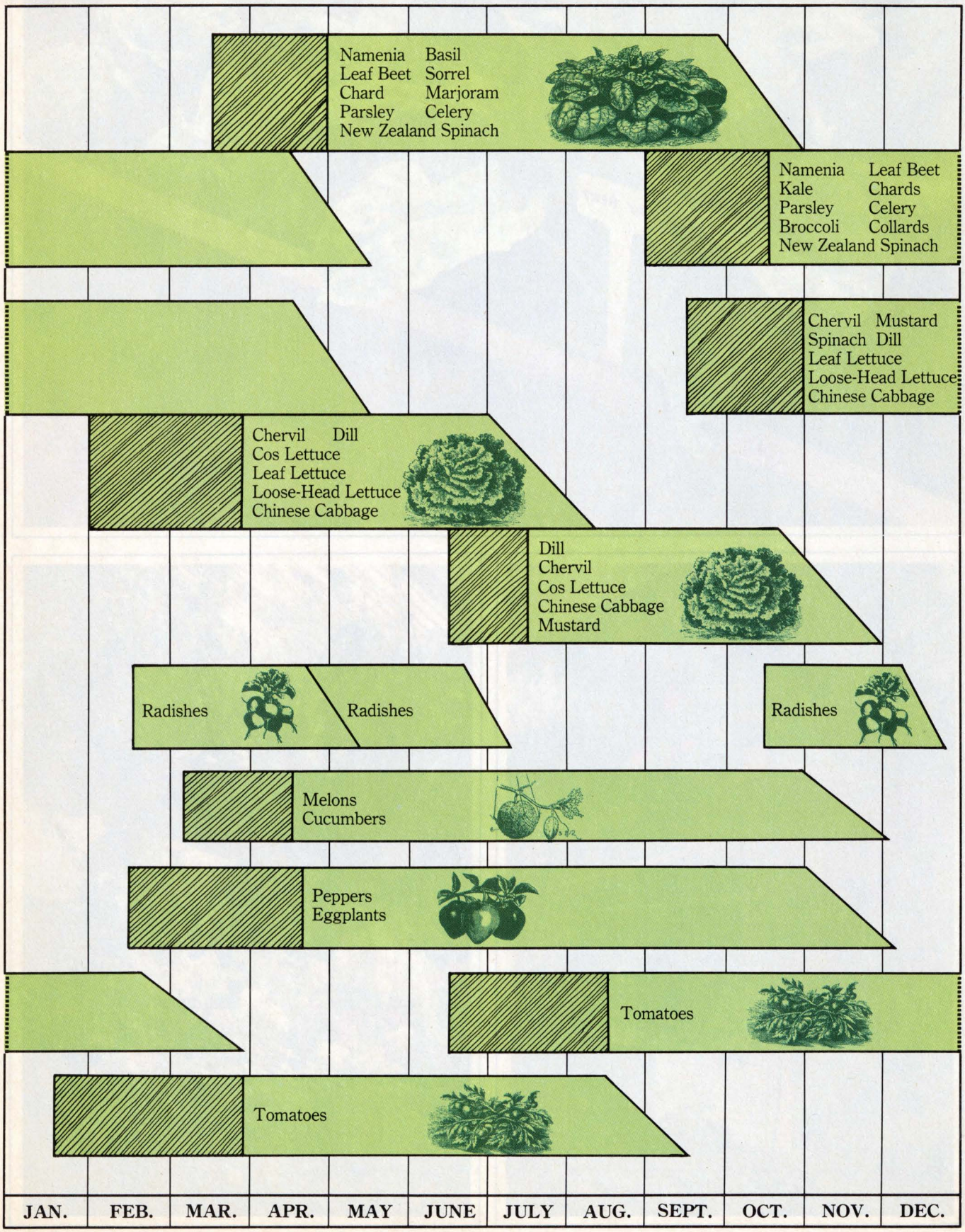
Camera Art



L. Gilkeson



Year-Round Planting Schedule



blooms, those that have a small, immature fruit at the base. (A detailed description of greenhouse pollination was published in *Harrowsmith* Number Sixteen, "No Bees, No Breeze Gardening.")

Accompanying charts describe the year-round planting schedule at the Ark, plant layout, and our preferred vegetable varieties. All can be adapted, of course, to accommodate personal preferences and one's own greenhouse environment.

Various perennial fruits can be grown in the home greenhouse, providing wonderful treats for the gardener who has the patience to await the results. Grape vines grow very well at the Ark, where they are trellised against the back wall of the greenhouse. A grape vine can be trained to provide shade in summer, creating a beautiful, living screen between the house and greenhouse (a checkered tablecloth, a bottle of Chianti – the romance is home-grown). When choosing a variety, look for a really good-tasting table grape, preferably one with resistance to powdery mildew. Grape fungus diseases are a greater problem under glass than they are outdoors.

For two years we have kept a peach tree in a large tub at the Ark, and it is now about two and a half feet high. Last summer we were rewarded with 31 ripe peaches of good quality. For tubbed trees, the soil should be rich and very well drained. Great care must be taken to assure a steady supply of water from fruit set to harvest. And do be sure to order only dwarf trees – anything larger will outgrow the greenhouse.

That, unfortunately, is what happened to our fig tree. We have learned from experience that fig roots must be very well controlled or they will spread rapidly producing an immense, vigorous tree with very little fruit. Our oldest fig was removed last summer, because, after bearing in its second year, it subsequently grew so large that it was pushing the glazing off the greenhouse even after drastic prunings. A concrete planter two to three feet square or a huge clay tub, in either case with a layer of gravel in the bottom, should be sufficiently restraining. Select a self-fruitful variety of fig (or any other fruit tree). Two that are now being tried here are *Everbearing* and *Celeste.* Like grapes and peaches, figs will lose their leaves and become dormant in winter.

Both grapes and figs can easily be grown from cuttings, although we have bought young trees from Bountiful Ridge Nurseries in the United States. Such importation involves special paperwork and permits, but is worthwhile if one wants a variety that can be bought only south of the border. Contact Agriculture Canada for details on importation.

Depending upon the temperature range in one's greenhouse, it may be possible to grow these and other exotics. A greenhouse guava tree, grown from seed purchased from Otto Richter's, is now in its third year at the Ark and has set four fruit, not yet ripe. According to those who know, the wait will be worth it! Several dwarf citrus trees (the type often sold by florists) have been temperamental about soil requirements but eventually produced fruit. Although our oranges are small and not particularly good quality for anything but grated peel, they are reward enough, perhaps, for those who have refrained from buying oranges because of the dyes and pesticides that may have been used in their culture. One lemon tree is now producing nice-sized, juicy fruit after three seasons of growth.

Friends of ours on Guernsey, an island in the English Channel, manage a large greenhouse complex in which citrus trees, bananas and pineapples are grown. The large orange and lemon trees were started from pips, and are growing in halves of wooden barrels, producing excellent fruit five to seven years after germination.

Guernsey, of course, has few of the climatic problems one is likely to experience during the northern winter, and figs and pineapples may not find a place with the lettuce and chard in everyone's greenhouse. Nevertheless, it's nice to have some idea of the possibilities of the solar greenhouse. We agree heartily with our neighbour, Cef Pobjoy, who says of his solar greenhouse, "Anybody who's given the opportunity to live with a greenhouse for a month will almost always build one." □

Each arrow is divided into two sections; a shaded portion, indicating that the plant is in a flat, and a solid portion, during which time the plant is in its greenhouse bed. (Radishes are seeded directly into the beds.) Seeds are sown at the time indicated by the left border of the arrow and transplanted at the left border of the solid portion. When the arrow begins to taper, harvest begins.

Linda Gilkeson is the owner of Rosmarinus Herbs and co-ordinator of the Ark's greenhouse programme. Susan Mahoney is education co-ordinator at the Ark. Funding for the Ark is made available through the Canada-P.E.I. Agreement on Renewable Energy Development.

SOURCES

For further information and a list of publications write to: The Ark Project, R.R.4, Souris, P.E.I. C0A 2B0.

HORTICULTURAL MANAGEMENT OF GREENHOUSES IN THE NORTHEAST
By Miriam Klein
Memphremagog Group
P.O. Box 456
Newport, Vermont 05855
Excellent guide for home greenhouses. Highly recommended.

ORGANIC GARDENING UNDER GLASS
By George and Katy Abraham
Rodale Press
Emmaus, Pennsylvania 18049
Useful reading, though plant schedules are not applicable to most parts of Canada.

SOLPLAN 3
The Drawing-Room Graphic Services Limited
Box 86627
North Vancouver, B.C. V7L 4L2
Information on the construction and management of energy-efficient greenhouses for the Canadian climate.

THE FOOD AND HEAT PRODUCING SOLAR GREENHOUSE
By Rick Fisher and Bill Yanda
John Muir Publications
Box 613
Santa Fe, New Mexico 87501
How to build and operate a sun-powered greenhouse, with emphasis on keeping costs to a minimum. Many plans and photographs.

THE SOLAR GREENHOUSE BOOK
Edited by James C. McCullagh
Rodale Press
Emmaus, Pennsylvania 18049
Sections cover design, construction and maintenance of the self-heating structure. Plans for freestanding and attached solar greenhouses, pit greenhouses and solar cold frames.