

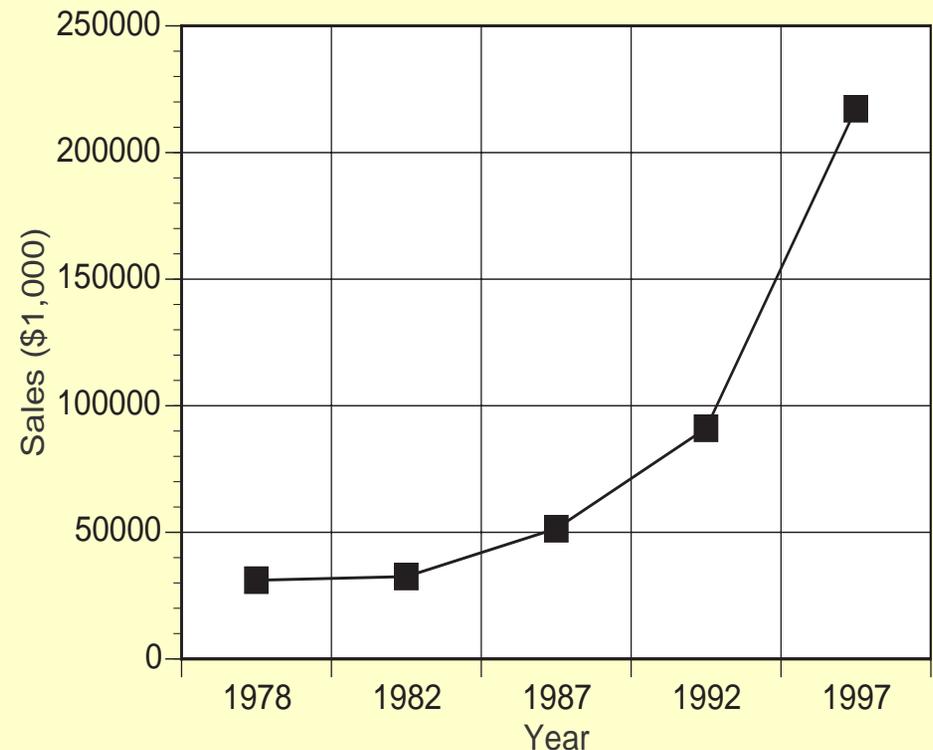
NEW COURSES and Growing Technology Seminars
Mary Peet

NC STATE UNIVERSITY

Why Consider Alternatives to Tomatoes?

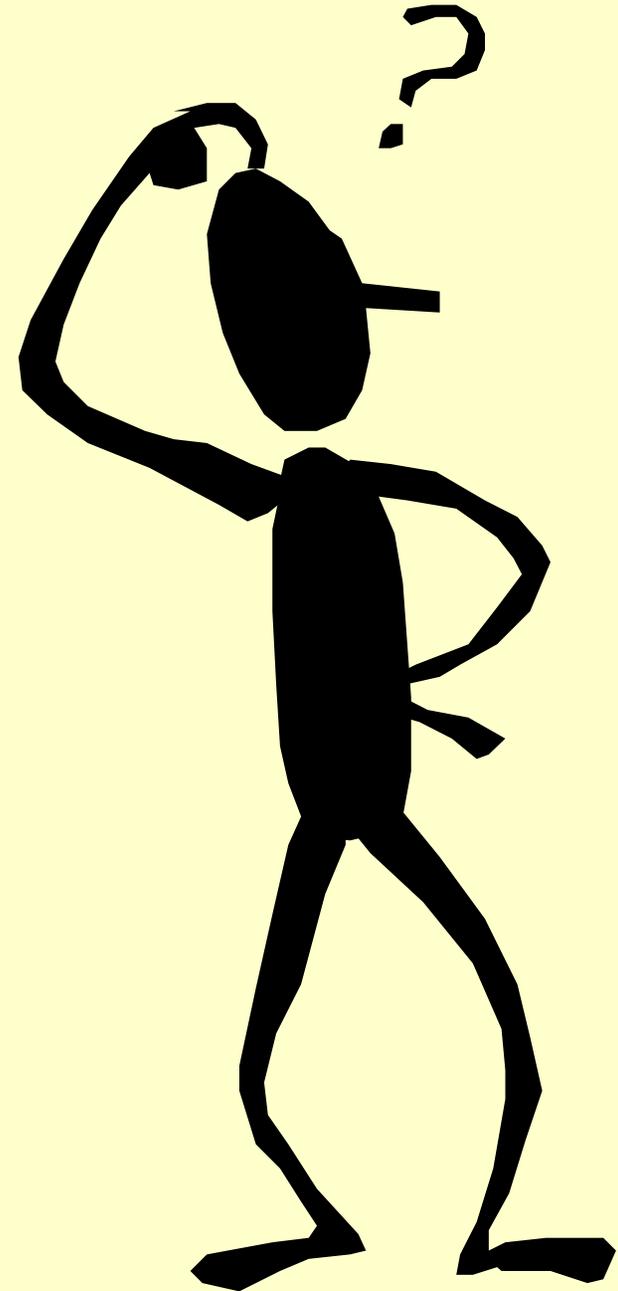
- Consumption of greenhouse tomatoes has increased dramatically, but so has supply
- Overexpansion of greenhouse tomato industry in North America, especially Canada, may drive down prices of greenhouse tomatoes even further
- As tobacco farmers diversify to remain profitable, greenhouse vegetables are a good use for transplant houses

Sales were up 139%
(annual increase of
28%)-now represent 30-
40% fresh market share!



Topics

- Themes:
 - Creative packaging
 - Emphasize local production & promotion
 - Use new techniques selectively to be competitive
 - Simple, cost-saving innovations can be profitable
- Crops
 - A Fantasy Adventure!
- Pro's and Cons
- Economics
- Marketing, Marketing, Marketing!
- Organic production
- Conclusions



For in-depth information & a copy of this
presentation:

www.ces.ncsu.edu/greenhouse_veg/

NC STATE UNIVERSITY

College of Agriculture
and Life Sciences

Search This Site

Welcome to the North Carolina State University Greenhouse Food Production website!



For those of your looking for specific information, check the [Topics Website](#) for articles, links, and presentations on various subjects.

For those of you looking for more information, or online Calculators and other tools, there is a [Resources Website](#).

[News](#)

[Acknowledgments](#)

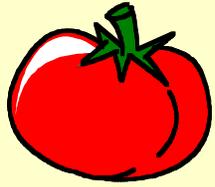
PowerPoint talks, articles, websites, EC and fertilizer converters and other resources

Topics

<u>Greenhouse Tomato Production</u>	<u>Choosing a Crop</u>
<u>Selecting Greenhouses</u>	<u>Irrigation and Fertilization</u>
<u>Cultural Practices</u>	<u>Organic Production</u>
<u>Managing the Environment</u>	<u>Economics</u>
<u>Ethylene</u>	<u>Disease Management</u>
<u>Insect Management and Biological Control</u>	<u>Physiological Disorders</u>

Resources

<u>Tools</u>
<u>More Print Information</u>
<u>More Web Information</u>
<u>Information on Growers' Association</u>
<u>Get a CD Copy of the NCGVGA Meeting Presentations</u>
<u>Equipment and Supplies</u>
<u>Contact Information</u>



Major Greenhouse Vegetables

- Tomatoes-most common
 - Beefsteak 'Trust' (80% of acreage)
 - Cluster 'Tradiro' (becoming more popular)
 - Cherry, grape, Roma, yellow tomatoes
- Cucumbers
- Lettuce
- Peppers
- Herbs
- Melons

Types of systems

- Soil-less required for organic certification
- Containers of soilless media (Bato buckets & perlite now popular)



Types of systems

- Rockwool-most common in large commercial installation
- Hydroponic-(NFT most common for lettuce)



New Trends/Techniques to be Competitive

- Natural vs. mechanical ventilation
- Horizontal airflow fans vs. polytubes
- Higher ceilings (8-10 ft.)
- Screens for air inlets; double entry doors
- Bumblebees for tomato pollination
- Computer controllers to water by solar integral
- Fertilizer injectors
- pH and EC monitors
- Biocontrols





Thermostats and bumblebee hives should be shaded. Winders make it easier to lower vines. Simple computer systems are also available.



Horizontal airflow fans are better than polytubes for circulating air



Harvest and pruning aid



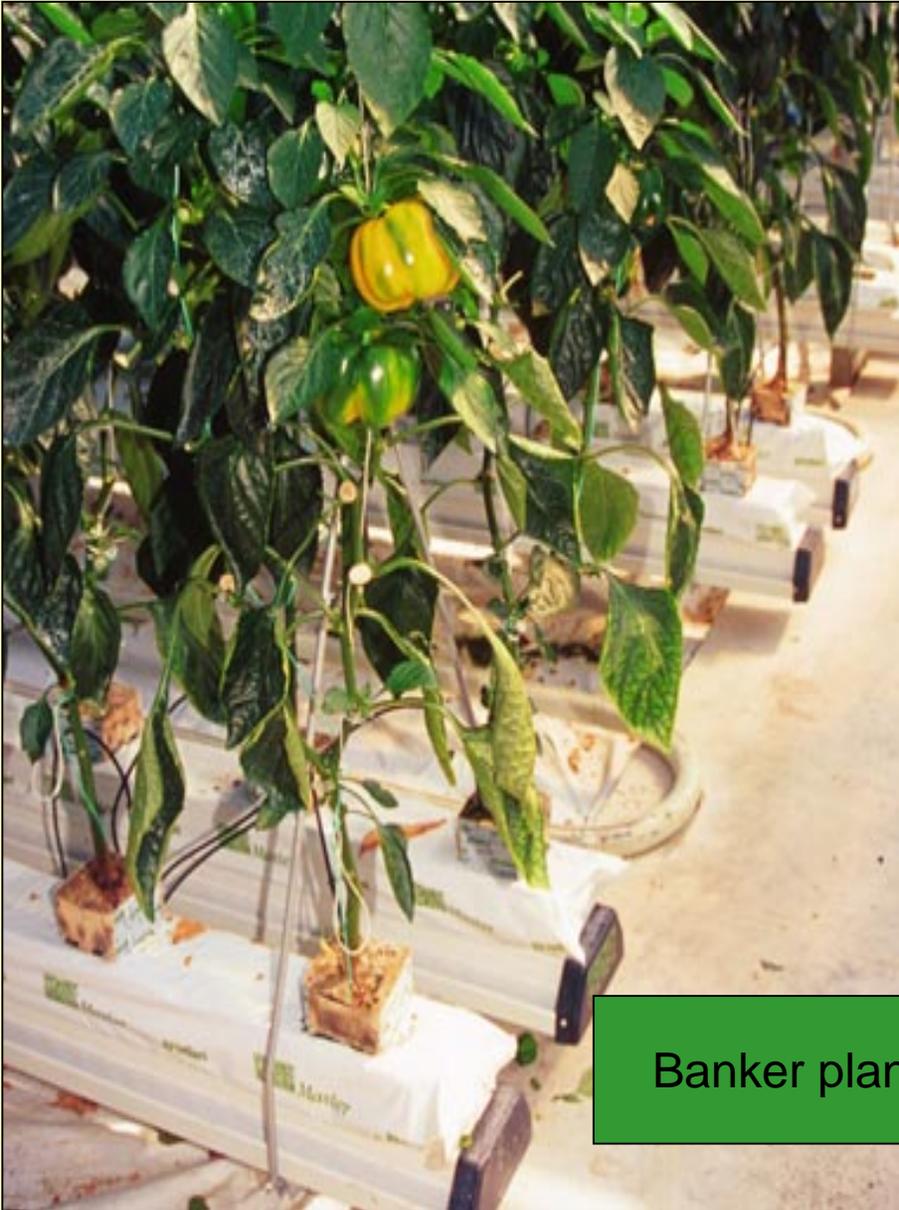
Footwash at entrance-Tyvek suit?

New Trends/Techniques Used in Large Greenhouses

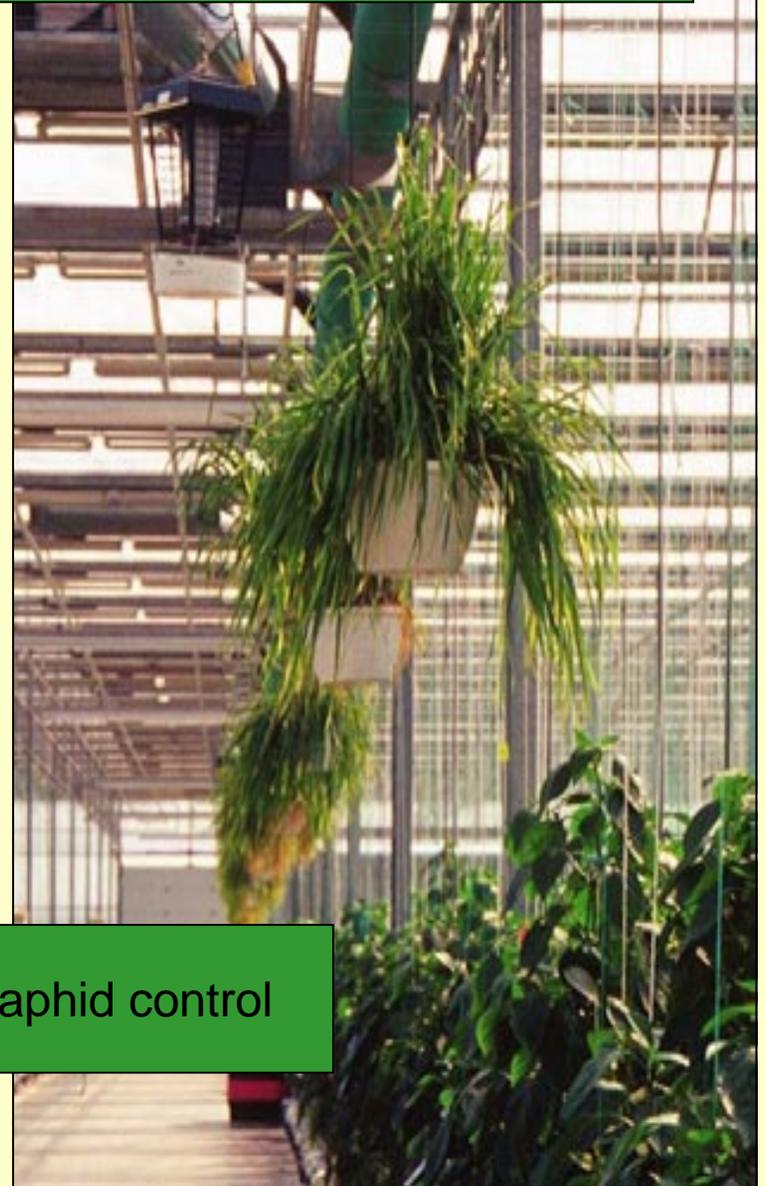
- Crop consultants for biocontrol
- Sorting/packing equipment
- Hanging gutters
- Intercropping
- Artificial lights
- Hot water heat with pipes
- Automated harvest equipment



Rockwool, water pipes & hanging gutters



Use bug-zapper only at night
when greenhouse is closed!



Banker plants for aphid control



Computer Controls are centralized, but workers also enter yield and labor data throughout the greenhouse



Specialized equipment to put on stickers





Lettuce-whole heads

Comments: Usually grown in NFT pipe or deep trough (raft) systems. Whole heads are harvested. Boston, Bibb or leaf lettuce types most frequently grown.

Pro

- Grows rapidly (50-60 days)
- Hydroponic systems cleaner than field crops-no dirt or grit (food safety issues)!
- Doesn't take up much space
- Requires less heat

Con

- Must be wholesale marketed (limited local retail potential to restaurants and Farmers Markets)
- Summer production difficult
- Diseases may appear in recirculating systems
- Packaging (clamshells) can be expensive

Hydro-serres, Mirabel, Quebec

Deep trough, floating raft hydroponics



Green Haven Plant Farm, Carthage NC

NFT Pipe System Hydroponics



Green Haven Plant Farm, Carthage NC

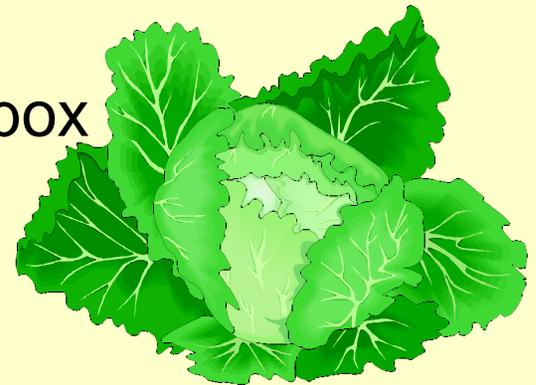
NFT Pipe System Hydroponics



Economics-Lettuce

- British Columbia Finance and Business Management enterprise budgets: <http://fbminet.ca/bc/pfp/veg.htm>
- Economic Evaluation of Hydroponics...^{*}
 - Fixed cost of 3 gutter connected 9.14 x 40.2 m with ventilation, lighting, heating cooling, back-up generator: \$82,970 (20 year life)
 - Hydroponic system for 3 greenhouses: \$17,150
 - Total annual variable costs for lettuce (90 harvests): \$168,350
 - Breakeven price for lettuce: \$13.18/box

^{*}HortScience 2000 35:993-999



Lettuce-Salad mixes & edible flowers

Comments: Usually sold as individual leaves which are trimmed off plants

Pro

- Flexible: Can be grown in soilless media, float system, or NFT systems
- Can be marketed locally to chefs, restaurants, specialty grocery stores, or in local farmer's markets
- Rapid growth



Con

- Takes lots of 'fussing' to adjust blend for appearance, taste, and time of year
 - Different types grow at different rates-grow separately & mix later
- To bag up blends for supermarkets, controlled atmosphere packaging and HAACP facilities are necessary, industrial kitchen approval?
- Very perishable once cut
- Requires intensive management

Typical Lettuce Mixes & Fertilizers

- Leaf lettuce: 2/3 red and 1/3 green oakleaf (non-spicy)
- Chef mix (mesclun):
 - Arugala
 - Spinach
 - Chervil
 - Endive
 - Chicory
 - Cress
 - Red mustard
- Typical ppm
 - N 150
 - P 40
 - K 180 (No heading if higher)
 - Ca 230
 - Mg 30
 - Fe 5
 - Mn 0.5

Creekside Nursery in Pa.-sales to chefs



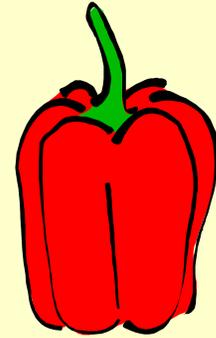
Edible Flowers & Herbs at Creekside



Vollmer Farm-local sales to public



Peppers



Comments: Similar production practices to tomatoes.

Colored bells most commonly grown type, but can get greenhouse cvs of chile peppers as well.

Pro

- Not as much price competition as tomatoes?
- Similar growing conditions to tomatoes, so can be grown in same house, if necessary

Con

- Sometimes described as 'trap crop for pests
- Yield on weight basis about half that of tomatoes, price not necessarily twice that of tomatoes
- High quality peppers available from Holland and Canada-not affected by dumping charges
- Need pollination and pruning

Greenhouse Peppers

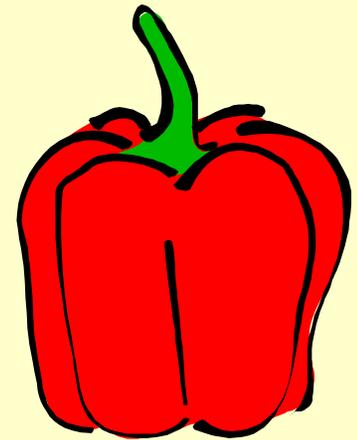


Add Innovative Packaging!



Economics-Peppers

- British Columbia Finance and Business Management enterprise budget 1993:
<http://fbminet.ca/bc/pfp/veg.htm>
 - Target production: 21 kg/m²
 - Target price: CD\$4.00/kg
 - Target grades: 44% X-large; 36% large
 - Income at target values CD\$75/m²



Cucumbers

Comments: requires different fertilization and climate from tomatoes, but similar substrates & training (upright crop). Usually shrink-wrapped before sale. Long English types most common, but some shorter types grown.

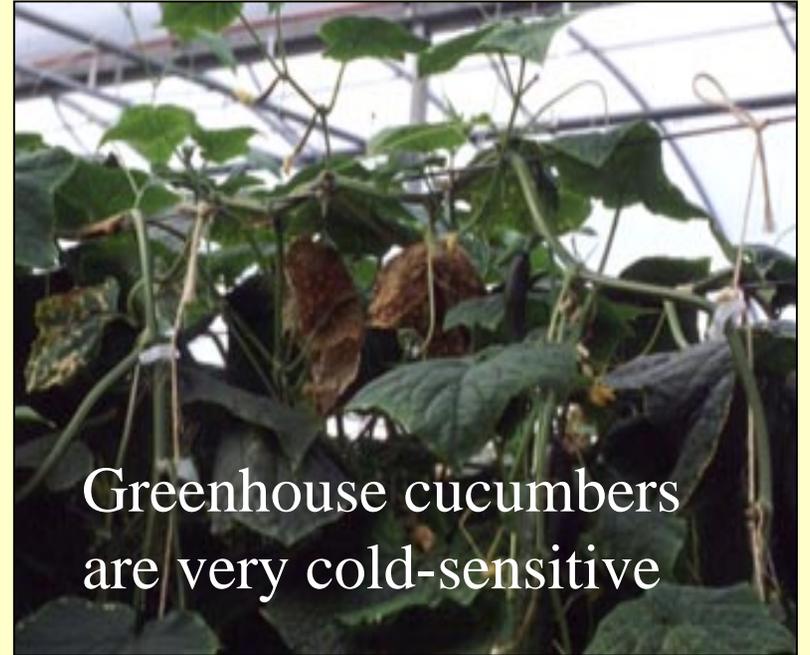
Pro

- Very productive-high yielding
- Fewer quality defects than tomatoes
- No pollination required (all female, parthenocarpic fruitset)

Con

- Limited local sales
 - For retail only need 10% of tomato acreage to avoid glut
- Competition in wholesale market with large producers
- Some pests in common with tomato (spider mites)
- Must be shrink-wrapped





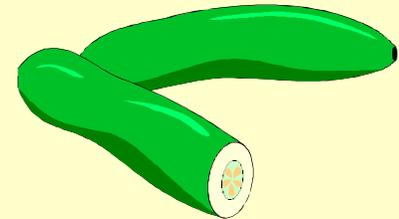
Think Packaging and Local Advantage!



Package differently from large commercial growers-No shrink-wrap on these organic cucumbers and flower is still attached!

Economics-Cucumbers

- British Columbia Finance and Business Management enterprise budget 1996: <http://fbminet.ca/bc/pfp/veg.htm>
 - Target production: 115 (6.4 cases)/m²
 - Target price: CD\$10.33/case of 18
 - Income at target values: CD\$66/m²
- 1992 US data*
 - Production costs/box \$9.84 US (Tucson)-\$12.91 (Columbus, Ohio)
 - reflects differences in transportation, labor, heating, lighting



*J. Prod. Agr. 5:438-444

Herbs

Comments: can be grown in small pots, NFT systems, or soilless mixes; can sell potted plants, whole plants, or cut the stems & let plants regrow; basil most widely grown herb

Pro:

- Local sales to chefs, restaurants, specialty groceries, direct markets
- Rapidly growing crop
- Doesn't require much space or fertilizer
- Fewer defects than tomatoes

Con:

- Some large companies are emerging
- Packaging required for wholesale market
- Many possible herbs-have to estimate demand
- Need to 'fuss' with types of herbs, suppliers, and cultural practices
 - consider daylength effects on blooming-may affect quality, e.g. basil
 - Basil susceptible to fusarium wilt

Container production of basil





Economics-Herbs

- Economic Evaluation of Hydroponics...*
 - Fixed cost of 3 gutter connected 9.14 x 40.2 m with ventilation, lighting, heating cooling, back-up generator: \$82,970 (20 year life)
 - Hydroponic system for 3 greenhouses: \$17,150
 - Total annual variable costs for basil (90 harvests): \$159,260
 - Break-even price for basil: \$0.58/plant
- [http://www.attra.org/attra-pub/ghveg.html#hydro-economic evaluation of organic herb production & some general cost data](http://www.attra.org/attra-pub/ghveg.html#hydro-economic%20evaluation%20of%20organic%20herb%20production%20&%20some%20general%20cost%20data)

Melons

Comments: Grown in upright training system similar to tomatoes, peppers, cucumbers. Also need pollination

cvs: Galica type, Sprite & Emerald Jewel (Japanese type); most fruit 1 1/2 lbs.

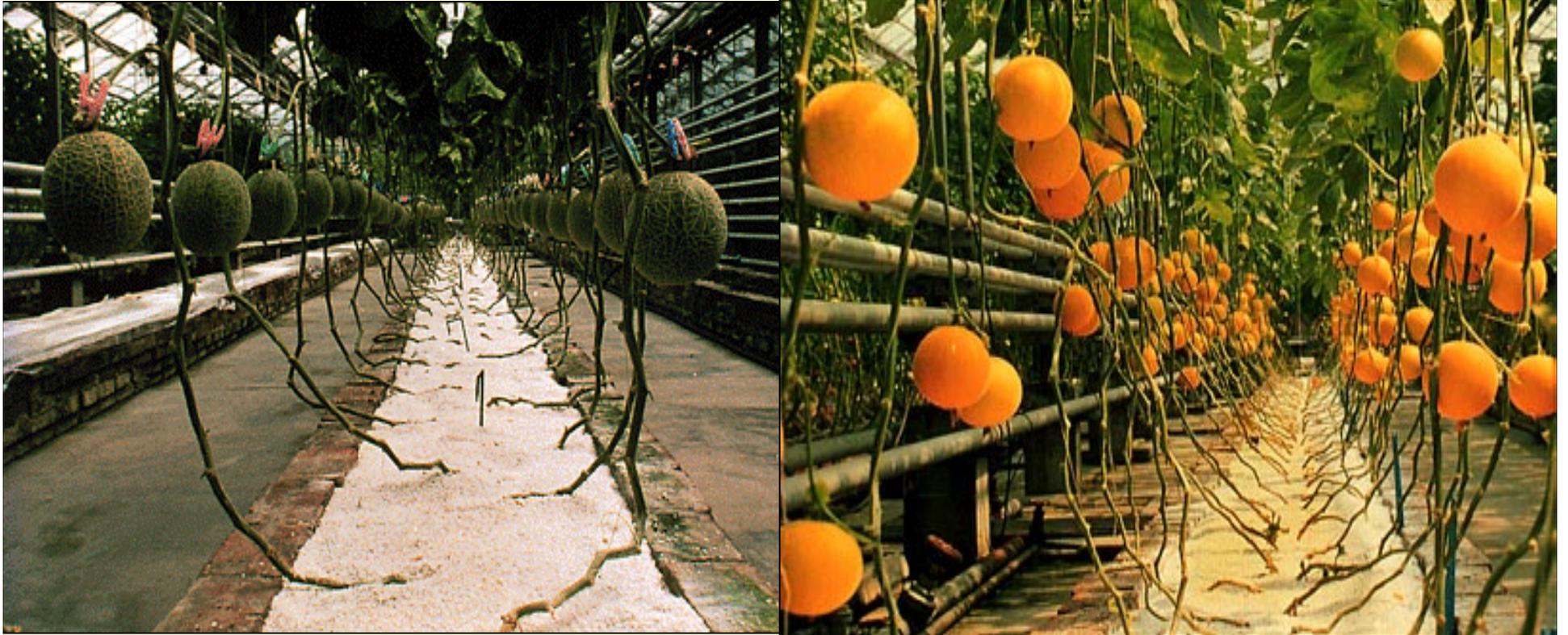
Pro

- Unique product-can't be bought in stores!
- Can be sold in small amounts, often for a high price (trendy!)

Con

- Usually only one fruit harvested per plant
- Fruit requires support in most cases
- Low production on an area basis
- May not be built-in market (no plu#)
- Need to count days from flowering to determine ripeness (no visual or aroma clues)

Melons in Chinese Greenhouses



Melon Production in Europe



Economics-melons

- Suwanee Valley Research Report 96-17
 - Cultivar: Gallicum, green-fleshed muskmelon
 - Grown 2 or 3/per lay-flat perlite bag
 - Supported fruit in sling
 - Produced 1.8 fruit/plant (1.4 marketable)
 - Average frt weight 3.3 lbs

Cluster Tomatoes

- **Comments:** Grown like other tomatoes, but packaged differently. Cultivar choice important because all fruit on the vine need to ripen at the same time

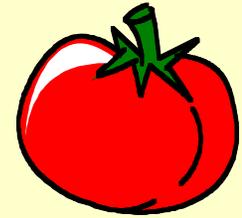
Pro

- May be easier to compete with large operations than for beefsteak tomatoes (easier to market)

Con

- Very delicate (tend to fall off cluster)
- Need specialized packaging facilities (nylon bags)
- Large commercial growers in US and Canada
- Flavor not as good in some cultivars (Tradiro)
- Fewer lbs/plant than beefsteak types

Specialty Tomatoes



- **Comments:** Grown like other tomatoes, but packaged differently
 - Cvs: try Sungold (yellow miniature pear-shaped, very sweet); 647 or Santa for a grape tomato

Pro

- Excellent sweet flavor; high in fructose
- Fewer physiological disorders
- Grape tomato seed may be difficult to buy

Con

- Hard to compete with pricing on field crop
- Need specialized packaging (clamshell or basket)
- Labor-intensive to pick
- Lbs/plant for grape tomatoes 1/3 that of beefsteak



Canada



Canada



China

Cherry Tomatoes



SunGold tomatoes from Specialty Crops
Center www.ces.ncsu.edu/specialty_crops/



Field-grown cherry tomatoes in Davis, CA farmers market

Tell About Your Product!



Heirloom Tomatoes



Sprouts/Microgreens

Comments: similar to producing bean sprouts, but some leaves produced

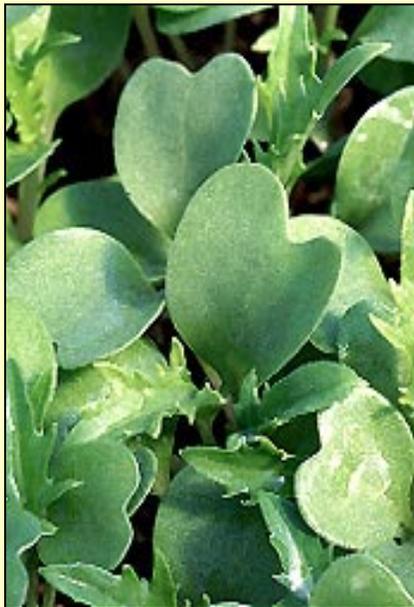
Pro

- Trendy right now
- Unique product
- Market locally to chefs, restaurants, specialty groceries
- Quick turn-around of space
- Little or no fertilizer needed

Con

- Need to develop market
- Production practices & cultivars experimental- 'cutting edge'
- Product has short shelf-life

Micro-Greens available from Johnny's Selected Seeds



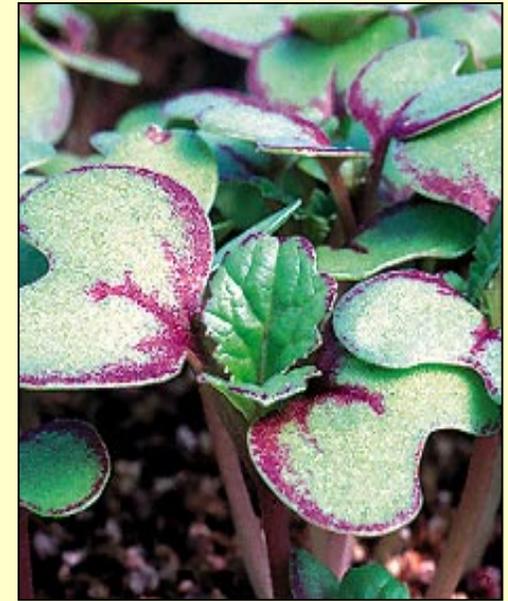
Kyona Mizuna



Herb-Salad Burnet
(*Sanguisorba minor*)



Red Russian Kale



Red Giant Mustard

Photos courtesy of Johnny's Selected
Seeds, Albion, Maine

Potential Microgreens/Salad mix



Braising mix from
Johnny's Selected
Seeds

Spinach



Belgium endives produced in California



Sprout Production in California





Sunflower and alfalfa sprouts



Clover and mung bean sprouts



Squash & Baby Squash

- **Comments:** need bumblebees for pollination
- **Pro**
 - High quality product
- **Con**
 - Requires 6-8 ft² per plant, but only produces 10-15 lbs.
 - Susceptible to powdery mildew



Squash Production in the Netherlands



Strawberries & Other fruit

Comments: Grown on benches with soilless mixtures or hydroponically. Requires cooler temperatures than tomatoes.

Pro

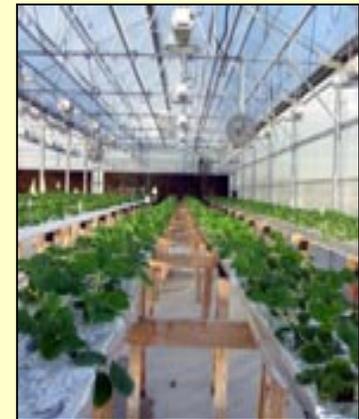
- Fruit higher quality and 'safer' than field crop
- Can produce out of season
- Easy to market in any amount
- Can be grown in cool greenhouse

Con

- Upscale product-need to wholesale at \$18-24/flat (usually only Nov.-March)
- Relatively low production per unit area : need 1.4 lbs/plant to break even
- Hard to get cultivars that do well in greenhouse
 - Need day-neutrals or chilled plants (try Gaviota)
- Susceptible to a number of diseases and pests
- Need to pollinate

Greenhouse Strawberry Production at the Specialty Crops Center

http://www.cals.ncsu.edu/specialty_crops/



Photographs courtesy of Barclay Poling and Specialty Crops Program

Eggplant

Comments: Require the same or slightly higher temperatures as tomatoes

Pro

- Fruit higher quality and 'safer' than field crop
- Can produce out of season

Con

- Usually only a small premium over field prices (10-15%)
- Relatively low production per unit area compared to tomatoes
- Not an easy crop to grow well
- Need to pollinate
- Very attractive to pests

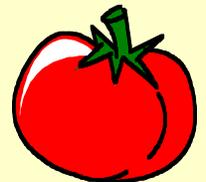
Economics-Eggplants

- British Columbia Finance and Business Management enterprise budget 1992:
<http://fbminet.ca/bc/pfp/veg.htm>
 - Target production: 26.5 kg/m²
 - Target price: CD\$1.46/kg
 - Target grades: 15-20% premium over field eggplant
 - Income at target values CD\$39/m²



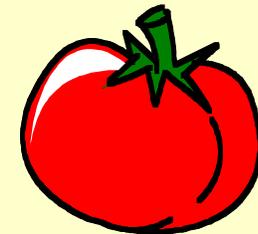
Economics-tomatoes

- The Bottom line in Greenhouse Tomato production-ARE 18, Sept. 1999: <http://www.ag-econ.ncsu.edu/publistres.htm>
- Extension report Suwanee Valley AREC 91-20 Costs of production for NFT-pipe greenhouse tomatoes in North Florida Order form: http://nfrec-sv.ifas.ufl.edu/greenhouse_rpts.htm
- California: Total estimated costs to produce 1 lb or 1 kg of fruit: \$0.77/lb \$1.70/kg; total estimated production: 25 lbs/plant; 4 ft²/plant.
- British Columbia Finance and Business Management enterprise budgets: <http://fbminet.ca/bc/pfp/veg.htm>



Economics-Tomatoes

- British Columbia Finance and Business Management enterprise budget 1993:
<http://fbminet.ca/bc/pfp/veg.htm>
 - Target production: 47 kg/m² (=104 lbs/1.2yd²=10lbs/ft²)
 - Target price: CD\$1.60/kg
(=\$0.72CD/lb=\$0.43US/lb (@0.60 US=1.0 CD_
 - Income at target values CD\$76/m



General Considerations for Alternative Crops

- Marketing, marketing, marketing
- Use only cultivars recommended for greenhouse production
- Pesticide registrations limited
- Check if PLU# is available for wholesale market
- Determine if you (or a partner) have the patience and resources to experiment
- Try to avoid expensive, specialized systems
- Consider agri-tourism-charging tour groups to visit (senior citizens, schools, cooking clubs)

Other possibilities:

- Determine packaging requirements
 - Watercress or spinach
 - Blueberries, raspberries
 - Gourmet beans (french filet)
 - Sugar snap peas
 - Edible flowers-nasturtiums, pansies
 - Novelty tomato (yellow, grape)
- Pickling cucumbers (cello wrapped, tray packs)
- Organic production



Raspberries
grown by
Specialty
Crops
program



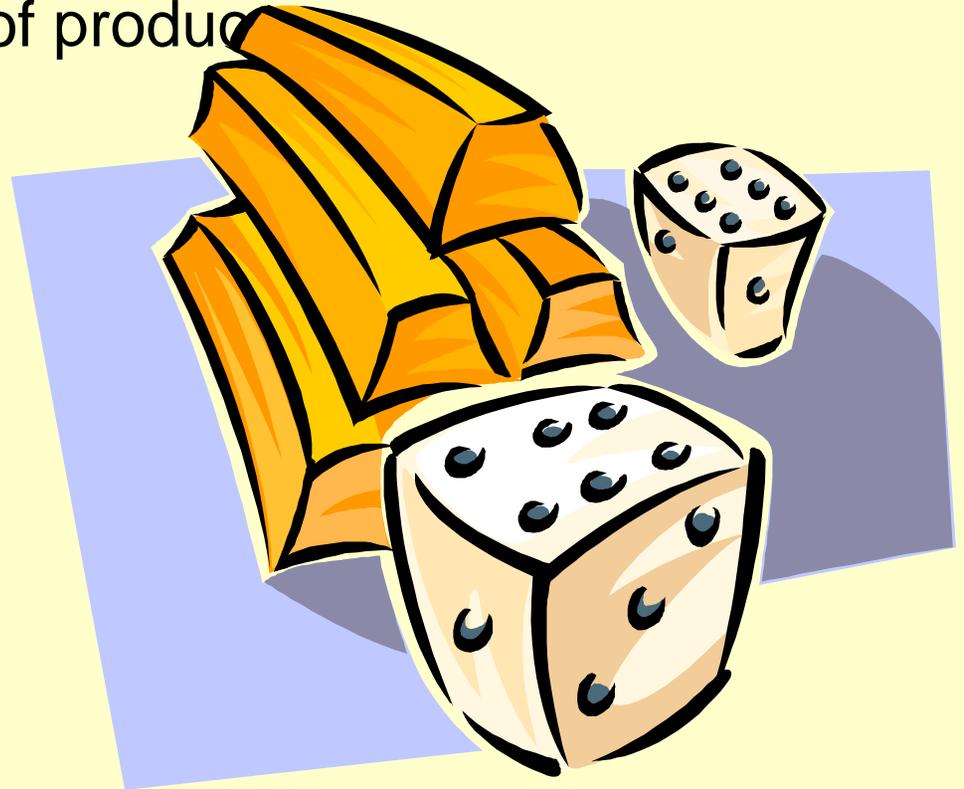
To get started:

- Make market arrangements
- Conduct trials
- Start small
- Increase production with demand
- Develop sufficient quality for high end markets, direct marketing



Success Factors for Marketing

- Enough volume
- Uniformity and quality of product
- Dependable supply
- Competitive pricing
- Identify to add value
- Luck?



Conclusions-Cover Your Costs*

- Greenhouse structure and equipment cost \$4.80/sq.ft on average
- Total for 20,000 sq.ft is \$96,000 (includes frame, construction labor, heaters, fans, cooling, irrigation, pump and well, electrical, and tools)
- Operating cost average is \$4.63/sq.ft (includes labor estimate of 20 h/week for a 24x96 foot greenhouse (2304 sq.ft))

*University of California publication 21575. Commercial Greenhouse Vegetable Handbook. 1998.