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This publication looks at marketing channels for and assesses the economics of small-scale organic production of fresh-cut herbs. Certified organic production differs from conventional methods chiefly in fertility management and pest control. Propagation methods differ for annuals and perennials. For information on producing potted herb plants, see the ATTRA publications *Sustainable Small-scale Nursery Production* and *Plug and Transplant Production for Organic Systems*.

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Strictly speaking, there is no longer a greenhouse herb industry in the U.S.(1) Commercial-scale greenhouse production is simply not economically feasible for fresh-cut herbs, when the entire U.S. market can be supplied from outdoor operations in favorable climates and from foreign greenhouse producers. Two large organic herb farms now supply the Seattle produce terminal serving the Pacific Northwest. Neither USDA's Agricultural Mar-



Lavender. Photo courtesy www.sxc.hu.

keting Service nor USDA's National Agricultural Statistics Service collects greenhouse herb information as a separate category. AMS collects information on fresh-cut herbs sold at 16 national terminal markets, and NASS collects information on organic vegetable production. Potted plants are lumped together with other nursery production (mostly in greenhouses). The hope raised 10 or 15 years ago that local growers would be supplying large amounts of fresh-cut herbs to the restaurant trade has been undercut by developments in transportation and global marketing systems, making even USDA-certified organic herbs readily and cheaply available from elsewhere.

Small farmers who have greenhouses grow herbs along with winter salad greens,

potting plants, vegetable starts, and ornamentals—some for direct market sales and some for home use.(2) Direct-marketed herbs are more likely to be sold as potted plants than as fresh-cuts. In parts of the U.S. east of California, fresh-cut herb sales make up only a minor portion of direct market sales. The potential for local sales of fresh-cut herbs to upscale restaurants has been largely overstated. Chefs can now have whatever organic herb they want within 24 hours, at prices lower than those of 10 years ago, although some do frequent their local farmers' markets.

A 45-acre Tilth-certified herb farm, Herbco, accounts for most of the organic herbs coming through the Seattle produce terminal. (Organic herb sales at selected terminals

Related ATTRA Publications

Enterprise Planning

Sustainable Small-scale Nursery Production

Agricultural Business Planning Templates and Resources

Keys to Success in Value-added Marketing

Marketing/Research

Herb Production for Organic Systems

Direct Marketing

NCAT's Organic Crops Workbook

Organic Marketing Resources

Organic Certification and the National Organic Program

Transitioning to Organic Production (*SAN publication*)

Hoophouses

Season Extension Techniques for Market Gardeners (*extensive information on walk-in hoophouses*)

Supplies

Seed Production and Variety Selection for Organic Systems

Suppliers of Organic and Untreated Seed (*Web-only database*)

Sources of Organic Fertilizers and Amendments (*Web-only database*)

are now reported by *NewFarm.com*.) The supply is supplemented by Jacobs Farm—growing on 300 certified organic acres at Pescadero, California. Working with a network of certified organic growers in Baja Sur (Mexico), Jacobs Farm advertises on its Web site that it can supply **any quantity of any temperate or tropical herb to anywhere in the U.S. or the world**. Operations are certified by Washington Tilth. Jacobs Farm, as well as CCOF-certified California growers, supplies organic herbs to Melissa's, a wholesale produce vendor to whole foods chains and co-ops around the country.

Technology and industry practices have also leaped forward. Heated wood-and-glass greenhouses are things of the past. Using the newer plastic products, walk-in hoop-houses have become the industry standard for U.S. greenhouse crops. See ATTRA's very detailed publication about hoop-house production entitled *Season Extension Techniques for Market Gardeners*. Hoop-houses generally do not require heat, but supplemental heat can be provided. Acres of state-of-the-art, climate-controlled, glass-and-steel greenhouses in Mexico are providing most organic herbs sold in the U.S., according to Tilth and USDA/NASS. Occasional sales at farmers' markets and through CSA baskets account for the rest.

In the past farmers have been advised to “research any niche market carefully” before investing. Finding reliable production statistics and economic information is admittedly difficult, however, for a limited-resource land owner, especially one without Internet access. To assess the potential market, do a risk-benefit analysis, and find a viable niche requires evaluation of statistics buried in government reports and produce industry sites, picking through Web pages, and finding privately held information. Recent attempts by the states of New Jersey and Montana to secure a place for their farmers in supplying herbs on a large scale (specifically greenhouse production in New Jersey) have not been successful. While New Jersey herbs showed up for a while in the late 1990s in East Coast terminal

market reports, they have been replaced by low-cost imports. The primary obstacle to greenhouse herb production in the U.S. is low-cost competition. At present, the only profitable greenhouse winter vegetable crop in the U.S. is tomatoes.(1)

The ATTRA publication *Sustainable Small-Scale Nursery Production* provides an in-depth overview of production and marketing of potted perennials. Many of the finer culinary herbs—especially the Mediterranean group (sage, marjoram, Greek oregano, the savories, thyme, rosemary, French tarragon, and lavender)—are perennials raised from cuttings. Purely ornamental varieties of these herbs exist, as well. Potted perennials raised from seed, rather than cuttings, include common lovage, alliums (such as garlic chives), fennel, and some of the Mexican herbs. One or two wholesale nurseries supply the entire U.S. nursery and garden store industry. Organic potted herbs are a seasonal item found at farmers' markets and a few specialized venues. The status of organic production of ornamentals is still under review.

Organic production of annual herbs such as basil is similar to that for most vegetables. For more information, see the ATTRA publication *Organic Crops Production Workbook* or the research studies summarized in the ATTRA publication *Herb Production for Organic Systems*. Most annual herbs have short enough growing seasons to be raised in beds outdoors for local markets. Some are started under cold frames, row covers, or hoop-houses.

The International Federation of Organic Agricultural Movements (IFOAM) has initiated a Participatory Guarantee System in the U.S. under the name “Certified Naturally Grown.”(3) This will benefit small, local growers. Locally Grown® is another new certification that does not entail the expense of organic certification.(4)

Fresh-cut organic herbs at farmers' markets generally sell for 4 to 10 times the price, by weight, of bulk supermarket herbs, but demand is limited. Vendors hesitate to bring more than a few bunches, for fear they will

not sell. The strategy of offering pre-ordering to regular customers via e-mail shows promise and has been tried by a Georgia grower.

Anyone considering raising herbs and seasoners in a greenhouse should do a cost-benefit analysis. Not everything can be raised anywhere at a reasonable return for the producer. The food and agriculture industry is changing very rapidly. For more help with enterprise planning, please request the ATTRA publication *Agricultural Business Planning Templates and Resources*.

Premium pricing can be critical to the viability of organic greenhouse operations, because production costs are often higher than those for conventional greenhouses. Organic pest control, particularly in labor costs, is generally more expensive than conventional practices. Yield and quality can vary widely, depending on the growing season and management practices. To achieve a satisfactory return on investment, organic growers must be prepared to develop innovative production and marketing strategies.

There are tradeoffs in every marketing strategy. A successful grower must develop markets in which the price for organic produce adequately compensates for all production costs. Additionally, the marketing process must be compatible with the grower's personality and business skills. The particular combination of components in any grower's marketing strategy will depend on local marketing opportunities, as well as the grower's desire to be directly involved in marketing, tolerance for stress, and ability to balance a variety of risk factors. For more information, request the ATTRA publications *Agricultural Business Planning Templates and Resources*, *Keys to Success in Value-Added Agriculture*, and *Direct Marketing*.

If you are considering building greenhouse facilities for organic production, research the market to assess the economic feasibility. Once you have made the most realistic cost estimates possible, you can develop a plan to adjust your production system, revise your marketing plan, or walk away while you still have your shirt.

ATTRA's greenhouse publication series (see list at right) provides in-depth discussions of fertility, pest control, and other topics from an organic standpoint. Additional resources for greenhouse herb production

are listed at the end of this publication. *The New Organic Grower*, by Eliot Coleman, has a chapter on "winter gardening" that provides information for USDA hardiness Zones 3 to 6 on technologies helpful in modifying a home-garden system for commercial production.(5)

Producing potted herb plants, plugs, and starts is part of the nursery business. See the ATTRA publications *Plug and Transplant Production for Organic Systems* and *Sustainable Small-Scale Nursery Production*. Potted plants are typically perennials, often Mediterranean herbs intended for permanent pot culture or for transplants that may serve both practical and ornamental uses in the garden.

Dried herbs found in grocery stores do not come from greenhouse production, but are field raised and sometimes wildcrafted outside the U.S. It is not economical to use controlled atmosphere space to produce dried herbs. The transcript of a presentation by Alan De Young, who represents the largest industrial herb producer and processor in the U.S., at the Fifth (and final) Richters Commercial Herb Growing Conference, Ontario, Canada, may be found in the proceedings of that meeting. It is the best account, by far, of contemporary Good Agricultural Practices (GAP) and Good Manufacturing Practices (GMP)—including certified organic—for herb products.(6)

Propagation Material

Herbs intended for fresh-cut sales are started either from seed or by a species-appropriate vegetative method—often as plugs—then grown out in bags of growing medium or in a hydroponic system. For information on the propagation method for a specific herb, see Table 1. For more information on organic plug production, see the ATTRA publications *Plug and Transplant Production for Organic Systems* and *Potting Mixes for Certified Organic Production*.

Organically grown seed of all types is currently in short supply. To produce organic seeds, an operation must be certified by a USDA-accredited certifier (see current list at www.ams.usda.gov/nop).

ATTRA Greenhouse Publications

Greenhouse and Hydroponic Vegetable Production Resources on the Internet

Greenhouse IPM: Sustainable Aphid Control

Greenhouse IPM: Sustainable Thrips Control

Greenhouse IPM: Sustainable Whitefly Control

Integrated Pest Management for Greenhouse Crops

Solar Greenhouses Resource List

Organic Greenhouse Vegetable Production

Plug and Transplant Production for Organic Systems

Potting Mixes for Certified Organic Production

Root Zone Heating for Greenhouse Crops

Compost-heated Greenhouses

Foliar Fertilization

Table 1. Popular Herbs

Herb	Type or cultivar	Recommended Propagation Method	Comments
Sweet basil (A)	Genovese, Italian Large Leaf, Thai, Mammoth	Seed	The most popular herb. Be careful not to start too early. Remove flowers as they appear for greater leaf production.
Dwarf basil (A)	Spicy Globe	Seed	See above.
Purple basil (A)	Dark Opal, Purple Ruffles	Seed	See above.
Chives (P)	Grolau	Seed	Be careful not to start too early. Rose-pink flowers borne in spring/summer. Chefs prefer fine-leaved types, but thick-leaved types hold up better in packages.
Cilantro (A)	Santo, Jantar	Seed	Easier to harvest if planted in clusters.
Dill (A)	Fernleaf	Seed	Ready for sale at 6–8 inches high. 'Dukat' is extra bushy.
Lavender (M)(P)	Munstead, Grosso	Cuttings	Seed does not come true to type.
Sweet marjoram (M)(P)		Cuttings	Best to use cuttings of true <i>Origanum majorana</i> . USDA has released hybrid <i>Origanum x majoricum</i> hardy to Zone 6
Mint (P)	Peppermint, spearmint, pineapple mint	Cuttings	May be erect or trailing. Many foliage variations. Can be invasive. Variegated good as ornamentals.
Oregano (M)(P)	Greek	Cuttings	Those with white flowers are preferred.
Parsley (A)	Curly	Seed	Can be used in containers. Makes a good edging plant. Technically a biennial, it's grown as an annual.
Parsley (A)	Flat leaf, cv. Italian Dark Green	Seed	Best for culinary use. Because of its fine flavor, prices are usually higher than for curly type.
Rosemary (M)(P)		Cuttings of a good-flavored variety	Erect and trailing forms available. Erect forms are best for culinary use. 'Arp,' while winter-hardy, is not recommended for culinary use.
Sage (M)(P)	Dalmation is best for fresh-cut herbs.	Seed or cuttings	Common sage is usually grown from seed; those with colored foliage are usually grown from cuttings. Erect and spreading forms. Suitable for containers. Try 'Purpurescens,' 'Tri-color,' or 'Aurea' for potted ornamentals.
Scented geraniums (A)	Lemon, peppermint, rose	Cuttings	Flowers of scented geraniums are smaller and less showy than those of bedding geraniums.
Tarragon (P)	French	Cuttings	Requires dormancy. Unusual growth pattern. "Russian" tarragon is of no commercial value.
Thyme (M)(P)	Lemon, French, English, silver, creeping, winter.	Cuttings	Cuttings ensure true-to-type. Best flowering is on older plants. Slow to grow back after cutting.
M = Mediterranean herb; A = Annual; P = Perennial			

If organic seed is not available, conventionally produced non-GMO untreated seed may be used for an organic annual herb crop, according to §205.204(a)(1) of the National Organic Program rules. Perennials must be raised for at least a year under organic management in order to be considered organic. See text of the Final Rule on sources of propagation material for organic production, below. For a list of companies selling certified organic and untreated seed, see the new ATTRA Web-only database *Suppliers of Seed for Certified Organic Production*. An Internet search on specific herbs is also advisable.

NOP Rule §205.204 Seeds and planting stock practice standard

(a) The producer must use organically grown seeds, annual seedlings, and planting stock: Except, That,

(1) Nonorganically produced, untreated seeds and planting stock may be used to produce an organic crop when an equivalent organically produced variety is not commercially available, Except, That, organically produced seed must be used for the production of edible sprouts;

(2) Nonorganically produced seeds and planting stock that have been treated with a substance included on the National List of synthetic substances allowed for use in organic crop production may be used to produce an organic crop when an equivalent organically produced or untreated variety is not commercially available;

(3) Nonorganically produced annual seedlings may be used to produce an organic crop when a temporary variance has been granted in accordance with §205.290(a)(2);

(4) Nonorganically produced planting stock to be used to produce a perennial crop may be sold, labeled, or represented as organically produced only after the planting stock has been maintained under a system of organic management for a period of no less than 1 year; and

(5) Seeds, annual seedlings, and planting stock treated with prohibited substances may be used to produce an organic crop when the application of the materials is a requirement of Federal or State phytosanitary regulations.

National Organic Program Final Rule,
www.ams.usda.gov/nop

For vegetatively propagated perennial herbs, greenhouse herb producers often take cuttings from their own “mother plants.” This practice gives producers already certified a decided advantage over start-up businesses, since they can procure organic starts at any time without any waiting period. Economies of scale have caused rapid consolidation in organic herb production. Growers seeking first-time organic certification or switching to a new certifier, as well as individuals planning to construct greenhouses for organic production, do well to secure their perennial herbs early in the mandatory three-year transitional period. After certification of a greenhouse operation, any new perennial plant stock must come from a certified organic source or be raised for at least one year under an approved organic management system before products derived from those plants can legally be sold as organic. This applies to foundation stock for potted plant production, as well as perennials for fresh-cut herb production. Section 205.204 is subject to interpretation by the accredited certifier for a given operation.

Marketing and Economics

Industry overview

New producers interested in the organic greenhouse herb business should take the following into consideration.

The organic premium in wholesale markets seems to be running about 33%. However, the market is segmented to such a degree that direct-marketed fresh-cuts can bring an organic premium of 400% or more.

USDA Agricultural Marketing Service (USDA/AMS) reports weekly wholesale prices for conventionally grown culinary herbs at 18 U.S. terminal produce markets. (See www.ams.usda.gov. The Web site has in spring 2005 become more user friendly.) The Web-based e-zine *New Farm* now reports weekly prices for organic herbs and, through its network of volunteer reporters, plans to report information on farmers’ market prices for organic herbs. On March

1, 2005, the only organic product reported through wholesale terminal market reports was basil, with conventionally grown basil selling for \$9.60 (per dozen bunches), compared to \$13.25 for organic basil (per dozen bunches) at the Seattle, Washington, terminal. (The *New Farm* site does not archive organic prices for comparison.)

The National Agricultural Statistics Service reported that, as of 2002, certified organic accounted for 30% of all U.S.-grown fresh culinary herbs in regular commercial channels. The Organic Price Index published on-line by *New Farm* (www.newfarm.com), compares organic and conventional fresh culinary herb prices, using USDA organic

fresh-cut herbs since 1999, despite slow increases for most food prices, due to inflation.

According to a West Coast organic wholesale produce vendor, the organic herbs coming through the Seattle Produce Terminal are from two sources: Herbco, a 45-acre certified organic farm in Washington state, and Jacobs Farm, a 300-acre certified organic farm in Pescadero, California. Jacobs Farm also sells for the 250-member Del Cabo Cooperative growing certified organic basil year-round in Mexico (Baja Sur).

Prices for the same herb the same week can vary among terminal markets. An unexplained anomaly is that an herb from Israel can sell for more than twice as much at an East Coast terminal than at a California terminal. West Coast terminal prices, under pressure from Mexican and Central American supplies, have decreased dramatically since 1999.

On March 1, 2005, at Boston and Philadelphia, the only organic herbs available were cilantro and parsley. At the San Francisco terminal, organic herbs available did not include basil but did include marjoram, oregano, tarragon, and chives. In Seattle, besides basil, herbs included lemon thyme, marjoram, oregano, peppermint, rosemary, sage, tarragon, chives, sorrel, spearmint, and thyme. USDA/ERS has just begun publishing organic prices (and corresponding conventional prices) for some produce from the Boston and San Francisco wholesale markets. Herbs could be added in the future. (See www.ers.usda.gov/data/organicprices.)

Grocery distributors depend heavily on wholesale sources for herbs. Food manufacturers rely on intermediate products such as essential oils, herb pastes and essences, and herb blends to season consumer products. Upscale urban restaurants meet their needs for the Mediterranean herbs (thyme, marjoram, summer savory, French tarragon, Greek oregano) from terminal markets, though they sometimes find the quality of local organic herbs very attractive. The



Potted herbs for sale at the USDA Farmers' Market in Washington, D.C. Photo by Bill Tarpenning, USDA.

data “gathered by AMS [USDA/Agricultural Marketing Service] employees” but reported separately from the National Wholesale Herb Report. Price comparisons over time (for conventional basil only) reveal that in November 1999, at the Philadelphia terminal, 15 bunches wholesaled for \$13.00, and at the same terminal on June 3, 2002, for \$10.00, or 11.00 to \$13.00 airfreighted from Israel. On March 1, 2005, at the Philadelphia terminal, comparable amounts were \$12.00 airfreighted from Israel and \$12.00 from Florida. This demonstrates level or decreasing wholesale prices for

prepping of herbs used as a food ingredient in meals served by restaurant chains and large institutions typically occurs far from the premises. Most public schools do not do food prep and cooking on site anymore. Due to concerted efforts by farmer groups in some states, some school systems have been re-educated about the advantages of buying produce from local sources. Farmer groups then must set up food preparation centers and deliver produce according to specification (washed, pre-cut, bagged, etc.).

The two top U.S. fresh-cut herbs year-round—parsley and cilantro—come from large, high-tech greenhouses in California, Mexico, and the Caribbean. Countries air-freighting fresh herbs and related specialty crops to the U.S. now include Mexico (lately Baja Sur), Peru, Costa Rica, Colombia, The Philippines, Canada, and France, as well as Israel, where dry desert air and mineral-laden water provide a competitive advantage for Mediterranean herbs. Peru has the advantage of a complementary season. California, Florida, and Hawaii lead among U.S.-based suppliers—although an undetermined share of California production may be repackaged herbs from Mexico and Central America.

The New Jersey Department of Agriculture, in cooperation with Rutgers University, devoted significant time and money in the mid-1990s to development of a greenhouse herb industry, and for a time New Jersey greenhouse growers wholesaled horseradish, mint, cilantro, and basil to East Coast terminal markets. Now year-round herb farms have turned to direct marketing (see www.plochfarms.com), and Rutgers (the state university of New Jersey) has turned its attention to the economics and production of greenhouse flowers. See <http://aesop.rutgers.edu/~farmmgmt/green-house/greenhouse-index.html>. The New Jersey Fresh program lists (by county) twenty farms with greenhouses offering herbs through roadside markets and one pick-your-own herb farm with a greenhouse. None are certified organic. See www.state.nj.us/jerseyfresh/index.html.

It is estimated that a city the size of Kansas City, Missouri, would need only one three-greenhouse operation to supply all of its culinary herb needs year-round—if the metropolitan area depended totally on local production. As in other aspects of herb raising, when the wholesale market expands, existing growers get bigger; improvements in transportation have facilitated imports of fragile crops from distant locations. However, volatility in oil prices is an unknown factor in projecting future markets for locally produced greenhouse herb crops.

New Farm is building a network that can report direct-marketed weekly organic produce sales (including fresh herbs). For updates, go to www.newfarm.com and follow the dashboard links. *New Farm* estimates that alternative marketing methods account for at least 50% of sales of organic fresh herbs. For an overview of direct marketing methods, see the ATTRA publication *Direct Marketing*.

Key success factors

- Industry research (as reported in the media, including cookbooks that influence consumer awareness) will continue to dictate the market environment and determine the popularity and sales volume of individual herbs.
- Grower development of marketing and research must be pursued diligently in order to identify changing environments and emerging opportunities.
- Growers must be able to produce and handle multiple products, preferably from a variety of crops, in order to reduce dependence on market fluctuations for any single crop.
- Developing a sales network of multiple buyers will reduce dependence on any single purchaser and increase the producer's relative bargaining power.
- Due to labor-intensive practices of small operators—who cannot afford the high-tech, computerized greenhouses characteristic of foreign competitors in greenhouse production—growers must be able to secure a consistent labor supply at relatively low cost.

Adapted from Watts and Associates. 2002. Market Opportunities and Strategic Directions for Specialty Herbs and Essential Oil Crops in Montana. Prepared for: Montana Department of Agriculture, Billings, MT; USDA Federal-State Marketing Improvement Program, Washington, D.C. p. 42.

www.ams.usda.gov/TMD/FSMIP/FY2000/MT0294.pdf

Local producers

Wholesaling organic fresh-cut herbs

It is now customary for supermarkets to charge produce vendors “slotting fees” for shelf space. In addition, vendors may be asked for advertising and promotion allowances that can add up to thousands of dollars. There has been tremendous consolidation in the retail food sector in recent years, emphasizing economies of scale. Few independent grocers exist who can make their own decisions on stocking local produce; chains stock their retail stores from regional warehouses, where volume and price rule



Herbs for sale at the Crescent City Farmers' Market in New Orleans, Louisiana. Photo by Bill Tarpenning, USDA.

the terms for vendors. At a USDA conference in Little Rock, Arkansas, in 2001, the produce buyer for a major national chain—which advertises its “buy local” program—acknowledged that his stores buy local produce only when a sudden, temporary short-

age of the item occurs. Natural and health food stores, which buy more organic produce, are under essentially the same constraints, since they must commit to a wholesale supplier to ensure year-round supplies. Moreover, even when a local store commits, as matter of policy, to reserve slots for local organic herbs, *no one can guarantee sales volume in advance of planting*. The risk inevitably is borne by the grower.

Desmond Jolly, who directs the University of California-Davis Small Farm Program, urges small growers to investigate alternative business models in keeping with the rapidly changing U.S. economy. Forming a marketing cooperative (7) is one way for small growers to generate the economies of scale necessary to bargain with supermarket chains or institutional buyers.(8) USDA's Rural Business-Cooperative Service can provide publications and guidance on forming a producers' cooperative. Request these RBS publications from ATTRA.

Some enterprising growers integrate greenhouse production with retail sales, services, entertainment, and community participation. For more information on rural tourism and farm profiles, see the ATTRA publications *Entertainment Farming and Agri-tourism* and *Lavender Production, Products, Markets, and Entertainment Farming*. Also see herb farms participating in the Jersey Fresh Program at www.state.nj.us/jerseyfresh/index.html.

New product directions

Ethnic cuisines, with their own particular herb preferences, are becoming extremely popular. With an increasing Hispanic population, U.S. vendors now supply culinary herbs that only a few years ago were considered exotic. Sales figures for epazote recently appeared for the first time on the National Wholesale Herb Report. As demand for Thai herbs and seasoners levels off, demand for Vietnamese herbs picks up. Less common herbs include chervil, curry leaf, salad burnet, sorrel, ajmud, West Indian culantro, Mexican mint marigold, hojo santo, garlic chives, lemon balm, shun-giku (garland chrysanthemum), Mexican oregano (*Lippia graveolins*), bergamot, rue, and summer savory. When possible, ethnic communities in the U.S. import their traditional herbs, but potential exists for supplying such herbs to local ethnic markets, or to wider markets if a trend develops. Urban areas across the U.S. with any significant

Since 2004 (until summer 2005) USDA has been rigorously enforcing a 1968 ban on import of “Szechwan peppercorn” (*Zanthoxylum rhetsa*) and fresh lime leaves (*Citrus x auratifolia* ‘Keffir’) used in Thai cooking. These Rutaceae species are suspects in spreading citrus canker. Local production within the U.S. is still allowed, and imports are now allowed on a limited basis—if the spice has been heat-treated. ‘Keffir’ lime leaves were identified by Lynette Morgan in 2000 (see Resources) as a promising greenhouse crop for Australia and New Zealand. Lime trees are easily grown in a greenhouse, and propagation material for ‘Keffir’ is available through classified ads placed by Florida growers in the Florida Market Bulletin (published by Florida Department of Agriculture on-line). See www.fl-ag.com/fmb.

Hispanic population soon have their own bodegas selling traditional herbs and seasoners. Herbs raised for an ethnic market must be propagated from the exact cultivar used in the ethnic cuisine.

ATTRA occasionally has requests for information on growing very specialized herb/seasoner crops—such as ajwain, annatto, black pepper, royal cumin, galangal, saffron, ginger, black tea, coffee, chocolate, and capers. They have all been tried long ago in either greenhouse or outdoor production in the U.S., but significant constraints emerged in trials. None proved economically viable. See **Resources/uncommon herbs** for further information.

Production

A basic text for beginning greenhouse growers

Sandie Shores' *Growing and Selling Fresh-Cut Herbs* (8), based on the fresh-cut herb business she began and operated for 20 years in southern Minnesota, can serve as a manual for inexperienced greenhouse herb growers. The first part of her book deals with the business side of growing herbs and includes information on things like business laws, financing, insurance, finding markets (wholesale, restaurant, supermarket, farmers' market, etc.), managing employees, and pricing. Part Two discusses greenhouse planning and operation—including information on the various types, how to choose one, how to erect one, and what equipment will be necessary (heating, cooling, lighting, fans, benches, irrigation, etc.).

Parts Three and Four provide general information on production methods and then specific crop-by-crop information. The author also provides tips on “great growing” and postharvest and packaging information. See **Further Resources** for ordering this book.

Starts

The Mediterranean herbs favored in French cuisine are best started from cuttings (see Table 2). Greenhouse production preserves

culinary quality through controlled growing conditions. Ornamentals sold as potted plants can be started from seed or from cuttings. Certified organic production will differ from conventional chiefly in the areas of fertility and allowable methods of pest control. Organic greenhouse production practices are discussed in a series of ATTRA publications. *Organic Greenhouse Vegetable Production* addresses organic fertility programs, soil and soilless culture systems (growing in bags, vertical towers, straw bales, and shallow beds), and economics. *Plug and Transplant Production for Organic Systems* addresses container options, seeding and germination, nutrition, temperature, irrigation, and growth regulation. For organic methods of hydroponic production, see *Greenhouse and Hydroponic Vegetable Resources on the Internet*.

Practices specific to herb production

Greenhouse production methods for herbs are similar to those for greenhouse-grown vegetables. There are some practices, however, that are specific to herb production. Fertility and irrigation, for example, must be managed somewhat differently. Too much water or fertilizer may result in poor establishment of slow-growing seedlings or semi-woody cuttings, excessive growth of species with rapid growth rates, or lower essential oil content, resulting in diminished aroma or culinary value.(10)

Greenhouse temperatures for herb production are about the same as for bedding plants: day temperatures of 70° to 75°F and night temperatures around 60°F. Fast-growing herbs such as basil, chives, and dill become overgrown if started too early.(4) Growth control techniques such as brushing and manipulation of day-night temperatures may be useful. Plugs can be held for a time until sales can begin.

Sage growing in a greenhouse. Photo © 2005, clipart.com



Low light intensity and overcrowding will cause plants to “stretch.” In herbs, this problem may be compounded: low light can also reduce the essential oil content. It is important in greenhouse herb production to provide maximum light in late winter and early spring. Eliot Coleman suggests raising winter thyme (mother-of-thyme, *Thymus praecox* ssp. *arcticus*), winter savory (*Satureja montana*), sage, parsley, sorrel, and dandelion for greenhouse production in USDA zones 3 to 6.(4)

Growing media

Although it can be done, few herbs are raised in soil inside greenhouses. More often, they are raised in a soilless medium. (Some farmers’ markets now require this.) Certified organic greenhouse-grown herbs must be raised in a certified organic potting mix. Commercial potting mixes typically contain wetting agents and synthetic fertilizers and are not allowable, requiring organic growers either to mix their own or to purchase a certified organic mix. (See the ATTRA publication *Potting Mixes for Certified Organic Production*.) Most organic potting mixes are based on good-quality compost amended with peat moss and perlite or vermiculite and supplemented with organic fertilizers like bone meal, feather meal, and kelp. Such a mix would be suitable for herb production, with one variation. Since most herbs are native to regions having neutral or slightly alkaline soils, the optimum pH for herbs is 6.0–7.0.(8) Most soilless mixes have a pH somewhere between 5.0 and 6.0,

so they will have to be amended with lime before use. For more information on soilless media, amendments, and suggested mixes, see the ATTRA publications *Organic Potting Mixes for Certified Production*, *Plug and Transplant Production for Organic Systems*, and *Organic Greenhouse Vegetable Production*.

Production scheduling

An important factor to keep in mind when scheduling plant production is not only how long it will take the plants to grow but also how long it will take them to be sold and moved out of your sales or production area. Other important questions include what plant species to grow, how much space is needed, and whether the plants will be grown from seeds or cuttings. If cuttings are to be used, space will be needed for the mother plants, and a mist chamber may be necessary.

Most herbs will need 6 to 10 weeks to reach saleable size. Researchers at Cornell recommend starting the following in March for May sales: parsley, rosemary, sage, thyme.(4) Anise, basil, borage, chives, coriander, dill, and fennel should be sown in April for May sales. Table 2 provides more specifics about production scheduling for fresh-cut herbs.

For greenhouse-grown fresh-cut herbs, each type has somewhat different requirements. For example, mint is best grown in a raised bed and cut uniformly, section by section, as market requirements dictate. Rosemary, on the other hand, is raised as potted specimen shrubs, and managed quantitatively over the years by reducing plants to the required number. Sprigs of rosemary are harvested individually.

For more details of production and harvest of specific herbs, study *Growing and Selling Fresh-Cut Herbs*, by Sandie Shores.(8)

Hydroponics

Hydroponics is the production of plants in a soilless medium in which all of the plant nutrients supplied to the crop are dissolved in water. Hydroponic systems—referred to

Rosemary is raised as potted specimen shrubs, and managed quantitatively over the years by reducing plants to the required number. Photo by Alex Fiore, www.sxc.hu



Table 2. Production Scheduling for Fresh-Cut Herbs

In *Growing and Selling Fresh-cut Herbs*, Sandie Shores provides production schedules for many commonly grown herbs. Four examples are provided here.

Herb	Days from Germination to Potting up	Days to Transplant-Ready	Days from Sowing to First Harvest	Days from Regrowth to Second Harvest
Basil	18 to 21	21	84 to 90	7 to 14
Chives	*	25 to 30	105 to 120	14 to 21
Cilantro	Direct sown	Direct sown	49 to 56	10 to 14
Sage	14 to 18	14 to 21	85 to 98**	7 to 14**
* Usually transplanted directly from flat to growing bed				
** Small yields in first year				

by such terms as water culture, nutriculture, solution culture, gravel culture, sand culture, aeroponics, mist culture, bioponics, aquaponics, and the nutrient film technique (NFT)—are commonly used in the commercial production of greenhouse herbs.

Most conventional hydroponic units are highly specialized, controlled-environment production systems. The technology associated with hydroponic production is well documented. Many good books and Cooperative Extension Service publications are available on this subject. Some recent literature is available on the highly developed European technology, including state-of-the-art facilities in the Caribbean serving resort hotels. The primary difference between organic and chemical hydroponics is the source of fertility and presence of microorganisms. Microbes are essential to organic systems because they help regulate pH and the availability of nutrients. Hydro-organics is based on hydroponic solutions derived from organic fertilizers that will go into solution—such as fish meal, spray-dried blood, and guano.

There are several advantages to producing herbs hydroponically (11):

- Hydroponics provides growers with control over nutrient and pH levels.
- Greater potential income is realized.
- Most recirculating systems are closed, meaning nutrients and water are recirculated, and none is lost into the ground.

- Most hydroponic systems are automated, saving labor costs and keeping materials costs to a minimum.

Integrated Pest Management (IPM)

Insects and diseases are a major challenge to greenhouse production. IPM is an important tool in the management of these pests. The primary goal of IPM is to optimize pest control in an economically and ecologically sound way. IPM involves the integration of cultural, physical, biological, and chemical practices to grow crops with minimal use of pesticides. Monitoring, sampling, and record keeping are used to determine when controls are needed to keep pests below an economically damaging threshold. Pest management, not eradication, is the goal of IPM. For more information, see the ATTRA publication *Integrated Pest Management for Greenhouse Crops* and individual publications on white fly, aphid, and thrips control. Using less permanent structures—such as hoopouses—can avoid build-up of pest infestations.

Diseases

The most common diseases in greenhouse herb production are fungal diseases, including botrytis, damping-off, and root rots. Vascular wilts are also common in herbs. These diseases can cause tremendous plant loss in just a few days if conditions are favorable and no control is in place.

Again, using temporary structures—such as hoophouses—can prevent disease build-up from year to year. Greenhouse conditions that contribute to air stagnation and poor air circulation, such as dense plant canopies and plant crowding, will increase the incidence of disease. There are several general practices that are important in disease prevention (12):

- Use irrigation techniques that minimize leaf wetness. Avoid late afternoon and nighttime irrigation.
- Maintain good air circulation in the greenhouse.
- Remove diseased plants and plant parts immediately.
- For herbs grown in ground beds, rotate plant families.
- Use only clean stock for propagation.
- Thoroughly clean containers with a bleach and water solution.
- Pasteurize or sterilize growing media.
- Control insects that vector disease.

These and other aspects of greenhouse disease control are discussed at length in ATTRA's *Integrated Pest Management for Greenhouse Crops*.

Insects

Whiteflies, aphids, fungus gnats, spider mites, and thrips are the major insect pests affecting herbs.(8) ATTRA's series of greenhouse IPM publications includes general and specific information on managing these pests.

Very few herb crops have either natural or synthetic pesticides labeled for their use, mostly because herbs are considered a minor or specialty crop. Biorational pesticides registered for use on herbs include neem, insecticidal soap, horticultural oil, pyrethrins, *Streptomyces griseoviridis* (a naturally occurring, soilborne bacterium), and the fungus *Beauveria bassiana*. It is important for herb growers to remember that many of these pesticides taste really bad, so all herbs cut from sprayed plants should be thoroughly washed.

It is always best to ask your certifier whether specific brands of products are permissible. Guidance is also available from the Organic Materials Research Institute (OMRI), which maintains a list of permitted and prohibited products.

For more information on natural pest control in certified organic production, please see the ATTRA *Greenhouse IPM* series.

Creeping thyme.
Photo by Shonna Clark,
www.sxc.hu



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- 4) Locally Grown®
www.locallygrown.com
Originally a marketing tool for the conventional produce industry, the label can be adapted for low-input and sustainable produce marketing.
- 5) Nation, Allan. 2004. Buying co-ops vs. marketing co-ops. *Stockman GrassFarmer*. August. p. 9–10.
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Further Resources

Sustainable Agriculture Research and Education (USDA) Project Reports

www.sare.org

To search the project database, click on Projects in the dashboard, then use the search engine per instructions.

FNE03-486. Final Report. 2004. Effects of Vermicompost Applied in a High Tunnel.

LS03-147. Final Report. 2004. Bioactive Natural Products: A feasible method of organic disease management in float bed production systems.

FNE03-468. Final Report. 2004. Organic Plug Production: Evaluating Growing Media, Fertilizer and Economic Feasibility.

LNE02-164. Annual Report. 2004. Biological Control Practices for High-Tunnel Crop Production.

ONE05-037. 2005. Awarded. Developing Beneficial Insect Habitat for Greenhouses.

FS00-118. Annual Report. 2000. Developing Marketing Strategies for Culinary and Medicinal Herbs.

LS94-013. Final Report. 1994. Plant Shelters to Extend the Growing Season for Herbs.

FNE03-464. Overwintering and season extension of organic culinary herbs in unheated high tunnels
Michael Glos, Kingbird Farm, Berkshire, NY

Historically, growers in New England can offer only four or five months of annual and perennial herbs, and farmers there are interested in developing techniques both to extend the season and to improve the overwintering of tender herbs like rosemary by using unheated high tunnels. Some plants will be mulched or grown under hooped row covers, and the harvest results and tender-plant survival will be recorded. The results will be presented at a field day, in an Extension newsletter, and through conferences and media outreach.

Books/Directories

Brester, Gary, Kole Swanser, and Tim Watts. 2002. *Market Opportunities and Strategic Directions for Specialty Herbs and Essential Oil Crops in Montana*. Prepared for the Montana Department of Agriculture and USDA Federal-State Marketing Improvement Program. Watts & Associates, Billings, MT. 64 p.

www.ams.usda.gov/TMD/FSMIP/FY2000/MT0294.pdf

Coleman, Eliot. 1999. *Four Season Harvest*. Chelsea Green, White River Junction, VT. 234 p.

Inspired by Scott and Helen Nearing's garden in the late 1960s and based on the author's success with harvesting fresh vegetables year-round in New England, this book contains details on design, construction, and management of the outdoor garden, cold frames, tunnels, and root cellars. It includes growing tips for 50 vegetable crops, a planting schedule for extended harvests for all locations in the U.S., and sources of tools and supplies. Available for \$24.95 from:

Chelsea Green Publishing
P.O. Box 428
White River Junction, VT 05001
800-639-4099

Edey, Anna. 1998. *Solviva: How to Grow \$500,000 on One Acre and Peace on Earth*. Trailblazer Press, Martha's Vineyard, MA. 230 p.

This publication features organic vegetable production in a solar greenhouse. Solviva refers to Edey's award-winning solar-powered and animal-heated greenhouse on Martha's Vineyard [unfortunately no longer in operation]. The book discusses greenhouse design, function, construction, and management. Ms. Edey includes many energy-efficient designs such as water walls and growtubes. She also tells how much everything costs, which is invaluable for market gardeners. Although her main crop was lettuce, her techniques could be applied in any greenhouse. Solviva is available for \$35 (plus shipping/handling). Order by mail or on-line from:

GFM Books
P.O. Box 3747
Lawrence, KS 66046
800-307-8949
www.growingformarket.com

Facciola, Stephen. 1998. *Cornucopia II: A Source Book of Edible Plants*. Kampong Publications, Vista, CA. 713 p.

Indispensable reference work for food plants worldwide. Includes cultivar lists. Widely available through commercial publishers and on the Internet.

Morgan, Lynette. 2002. *Fresh Culinary Herb Production: A technical guide to the hydroponic and organic production of commercial fresh gourmet herb crops*. Suntec, New Zealand. 132 p.

In the U.S. order Dr. Morgan's book on-line from www.growingedge.com/store, or call toll-free 800-888-6785 or 541-757-8477. Descriptions of organic

production do not necessarily conform to the Final Rule of the U.S. National Organic Program.

Nelson, Paul V. 2003. *Greenhouse Operation and Management*. 6th edition. Prentice Hall, Upper Saddle River, NJ. 692 p.

Standard reference text for growers and greenhouse managers. Covers essential principles, skills, and relationships required to manage most modern greenhouses. Includes engineering, heating, cooling, and fertilization calculations.

Shores, Sandie. 2003. *Growing and Selling Fresh-Cut Herbs*. 2nd ed. Ball Publishing, Batavia, IL. 483 p.

Excellent book on herb production, both in the greenhouse and in the field. Designed for the beginner. The chapters on specific herb crop production methods include information on greenhouse production. Widely available for \$27.95. It is also available through the author's Web site, www.freshcutherbs.com, where she also answers questions from growers.

Staff. 2004. *Thomas Food & Beverage Market Place*. 3 vols. Grey House Publishing, Millerton, NY. 8122 p.

Compiled from two respected food industry databases, this directory provides comprehensive information on more than 40,000 companies supplying the U.S. food and beverage industry. Good for locating equipment. Available on-line (by subscription), or call ATTRA at 800-346-9140 for a specific resource.

Tatum, David. 2001. *Starting a Greenhouse Business*. Mississippi State University Extension Service. 5 p.

*<http://msucare.com/pubs/publications/p1957.htm> Estimated investment cost per sq. ft. for turn-key quonset-style greenhouse in Mississippi. Tips on retail and wholesale marketing. Reprinted in *American Small Farm magazine*, July 2002.*

Tucker, Arthur O., and Thomas DeBaggio. 2000. *The Big Book of Herbs*. Interweave Press, Loveland, CO. 688 p.

A comprehensive illustrated reference to herbs of flavor and fragrance.

Periodicals

GMP is a leading trade journal for the greenhouse industry. It is designed for greenhouse managers.

Contact:

GMP
P.O. Box 1868
Fort Worth, TX 76101
817-882-4120

817-882-4121 FAX
800-433-5612
www.GreenBeam.com

The Growing Edge is a bimonthly magazine that focuses on hydroponics and high-tech gardening from an ecological angle. The emphasis is on greenhouses, hydroponics, artificial lighting, drip irrigation, and other protected culture methods. Special issues have featured articles on bioaponics and organic soilless culture. Back issues are available. Contact:

The Growing Edge
New Moon Publishing
341 SW 2nd Street
Corvallis, OR 97333
800-888-6785
www.growingedge.com/
\$26.95/year

Sample article: Creaser, Gordon. 2002. Antigua Fresh hydroponics. *The Growing Edge*. July–August. p. 45–47.

Growing for Market, a newsletter for small producers of vegetables, herbs, and flowers, provides up-to-date marketing information. Geared to small-scale operations and focused on sustainable production techniques. Available for \$27/year from:

Growing for Market
P.O. Box 3747
Lawrence, KS 66046
800-307-8949
www.growingformarket.com

Fruit & Veg Tech, an Elsevier Intn'l quarterly publication, provides details on what new technologies the worldwide greenhouse industry is adopting. High-tech greenhouse production in other countries is a major source of competition for U.S. greenhouse growers. A related publication is *FlowerTech*. See www.HortiWorld.nl. Subscriptions are \$54 U.S./yr. (4 issues); subscribe through Web site with a credit card, or by mail.

HortScience is published seven times a year by the American Society for Horticultural Science and is available at any land-grant university library system.

Institutional/non-member subscriptions are \$400/yr.
113 South West Street, Ste. 200
Alexandria, VA 22314-2851
703-836-4606
703-836-2024 FAX
ashs@ashs.org

Sample article: Russo, V.M. 2005. Organic vegetable transplant production. *HortScience*. Vol. 40, No. 3. p. 623–628.

Articles

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Web sites

National Ag Risk Education Library
www.agrisk.umn.edu

National Organic Program
www.ams.usda.gov/nop

Organic Materials Research Institute
www.omri.org

Herb Growing and Marketing Network
www.herbnet.com

Missouri Alternatives Center (Click on H for herbs.)
<http://agebb.missouri.edu/mac/links/index.htm>

North Carolina State University herb factsheets
www.ces.ncsu.edu/hil/
Now has links to other state Extension herb publications.

Richters Herbs
www.richters.com

Uncommon herbs/seasoners

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