USDA Rural Development
Rural Business Enterprise Grant

Goods from Your Woods:
A Feasibility Study of Understory Crops in Western Massachusetts

Technical Report in Depth

Conducted by the
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Project Description:

There's nothing new about cultivating forest plants for food, medicine, household objects and decoration. What is only a few generations old is our society's rapid industrialization and light-speed technology that has distanced so many of us from the land and its lore. Thus, forest products other than logs seem like a new idea for many folks. This study was conducted to rediscover some old traditions and identify new understory crop possibilities that will enable forest landowners in western Massachusetts to diversify their economic activities.

Another goal was to identify value-added markets for locally produced understory forest products that will enable landowners and others in western Massachusetts to expand their sales and marketing of these products in the future. Marketing and evaluation information gathered from researchers, educators and current producers provide an overall perspective on the distribution channels and potential markets for understory crops that can be grown in western Massachusetts.

Acknowledgements:

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Choice of Understory Crops for the Study

There are many possible understory crops that may be produced in western Massachusetts. Four criteria were used to choose which to study in depth for this report:

1) viability of cultivation in Massachusetts
2) strength or development of markets
3) scalability of operation
4) interest by participants

Four understory crops were chosen: cultivated edible mushrooms, medicinal plants such as ginseng and goldenseal, native shade plants for landscaping and evergreen boughs for holiday decorations.

- Edible mushrooms such as shiitake and oyster mushrooms are experiencing growing demand and interest among consumers, and may be developed at a small or large scale.

- Ginseng and goldenseal are well suited to being grown in rich, hilly forests of western Massachusetts and ginseng especially has a very high market value due to strong east Asian consumption.

- Native shade plants are growing in popularity for landscaping and restoration projects as knowledge about invasives and desire for local plants increases.

- Evergreen boughs from white pine are plentiful in Massachusetts forests, and the sale of wreaths and other holiday decorations can be developed on small or large scales for a given operation.

In depth information regarding the cultivation and marketing of these crops follows.

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Section 1: Cultivated Edible Mushrooms

Introduction

Edible mushrooms are delicacies which enjoy growing popularity worldwide. Preparation of logs for mushroom growing is time and labor intensive at the start, but afterwards requires relatively low maintenance. For the small woodland owner, cultivating edible mushrooms is an activity very compatible with forest management that offers additional profitable income on an annual basis with relatively little overhead. Interest in edible mushrooms is growing, and consumption is increasing, though supply is as well which has made prices stable or falling. However, there is a strong market for local produce in western Massachusetts supported by networks of Consumer Supported Agriculture farms and farmers markets as well as the Local Hero campaign by CISA. For those interested in producing mushrooms there are ready made marketing outlets present. Mushrooms can be produced on wood normally split for firewood which raises the profitability of the log by several hundred percent. A cord of split firewood that could be sold for $150 per cord may produce shiitakes worth $500 or more.

Wild-crafting Edible Mushrooms

Many varieties of edible mushrooms grow wild in the woodlands of western Massachusetts. Chicken-of-the-woods (Laetiporus sulphureus) are found on living or dead hardwood or coniferous trees, while pear-shaped puffballs (Lycoperdon pyriforme) are seen on rotting logs and stumps. Oyster mushrooms (Pleurotus ostreatus) may also be found on standing or fallen dead trees. Harvesting wild mushrooms is best practiced by experienced individuals, since certain varieties can be mistaken easily for poisonous fungi. Toxins found in certain mushrooms cause illness or death, with the most dangerous compounds often not showing symptoms for hours to a day after the mushroom has been eaten.

Characteristics

Mushrooms are fungi. Unlike plants, they do not use photosynthesis to produce food. Instead they break down organic matter by decaying it. What we think of as mushrooms, the cap and stem or flat fan-shaped growth is but one part of a mushroom's life cycle. It is the fruiting body of a large network of threadlike cells called *mycelia* that spread through wood or plant matter. Mushrooms may grow on living or dead trees. They are a sign of damage or decay on a living tree, and often populate dead trees or fallen logs profusely.

The forest understory is suited to the growth of mushrooms. Walking through your woods in a cool wet summer you will see countless varieties of mushrooms, bracket fungi like the mahogany lines of turkey tail (*Trametes* versicolor) to delicate branching coral fungi.

You may come across alien sac fungi like the brilliant, common jelly baby (*Leotia lubrica*) or the familiar cap and stem of the meadow mushroom (*Agaricus campestris*). Some mushrooms are edible and highly delicious. Of these, many may be cultivated on logs or other organic matter such as wood chips or straw. What the mushrooms are grown on is called the *medium* or *substrate*. Mushrooms reproduce through releasing small cells called *spores* which are produced in the fruiting body. The substrate is inoculated with spores and kept in conditions that will encourage growth: damp, dark and warm. By flushing the substrate with water, a grower can produce a steady supply of edible mushrooms to be sold fresh or dried. Cultivation also minimizes risk of poisoning due to misidentification.

Types

Shiitake (Lentinula edodes): These well-known gourmet mushroom originated in Japan and are highly prized by chefs for their nutty flavor and high protein content. A gill fungi with a near flat cap generally 1 ½ to 2 inches wide that stands on a thin stem. They range in color from golden brown to brownish-black on the top of the cap with cream colored gills beneath. Shiitake are a source of lentinan an anti-carcinogen.

Oyster mushroom (Pleurotus ostreatus): Native to New England this mushroom can be found in the woods growing on the sides of standing dead or fallen trees. Named for their semi-circular, shell-like shape, the caps come in a wide variety of colors. From white to grey or violet-brown, they have white gills underneath and range in size from 2 to 8 inches across. Smooth and moist, they are tender when cooked with sometimes a slight anise flavor. Those grown later in the year have a chewier texture.

Shiitake and oyster mushrooms have advantages for the beginning mushroom farmer (Beetz and Kustodia, 2004). There is much information available about their cultivation, and they are among the easiest to cultivate. Markets for shiitake mushrooms are well-developed and the mushroom enjoys a reputation for good taste and desirability. Oyster mushrooms have the drawback of causing allergies in some growers: the spore can be a source of irritation. However, wearing a mask while harvesting can reduce this problem and the fact that this mushroom is native to our forests may be a strong selling point.

Other edible mushrooms:

- Black Morel (*Morchella elata*)
- Yellow Morel (*Morchella esculenta*)
- White button, Portabella and Crimini (*Agaricus bisporus)*
- Chanterelle (*Canterellus cibarius*)
- Maitake (*Grifola frondosa*)
- Lion's Mane (*Hericium erinaceous)*
- Porcini (*Boletus edulis*)
- Hedgehog (*Hydnum umbilicatum*)
- Yellowfoot Chanterelle
- Enoki (*flammulina velutipes***)**

Table 1: Edible Mushrooms, Spawn and Retail Price.

Species	Type/Cost of Spawn	Mushroom Price (retail)
Shiitake, *Lentinula edodes*	Sawdust: $19/5 lbs. (30-50 4 ft logs) Plug: $9 for 750 (15 4 ft logs)	$11.99/lb (organic)
Maitake (or hen-of-the-woods), *Grifola frondosa* (native to N. America)	Sawdust: $19/1kg (15-25 4 ft logs) Plug: $24.95/300 plugs	
Oyster or Straw Mushroom, *Pleurotus ostreatus*	Sawdust: $19/5 lbs	$9.99/lb
Lion's Mane, *Hericium erinaceous* (native to N. America)	Sawdust: $19/1kg Plug: $24.95/300 plugs	
Agaricus spp.		$3.99/lb
Chicken-of-the-Woods, *Polyporus sulphureus* (native to N. America)	Plug: $39.95/1000 plugs, $24.95/300 plugs	

Information from Field and Forest Products Mycomart < http://fieldforest.net>, and The Mushroom People http://www.mushroompeople.com accessed June 21, 2007. Prices where available from Whole Foods Market, April 17, 2007.

Cultivation

Mediums: Edible mushrooms may be cultivated on a variety of materials called the medium or substrate. These mediums fall into two general categories, which have different needs and requirements. Woodchips, sawdust and straw are commonly used. Small diameter logs are drilled with holes and impregnated with mushroom spawn. Synthetic logs made of wood chips or other organic matter mixed with grain, are increasingly being used in large-scale industrial production. (Royse, 2001)

Shiitake (*Lentinula edodes*), maitake (*Grifola frondosa*), oyster mushrooms (*Pleurotus ostreatus*), lion's mane (*Hericium erinaceous*) and chicken-of-the-woods (*Polyporous sulphureus*) all grow well on hardwood trees, especially oaks, beech and maple. *Agaricus spp.* (white button, portabella, and crimini) and oyster mushrooms grow well on loose media such as straw or wood chips. (Jacke and Toensmeier, 2005) Recommended substrates are listed in Table 1 above. The mediums have different requirements which may be advantageous or disadvantages for the new grower or small producer.

Log cultivation:

- Well-suited to small to medium size production
- May be accomplished by an individual
- May cultivate out of doors
- Small area needed due to dense stacking of logs
- May fetch higher prices ($16/lb shiitake reported at Ithaca farmer's market, Chenango County Extension Class) than those grown on loose media
- Increase income potential of firewood grade logs

Loose media cultivation (woodchip, sawdust, straw and synthetic logs):

- Good for large scale production
- Difficult to accomplish alone
- Higher productivity than log cultivation
- Year-round, indoor production
- Mediums must be pasteurized or sterilized prior to inoculation
- Climate controlled space needed
- Higher risk of pathogens

Inoculant: The medium is inoculated with mushroom spawn which comes in two main forms. The small powdery spores are available mixed with sawdust, as well as impregnated into small pegs or plugs of wood. Grain may be added to the sawdust as an

additional nutrient source to start the spawn growing. Sawdust spawn is commonly used with loose material mediums and logs, while plugs are made for use with logs.

Strains have been bred for different growing seasons such as warm season, cool season and wide range. If growing mushrooms in the fall or spring, cool season strains are desirable; if in the summer, warm season or wide range. (Hill, 1999) It is recommended to use at least two cultivars to avoid loss of the whole crop if a disease strikes one. Try different strains over time to see which work best in your particular area. Inoculant may be purchased from suppliers such as those listed at the end of this section. Health regulations and standards for production of spawn are rigorous, which may make production of spawn for sale not suited to small growers.

Choose logs of a tree species that is suited as a medium for your desire mushroom species (see Table 1). Oak logs are the most desirable medium, denser wood making for a longer lasting period when the log may fruit. However, other hardwoods work well, and less dense woods such as birch or poplar may fruit sooner than denser woods. (Steinberg P.C., 2007)

Preparation of the logs:
Proper timing of cutting and storage of logs will determine whether they can be used as mushroom media. Logs for mushroom cultivation must be cut when the trees are dormant but the sap is flowing. During fall after the leaves have fallen or in late winter before the buds have broken are suitable times. Inoculate as soon as possible after the logs are cut. If it is necessary to store them, keep in a shady, moist spot to keep them from drying out. Place logs beneath the shade of an evergreen or other cover. Cover them with a tarp to protect them from wind, or if cut during the winter, stack them so that they will all be covered by snow. Logs cannot be drier than 29% in order to grow mushrooms, anything drier should go in the firewood pile.

Measuring Wood Moisture
To measure the moisture content of a log, you may use a moisture meter or indicator logs. Moisture meters are available for sale from lumber supply companies and cost from $100 to $300. Indicator logs are additional logs included in mushroom log stacks which are not impregnated with spore. Moisture can be measured from this log by cutting a "cookie" (a one inch crosswise slice) from the log, 6 inches from the end of the log. Weigh the cookie and dry overnight in an oven at 300 degrees Fahrenheit. Re-weigh the slice and calculate the moisture using the following formula:

(Dry weight/original weight X 100)-100 = Percent Moisture Content

Have one indicator log per 10-15 logs. Measure the moisture content twice a month in the summer, and once a month during cooler times of the year. To increase the moisture of the logs sprinkle with water equal to 1 inch of rainfall over 24 hour period. (Hill, 1999)

Choice and Storage of logs

Choice and storage of the individual logs are important for health and safety reasons. Be sure that the trees cut are live and undiseased, with no other mushrooms present. This ensures that only the desired species will be cultured in the log. Once cut, do not allow them to touch the ground and try to keep the bark layer intact. Store the logs on a palette or tarp. The reason for this isolation of the logs is to keep them from being contaminated by local fungi.

Logs should be cut to a size that will make them manageable to move. Use logs that are three to eight inches in diameter, with 4-6 being the optimal range. Logs smaller than 3 inches dry out quickly, and those larger than 6 inches require more spawn due to their larger volume.

Inoculate the logs by drilling holes and filling them with spawn. Using a power drill, make holes perpendicular to the surface in straight lines along the length of the log. Stagger the lines to make a diamond pattern with the holes. A rule of thumb is to make a number of lines of holes equal to the inches of the logs diameter. (Hill, 1999) The depth of the hole will be approximately 1 inch or as appropriate for the species of mushroom.

Insert the spawn plug into the hole, or fill it with sawdust using an injector available from spawn suppliers for this purpose. Plugs need to be hammered into the hole until flush with the surface. After the spawn is inserted, seal the hole with wax to retain moisture for the spawn and to keep loose spawn from falling out. Use food grade or cheese wax. In one day, 2 people can reasonably expect to drill and inoculate 80 logs.

Logs may be stacked in a variety of ways. The standard pattern is to lay them in a criss-cross pattern: multiple layers with logs lying parallel to those on the same level, and at right angles from the layers above and below. Other methods such as the slope or x-pattern are described in the USDA Forestry service bulletin, AgroForestry Note 19 from July 1999 (see resources). Once the logs have been inoculated, they may be allowed to come into contact with the ground, however to avoid rotting of the logs on the bottom layer it is recommended to stack the logs on palettes. Label the logs with the species, cultivar and date inoculated. Inexpensive tags may be manufactured from cut aluminum cans and nailed to the log. (Chenango County Extenstion class, WWWFF)

Once inoculated, the logs begin an incubation period that may last 6 to 18 weeks (Interview, Casey Steinberg). This period is known as the “spawn run”, during which the long threads of mycelia form and grow throughout the log. The logs should be heavily shaded at this time, with shade of 75-80% needed. The logs should be kept moist at 29% and above moisture content. The mushrooms will die if the logs dry out. Monitor twice monthly during the summer, once a month in cooler times of the year, and water logs in times of drought. The spawn run is complete when mycelia may be seen at the ends of the log.

Once the mycelia are established, to encourage fruiting you may flush logs with water to bring about harvest conditions. Soaking a colonized log overnight in water will bring

about mushroom growth about a week later. At Old Friends' Farm, Casey Steinberg and Missy Bahret have about 200 logs. In order to have a steady supply of mushrooms during the growing season, they flush 6 logs per week, which produce about 1 pound per log. They establish a rotation, allowing the logs to rest 8-12 weeks before being flushed again. Logs which are allowed to rest more, or which are not flushed but allowed to fruit at will, may produce over a longer period of time while those which are flushed produce more over the shorter term.

Pathogens and Disease

Be sure to avoid harvesting mushrooms with withered or unusual appearance. Larger scale cultivation is especially vulnerable to bacterial and fungal diseases which can affect cultivated edible mushrooms. Viral infections are less common than with vegetables. Bacterial infections such as bacterial blotch and mummy disease are avoided through adjustment of climate, as well as sanitation and hygiene procedures on the part of workers. Fungal diseases are commonly spread through dust, insects or by spores on the clothing of harvesters. Fungicides such as Vorlex and Bravo are commonly used, however, the incidence is often only reduced by 30%. Green mold (*Trichoderma harzianum*) is a new hazard, which caused the loss of 30% of the crop in Pennsylvania recently. Treatment for this blight is to sterlize and sanitize crop after harvesting is complete, as well as restricting movement of workers from one room in a facility to another which can spread the mold. (Mana Mushroom, 2007)

Spawn Suppliers:

Fungi Perfecti (founded by Paul Stamets, author of *Mycelium Running* and *Growing Gourmet and Medicinal Mushrooms*)
P.O. Box 7634
Olympia, WA 98507
260-426-9292
www.fungi.com
(sawdust, grain and plug for: shiitake, reishi, maitake, lion's mane, pearl and tree oyster, chicken-of-the-woods and others)

Field & Forest Products
N3296 Kozuzek Rd.
Peshtigo, WI 54157
800-792-6220 (toll-free)
www.fieldforest.net
(sawdust and plug spawn for: winecap stropharia, shiitake and white morel)

The Mushroom People
P.O. Box 220
560 Farm Rd.
Summertown, TN 38483
931-964-2200
www.thefarm.org/mushroom/mpframe.html

(sawdust spawn and kits for: shiitake, maitake, reishi, button mushroom, Lion's Mane, portabello, tree and phoenix oyster, morel and button mushrooms)

Further producers are listed in the ATTRA publication Mushroom Cultivation and Marketing (Beetz and Kustudia, 2004)

Harvesting and Processing

Harvesting is a daily activity during the growing season. If flushing the logs, they should be check daily for fresh caps. Mushrooms are ripe once they have opened fully, going past "button" stage and the cap is about 60-75% extended. Harvesting later in the day is recommended, when the mushrooms are dry. Twist them from the bottom of the stem to break them off whole. Each log will likely fruit one or more times per year. A log can be expected to produce approximately 10% of the wet weight of the original log over the course of all the years it fruits. (Hill, 1999)

Table 2: Labor and Logs for Mushroom Cultivation Operation

Number of Logs	Level of Operation	Number of People Needed
10	Personal consumption	One
200-500	Small commercial operation	Couple or family
500-750	Medium sized commercial	Three to five people
1,000s	Large commercial operation	Hired labor

Source Chenango County Extension online Course, The How, When and Why of Forest Farming, Spring 2007.

Harvesting mushrooms

Mushrooms fruit in flushes or breaks when fruiting body of mushroom develops and matures. Occur in 7 to 10 day cycles. Flushes can be brought about or controlled by control of various factors including: water, CO2 and temperature. Multiple flushes are possible, but the majority of production takes place in the first two. (Beyer, 2003)

Harvest takes place in 2-4 day period within flush cycle. Pick by hand when cap has developed at desired level of maturity. Maturity is indicated by openness of cap rather than size of mushroom. Mushrooms mature in a wide variety of sizes. Mushrooms are desirable at different stages of maturity: some consumers prefer small, closed cap, others prefer wide open fully mature caps. If mushroom is soft or appears wilted or off-colored, it is either over-mature or diseased and should be discarded. (Beyer, 2003)

When harvested package in four to eight or twelve ounce till or box. Weigh before packaging, wrapping and labeling. (Mana Mushrooms, 2007)

Packaging and storage

Keep mushrooms in dry, aerated packaging in a cool, dark area. A cool or refrigerated area is required for the storage of fresh mushrooms. A range of 35 degrees to 45 degrees

Fahrenheit is required for safe storage. If sold to restaurant industry, blanch then pack in liquid which increases shelf life to 4-5 weeks. (Mana Mushrooms, 2007)

When in storage, the mushrooms should be allowed to breathe. Place in waxed paper bag, cardboard box or plastic box with openings rather than an intact than plastic bag. Refrigeration is needed for prolonged storage, and the shelf life of mushrooms varies depending on the species. Some species may be frozen directly such as maitake and tree oyster.

Shelf life for fresh mushrooms also varies. Standard button mushrooms last seven days under optimal conditions. Shiitake has a long shelf life of three weeks when stored properly. (Mana Mushrooms, 2007) Some mushrooms have a short shelf-live, such as the oyster mushroom which if sold fresh must be consumed in just a few days. However, this helps make such mushrooms more competitive for small growers who can be provide fresher produce with less damage from shipping. (Beetz and Kustodia, 2004)

Drying mushrooms can most efficiently be accomplished using a food dehydrator. Drying is a good use for mushrooms to be sold through mail order or for small, low quality specimens. Small size dehydrators may be purchased for $20-$40 at standard retail outlets for household goods, while larger models are available from mushroom supply sources.

The first time you try to dry mushrooms, do so in an isolated or well-ventilated area outside of main living areas. The drying process releases spores and spreads them into the air, causing strong allergic reactions in some people. Do not dry mushrooms in your home until you know whether you have such a response, and it may be recommended to do drying outside of living areas since allergies can be acquired with extended contact.(Kuo, 2002 and Steinberg Interview, 2007)

Drying may also be done in the sun on racks in an area with warm, dry air. This process is slower, but has been found to increase the vitamin D content in mushrooms. Drying greatly reduces the weight of mushrooms. Seven pounds of fresh shiitake produce one pound of dried mushrooms.

Marketing

Market trends

Production of mushrooms has increased from 350,000 tons in 1965 to 7.5 million tons in 2000. (Royse, 2001) Demand in the United States has quadrupled since 1966, with per capita consumption increasing from 1 lb per person at that time to 4 pounds in 2002. (Vegetable and Melon Outlook, 2002)

The primary mushroom produced and consumed in the United States, accounting for 90% of the market, is the white button mushroom (*Agaricus bisporus*). (Mana Mushrooms,

2007) Six farms account for 50% of the mushrooms grown in the United States (Mana). Grown on a mass production scale, the prices for these mushrooms is much lower than those commanded by exotic varieties such as shiitake, oyster mushrooms and portabello. Farmers growing *A. bisporus* gained $1.07 per pound on average, while growers of oyster mushrooms received $2.00 per pound. (Royse, 2003) Prices for shiitake mushrooms can be $7 per pound, up to $16 per pound for fresh, log-grown mushrooms. (Whole Foods, 2007, Cornell Extension Course)

The United States is the second largest producer of mushrooms in the world. (Vegetables and Melons Outlook, 2002) The top producer is China where they have been cultivated for nearly a thousand years. (Beyer, 2003) Pennsylvania, still the largest per capita producer of mushrooms in the United States was the site of the first structure for commercial growth of mushrooms in 1894.

The Mushroom for You

Decide what your product is. Will you primarily grow fresh mushrooms for sale locally? If so, are you trying to capture the maximum value for a niche market or are you trying to compete on a mass market scale? Will you dry and ship mushrooms? Or sell to a wholesale broker. Or are you interested in making value added products such as vegetarian pates or soup mixes? The product you choose will determine in large part what marketing venues you can pursue.

Marketing Outlets

There are many venues available: Niche markets include gourmet stores and health food stores. The health benefits of mushrooms are being researched and may create new niche markets for this product. (Stamets research) Direct markets include farm stands, farmer's markets and mail order via catalog or the internet. Indirect markets include grocery stores, CSAs and farm stands. Wholesale markets are restaurants and mass market brokers. Wholesale offers the lowest price per unit, while direct sales involves the greatest amount of effort and overhead.

CSAs offer an excellent opportunity for producers in this area since they are strong markets which are already well-established and have a customer base, and these farmers welcome diversifying their product base to offer more to their share holders. The organizers of all four CSAs contacted for this study (Riverland Farm, Red Fire Farm, Brookfield Farm, Mountain View Farm) expressed interest in carrying mushrooms from local producers and one already had with success. Any marketing plan in this area should include approaching a local CSA. Brookfield Farm and Riverland producers expressed interest in providing space for those who might be interested in cultivating mushrooms but who don't have land of their own. Dan Caplan said that Brookfield Farm has 45 acres of woods which are under-utilized. A project of this type would help provide more to their shareholders as well as help them make better use of their land.

Many CSAs are making strides in marketing to urban areas, increasing potential markets for those who might sell products through them. The Farm 2 Business program spear-headed by CISA has formed connections between businesses in urban areas. For

example, Meghan Arquing and Rob Lynch of Riverland Farm in Sunderland, MA make a regular stop at Springfield College and sell memberships to college employees. Ryan Voiland of Red Fire Farm in Granby works with Springfield Mass Mutual employees. Some CSAs such as Red Fire Farm have drop sites in urban areas in eastern Massachusetts. Some sell food in baskets or bundles, some put them in open crates from which share holders can choose a set volume of produce.

Another option for marketing understory crops through a CSA is to make arrangements to be present at a pickup site and sell them directly to consumers from an open basket or table. This may be a good way to introduce the product and gauge how much interest there is in including it in the share or as a product available at a farm stand.

Of the five CSAs interviewed for this project, those that deal with independent producers purchase products for re-sale rather than taking items on consignment. For example, mushrooms might be sold at farm stands run by the CSA. If so, they would be purchased as stock and re-sold at a 10-30% markup. However, other possible arrangements do exist. If part of a CSA share, they would likely be offered as an add-on. Many CSAs have additional products such as berries, cut flowers or fruit which members could opt for or not as they desired. The growers would be paid a set amount based on volume sold. At Food Bank Farm they sell mushrooms produced at Old Friends' Farm. Dan Caplan of Food Bank Farm reported moderate demand for the mushrooms, but that the amount they currently supply always sell out, which reflects possible room to grow in this market.

Local grocery stores have an interest in carrying mushrooms from small producers: Whole Foods has a mandate to carry 10% local food in their stores, and Green Fields Market has many local products, along with a relationship with Commonwealth CSA which is another likely prospect for carrying mushrooms. Ryan Voiland of Red Fire Farm recommended them as and excellent CSA to contact since they deal with many small growers. For sales through grocery stores, sampling is highly recommended as a way to reach a large number of potential consumers.

Selling to grocery stores should be done with caution, however, since regular quantity and quality will likely be required for an ongoing relationship to be established. Start by establishing your crop and sell in smaller venues which can be less steady to help yourself get used to the whole process of producing the mushrooms. When you have experience and are sure of the quantities you can produce, then begin to talk to more formal outlets.

Competitors:
Large scale in this region: Mycopia (CA), Mr. Mushroom (PA grows and packages in NY) and Phillips (PA, largest specialty mushroom grower) carried at Whole Foods. (Mana Mushrooms website, 2007)

Table 3: Example Budget for Shiitake Mushroom Cultivation

SHIITAKE MUSHROOM ENTERPRISE BUDGET				
1000-log operation				
INCOME	**year 1**	**year 2**	**year 3**	**year 4**
Number of logs	1,000	1,000	1,000	800
(1) lbs mushrooms produced	100	2,200	1500	600
lbs sold (fresh) 20% cull rate	80	1,760	1500	480
Price per pound	$3.50	$3.50	$3.50	$3.50
Total revenue	$280.00	$6,160.00	$5,250.00	$1,680.00
ESTABLISHMENT COSTS	**UNIT**	**QUANTITY**	**PRICE/UNIT**	**TOTAL COST**
(2) 5" X 48" green oak logs	log	1000	$0.75	$750.00
Mushroom spawn	gal	25	16	$400.00
Polyfoam plugs	box	3	12	$36.00
High speed drill	drill	1	250	$250.00
Drill bits	bit	10	6	$60.00
Water tank	tank	1	100	$100.00
Used refrigerators	unit	2	100	$200.00
Misc. (sprinklers/hose)		1	100	$100.00
Labor-drill, plant, cut plugs, plug, rack	hr	70	6	$420.00
Labor-inspect & water	hr	15	6	$90.00
(3) Total establishment costs				$2,406.00
FIXED COSTS	**year 1**	**year 2**	**year 3**	**year 4**
Hauling, $0.44/mi., 200 mi.-yr. 1; 3,000 mi ea., yrs. 2-4	$88.00	$1,320.00	$1,320.00	$1,320.00
Boxes ($0.50/3 lb mushrooms)	$13.00	$293.00	$200.00	$80.00
Utilities ($0.07/Kwh)	$25.00	$200.00	$200.00	$200.00
Labor ($6/hr)				
Soak/rack-yr 1: once x 1 min/log	$100.00			
Yrs 2-4: 4 times/yr x 1 min/log		$400.00	$400.00	$320.00
Harvest (17.5 lbs/hr)	$27.00	$603.00	$411.00	$165.00
Hauling (wage x distance/40 mph)	$30.00	$450.00	$450.00	$450.00

(4) Total fixed costs	$283.00	$3,266.00	$2,981.00	$2,535.00
Establishment costs	$2,406.00			
Total costs	$2,689.00	$3,266.00	$2,981.00	$2,535.00
(5) Net revenue over total costs	**($2,409.00)**	$2,894.00	$2,269.00	**($855.00)**
(6) Break-even price @ this yield	$2.61			
(7) Break-even yield @ Price per lb.	3,277.43			
(8) Total labor costs	$4,316.00			
Total labor hours	719.33			

Used by permission. As appears in the publication *A Forest Landowner's Guide to Evaluating and Choosing a Natural Resource-Based Enterprise*, 2004, NRAES-151, by Jonathan Kays, regional extension specialist—natural resources, Maryland Cooperative Extension and Joy Drohan, faculty extension assistant, Maryland Cooperative Extension. Sample budget data prepared by Dale Johnson, University of Maryland and Andy Hankins, Virginia State University.

Section 2: Medicinal Plants

Introduction

The New England countryside was a pharmoecopia to Native American peoples who lived here before European settlement. Many of these herbs and plants have been incorporated into modern medical remedies. Medicinal plants are generally sold in dried or powdered form. Some have international markets and in one case, ginseng, are worth hundreds of dollars per pound. Others have a domestic market and may be sold for $40 or $50 a pound. The parts of medicinal plants that are used include all parts of the plant, depending on which parts have the active chemicals in a given plant. In ginseng and goldenseal, the roots hold the medicinal value.

Characteristics

The medicinal plants that you may grow in your forest are generally small herbaceous plants that are adapted to growing in the deep shade of the forest understory, or in dappled shade at the forest edge. Many of these plants are rare or endangered. Goldenseal and Ginseng, once plentiful in North American woods are both listed on state and federal lists of threatened species. The commercial value of these plants has lead people to harvest them nearly to extinction in the wild. In China, there is no wild Asian ginseng due to deforestation and changed use of the land. This has created a strong market for wild or wild simulated American ginseng. Cultivating ginseng or goldenseal in a working woodland can be a way to restore these plants to the natural landscape. However, due to the high value of ginseng, theft is an issue to take into account when considering beginning cultivation. This may need to be addressed on the political level while pursuing the agricultural course of cultivation.

Types

American ginseng (*Panax quinquefolium*). A 1-2 foot tall herbaceous perennial, native to North America. After the third year of growth, the plant has three palmately compound leaves, divided into four to five sharp-toothed stalked leaflets. A group of 6 to 20 small whitish or pale yellow-green flowers are held on a long slender stalk in a dome like shape. The flowers develop into a tight group of red berries each containing two seeds. Due to the high value of the root, the plant is rare in the wild. It listed as a plant of special concern in Massachusetts and wild specimens are protected by law from tampering or harvest. Ginseng grows best in rich mesic intact forest understories with acidic, loamy soil. Various plants such as maidenhair fern, blue cohosh and trilliums are indicator species for this soil type.

Ginseng is related to Asian ginseng (*Panax ginseng*) which has a long history of use in China. It was listed in the first text of Chinese internal medicine, the *Nei Ching Su Wen* written over 4,000 years ago. (Hsu, 2002) Ginseng is valued in Chinese medical systems for stimulative properties of the body and libido, disease and balancing of bodily systems. American ginseng is said to be more cooling or *yin* than Asian ginseng, which has a warming or *yang* effect. Western medical research has found ginseng to be an adaptogen, an herb which helps the body rebound from various forms of stress. The active compounds in both American and Asian ginseng, complex triterpene saponins, are called ginsenosides. Further research is being done on the effects of ginseng on the cardiovascular and immune systems.

Goldenseal, (*Hydrastis canadensis)*. A hairy native perennial, goldenseal grows to be a foot or so tall with two sharply-toothed, lobed leaves. The single stalked, greenish-white has no petals, but is a cluster of stamens and pistils which develop into a cluster of red berries which together resemble a large raspberry. The medicinally active part of the plant is the rhizome, an underground stem much like a root. The rhizome is a bright yellow color inside, which gives the plant its name. This root contains berberine, an antibacterial compound, along with the alkaloids hysdrastine and canadine. The root has been used traditionally to treat inflamed mucous membranes as in the mouth or digestive system. Goldenseal is also rarely found in the wild due to over-harvesting. It is listed as an endangered species in Massachusetts and is protected from harvesting in the wild.

Table 4: Woodland Medicinal Plants with Current and Potential Commercial Value

Name	Parts Used	Medical Uses	Growing Sites	Retail Price	Wholesale Price
Black cherry *Prunus serotina*	Inner bark	Cough syrup.	Open fields, early successional forests		
Black coshosh *Cimicifuga racemosa*	Root	To ease menopausal and premenstrual symptoms.	Understory of forest with rich soils.	$19/lb	$5/lb
Bloodroot *Sanguinaria canadense*	Root	***Toxic.*** Anti-plaque agent in commercial toothpastes. Being investigated for antiseptic and anti-cancer properties.	Understory of forest with rich soils.	$32/lb	$8/lb
Blue coshosh *Caulophyllum thalictroides*	Root	Anti-inflammatory, used to trigger uterine	Understory of forest with rich, moist soils.	$11/lb	$5/lb

		contractions.			
Echinacea *Echinacea Purpurea*	Flower, leaves, stem, roots.	Immune booster, antibacterial.		Root: $24/lb Herb: $6/lb	
Elderberry *Sambucus nigra*	Berry, flowers.	Anti-inflammator, flu preventative.		Berry: $9.50/lb Flower: $12/lb	
Ginseng Panax quinquefolius	Root	Adaptogenic: helps body rebound from stress.	Rich, mesic woods.	$69/lb domestic, to $300 international --depending on quality.	
Goldenseal *Hydrastis canadensis*	Root, leaf.	Anti-biotic, anti-inflammatory.	Rich, mesic woods.	Root: $82/lb Leaf: $19/lb	$50/lb
Mayapple (Mandrake) *Podophyllum peltatum*	Root	***Emitic (causes vomiting and diarrhea if taken internally).*** Treatment of venereal warts.		$11.00/lb	
Pokeweed	Root, fruit, leaves	***Toxic***. Being investigated for anti-carcinogenic and anti-HIV properties.			
Sassafrass *Sassafras albidum*	Root bark, leaf.	***Essential oil is Toxic.*** Anti-inflammatory, post-poison ivy treatment.		Root bark: $17/lb Leaf: $11/lb	
Slippery elm *Ulmus rubra*	Inner bark.	Anti-inflammatory, for intestinal distress.		$22/lb	
Stinging nettle Urtica dioica	Leaf, root	Leaf: Immune system booster, to treat skin irritations. Root: treatment for prostate.		Root: $10.50/lb Leaf: $8.50/lb	
Witch hazel *Hamamelis virginiana*	Bark.	Astringent.		$11/lb	

Yarrow *Achillea millefolium*	Leaves, flowers, stems.	Anti-inflammatory, used to treat menstrual cramps, and stimulate digestion.		Flowers: $9/lb	

Please Note: Medicinal uses require proper preparation and application. No recommendations are being made about the use of these plants to treat medical issues.

Source: Plant information from Steven Foster and James A. Duke. Peterson Field Guides, Eastern/Central Medicinal Plants and Herbs; Wholesale prices from Miles Merwin. Medicinal Herbs can Earn Extra Income for Farmers; Retail prices from Mountain Rose Herbs http://www.mountainroseherbs.com/.

Cultivation:

American ginseng is difficult to cultivate, and takes a long time to mature. Before undertaking cultivation the steps of site identification and cost-benefit analysis are critical. The process is labor intensive, long-term and entails risks. However, if done successfully, the profits in producing ginseng can be great.

Site Identification

It grows best on gentle, shady northern woodland slopes with rich, loose soil with leaf litter from hardwood trees. The understory of a sugar bush may be particularly compatible with the needs of ginseng. Ginseng grows best in humus-rich soil that is moist but well-drained with a loose texture. It needs 70% shade and thrives in strongly to moderately acidic soils with pH from 4.5 to 6. Sugar maple deposits calcium in the soil when its leaves fall in the autumn, enriching the soil. These trees also have the property of "uplifting" water from deep in the soil through their long tap-roots, creating moist conditions in the soil friendly to ginseng.

Certain other plant species are indicators of sites best suited to growing ginseng. These plants also grow in rich, mesic forest sites. They include: spikenard, rattlesnake fern, maidenhair fern, (true) solomon's seal, trilliums, blue cohosh, herb Robert, wild ginger, and jack-in-the-pulpit. A complete list follows with the species rated for highest value as an indicator. The better the value, the greater the likelihood that ginseng planted in this site would prosper.

Table 5: Indicator Plants for Prospective Ginseng Sites

Value	Species
Excellent	Wild ginseng, maidenhair fern, rattlesnake fern, spikenard
Good	Christmas fern, blue cohosh, red baneberry, white baneberry, jack-in-the-pulpit, trillium, bloodroot, foamflower, jewelweed, mayapple, elderberry

Fair	Wild sarspaparilla, Virginia creeper, ground nut, lady's slipper

Sources: Visual Site Assessment and Grading Criteria for a Potential Woodland Ginseng Growing Operation in a Northern Forest by Bob Beyfuss of Cornell Cooperative Extension, Green County. Revised 9/2000, and How, When and Why of Forest Farming. Online Course. Spring 2007. Cornell Cooperative Extension of Chenango County. http://hwwff.cce.cornell.edu/index.php.

There are many sources of information for agricultural planning and site assessment and identification. See Landowner Overview about steps for planning and sources of information about your land.

Types of Cultivation:

There are three forms of cultivation for ginseng available to the prospective grower: field cultivation, woods cultivation and wild simulated. These forms vary in the amount of labor required, the productivity of the plants and the value of the mature roots. Ginseng in field cultivation matures the most quickly (in 3-4 years), but is the most labor intensive and brings the lowest price ($20/lb). (Hankins, 2000) Woods also requires a great deal of labor, but requires less than those in cultivated fields once planted in their final bed. The return for woods cultivated ginseng ($100/lb) is greater than that of field cultivated but the productivity is lower and the growth to maturity takes longer, from six to nine years. (Beyfuss, 1998) Wild simulated requires the least amount of labor, but has the lowest productivity and the highest prices (as high as $300/lb) (Persons, 1998) The price peaked in the mid 90s at $470/lb, prompting a run on wild ginseng that denuded North American hills of most of the remaining wild population.

Field Cultivation

Materials: Tractor, tiller, seeding and spraying equipment, hoes, shovels, shade material and wood for frame, irrigation equipment.

Seventy-five percent of the cultivation of ginseng in the United States occurs in Wisconsin, much of it in field cultivation. (Hsu, 2002) In 2000, 3,800 acres were in intensive ginseng cultivation in WI. (Hankins, 2000) Since ginseng requires upwards of 70% shade, field cultivation involves the creation of artificial shade. Shade structures are made from lathe (thin wood strips) or shade cloth strung across beams supported by tall poles placed throughout a field. The soil is tilled and amended to create a loamy soil rich in organic matter debris, with a pH of 6-6.5. Eighteen inches of organic compost of leaf litter or oat straw are added as mulch after planting. The optimal density for seedlings is 15 to 20 plants per square foot. In some large-scale operations, computer simulations of weather patterns are used to determine the schedule for applications of fungicides. (Hsu, 2002)

Field grown ginseng grows rapidly. Productivity of up to 2,500 lbs of dried root per acre are reported. (Hankins, 2000) The roots can be expected to double or triple in size annually. However, this means that they are lacking the qualities that make for a desirable "hand" of ginseng. Each year, the new growth on a ginseng plant creates an annual ring of growth. Field grown ginseng is harvested in the fourth year. Ginseng grown in the woods either wild or wild simulated gains many small growth rings, and becomes a dark color. Those grown in fields have wide rings and are light colored. With age the root is believed to grow stronger. Therefore, dark, many-ringed ancient roots are the most desirable, while large roots with few rings are less valued.

Field cultivation of ginseng is the best way to get a large quantity of the root, however, it is also the most labor and investment intensive, has the lowest return and runs the most risk of disease for the plants. Costs for establishing field cultivation with artificial shade can run up to $20,000 to $30,000 per acre. (Hankins, 2000) Field cultivated ginseng is not in demand by Chinese consumers. Expected to be self-sufficient for farm grade ginseng by 2000, China had begun exporting it to the United States by that time. (Adam, 2004) Other countries such as New Zealand, Chile and Canada have become competitors in this market. Large producers in Wisconsin and areas of the United States have reduced production dramatically since 1999. (Adam, 2004)

Woods Cultivated Ginseng
Materials: Garden tiller, backpack sprayer, ax, chainsaw, rake, shovel. (Persons, 1998)

A three year process is recommended for preparing woods for the cultivated growth of Ginseng. In the first year, the area to be planted is weeded and cleared of brush in the understory. Small trees may be felled to open space for planting of rows beneath the forest canopy. In the second year, the soil is loosened for planting. A tractor can be used, though care needs to be taken to avoid compacting the soil or damaging roots of trees. Ginseng requires an intact forest canopy providing 70% shade or more above, to prosper. Mice and slugs are killed at this time, beds and rows are created and the soil is amended with 18 inches of composted leaf litter.

Planting and cultivation begin in the third year. Stratified seeds are planted in August, using the same density and spacing as in field cultivation. (Hsu, 2000) After growing for a year in these rows, they small plants are transplanted they are transplanted into small beds of 4 feet by 10 feet. After two years of growth they may be sold as 2 year seedlings to other growers. Two to three year rootlets are generally valued at $1 a piece. Five to six year rootlets cost or may be sold at $5 a stem.

In year five, the seedlings are once again transplanted to raised bed rows spaced 18 inches apart. This is their final destination. Here they will be left to grow until mature at six to nine years. To insure good drainage for the plants, rows may be established on a slope or hillside. If planted there, the plant should be put in the ground with the tip of the branches or the node from which the stem grows pointing toward the downslope. (Chenango County Extension Class, 2007)

Stratifying Ginseng Seeds
Twelve to eighteen months may be required for the stratification of ginseng seeds. Collect seeds in early September. Bury by hand in mason sand ½ inch deep in cedar or other rot resistant boxes places out of doors. Cover the top of the box with metal screen to keep out animals. Put boxes in 75% shade and leave outside until the following September, or until the following May. The seeds require exposure to extreme cold temperatures of winter and extreme high temperatures of summer to break dormancy. Then, dig them out of the sand, wash and float the seeds before packaging to separate them from the seed coverings and other debris. There are generally 6,000 to 6,500 seeds to one pound. (Hsu, 2000; Persons, 1998)

Large or small scale operations are feasible for the woods cultivation process. Small $1/10^{th}$ acre plots are common. (Persons, 1998) Ginseng roots grown in this process may be sold for up to $100 per pound. They produce fewer seeds and smaller, more irregularly shaped roots, but do not show the high characteristics of the most highly valued specimens of ginseng. (Persons, 1998) This method represents a midpoint for value of roots and effort expended.

Wild Simulated
Materials: Spade or shovel, backpack for carrying seeds, hoe, rake.

Beds of wild ginseng are intended to emulate the conditions under which ginseng grows naturally. The plants are scattered widely, and little effort is made to improve the texture or composition of the soil where the plants grow. Little maintenance is done over the course of the plants' lives. Mortality is expected, and long-term growth is the goal. The plants grow slowly, establishing the tight growth rings and darker appearance that is the mark of high-quality ginseng roots.

Wild simulated plantings of American ginseng require less labor and give greater return per plant than the other cultivation methods. Hankins in 2000 estimated the input of time and money for wild simulated ginseng as $800 for seeds, 20 hours of labor per ½ acre. Seeds are planted and the plants are left to develop as they may until they mature. (Hankins, 2000) However, since little is done to prepare the bed for growth of the plants their success depends much more upon the choice of site. Finding a north-east facing slope with proper pH and soil composition is essential. Looking for indicator plants is critical. However, since the profit per plant is so much greater, a smaller area can be devoted to this form of cultivation. A grower in Chenango County of New York state devotes one acre to wild simulated. (Chenango County Extension Class, 2007)

Plant the seeds in the autumn when the leaves have fallen. There are different methods for establishing these beds. The first is suited to small areas. Simply take the stratified seeds and insert them into the ground by hand. Disperse them widely in an arbitrary pattern, not in rows or beds. Another more ordered method is used for larger areas. Once a likely site has been found rake away the leaf litter and loosen the soil to an inch or two

deep with a heavy rake. Spread the seeds, approximately with 4 seeds per square foot and then rake the leaf litter back over the area. Leave some lanes free for access. (Persons, 1998) Loose bed areas can be established running up and down the slope to allow more air circulation. Make the beds five feet wide and fifty feet long. Create three narrow furrows running parallel and plant the seeds one inch apart in the trench by hand. This should take approximately 500 seeds is roughly equal to an ounce. Cover the seeds with three quarters of an inch of soil and then cover the entire bed with an inch of leaf mulch. Animals and other natural mortality will thin these plants every year, leaving a smaller number of plants to be harvested in six to twelve years. (Persons, 2000)

A high value of ginseng can be grown on a small amount of land. On just ½ acre, over $30,000 worth of ginseng can be grown in six years. A half acre can produce up to 200 pounds of dried ginseng roots in six to ten years. The grower in New York state raised 80,000-100,000 plants on 4-5 acres of land. (Chenango County Extension Course, 2007) As reported in Scott Person's 1998 article Growing American Ginseng in its Native Woodland Habitat, on ½ acre 1, 125 lbs of field grown ginseng could be produced that was worth $12/lb at the time, 300 lbs of woods cultivated ginseng could be produced that was worth $100/lb, and wild simulated cultivation would produce 80 lbs at $300/lb over the course of the different lengths of time it would take for ginseng to become mature in these types of cultivation. (Persons, 1998)

Pests and Disease

Woodland animals and diseases can present a threat to your growing ginseng plants. An infestation of slugs can destroy an entire crop overnight. Deer mice eat the germ from ginseng seeds, and can affect hundreds of plants in a given night. Deer may graze ginseng plants when they are above ground. Poisoned slug bait in pellet form seeded around the ginseng plants three to four times a year is found to be effective. Traps such as buckets full of water with trap lids that the mice cannot exit from are often used. Fences raised during the growing season keep deer away from ginseng plants. Removing the fences during the winter can be beneficial if the deer browse other plants that may compete with the ginseng.

The threat of disease increases with density of cultivation. Field cultivated ginseng run the highest risk of being affected by blights such as Alternaria (*Alternaria panax)* a foliar fungal pathogen. Alternaria is the most common disease affecting American ginseng. It attacks the leaves of the plant and presents as small yellowish discolored spots on the leaves which expand creating a brown "halo". If allowed to progress a hole in the leaf and lesions form, eventually spreading to the stem. Removal of affected leaves halts the progress of the disease. The disease exists in the soil, and ample continuous rainy days create conditions ripe for it to affect the plants. Some growers believe that Jack-in-the-Pulpit (*Arisaema tryphyllum*) is a carrier of the disease and avoid locating their ginseng near to populations of that plant. Alternaria can be addressed through the application of fungicides in the spring, however, widely dispersal of the plants reduces the likelihood of it spreading from one plant to another.

Precautions to avoid these threats to the plants may be omitted for wild simulated growth of ginseng. The damage due to disease or pest affects the appearance of the plant and contributes to the gnarled or weathered look of wild plants. These affects are highly desirable and increase the value of the plant. However, this does mean that mortality and loss will be higher among these populations.

Rotating the crop in a given bed is a good way to reduce disease. Goldenseal is well-suited to be a complementary crop.

Harvesting

Harvesting ginseng roots or seeds is done by hand under all forms of cultivation. For simulated wild-grown this is especially important since completeness and quality of the root affect the high prices available for the roots, but in all cases the process is not easily mechanized. To gather roots, the dirt six inches around the plant is loosened by hand or with a small spade, and until the root may be pulled gently from the ground. The dirt is shaken from the roots. Young plants may be transplanted or removed for sale as bare roots or in containers for use by other cultivators. Harvest at desired maturity in the fall, after seeds have formed.

This process will be easier in woods cultivated beds since the ground is prepared and loosened more before planting and the roots will be in the ground for fewer years. Long-term growth plants are difficult to remove from the ground, having become tangled with the roots of trees and other plants existing in the forest underbrush. Growth in this entanglement creates the crooked and ungainly growth of wild simulated roots, making them much more valuable. The increased labor involved in harvest is an investment in the value of the roots.

Goldenseal has a much more elastic recovery to harvesting. In a study done in 2003 reported in the American Midland Naturalist, populations of ginseng and goldenseal when harvested to a small number of plants had very different recovery patterns. A group of goldenseal harvested down to 4 individuals showed amazing powers of recovery, with 923 stems growing in the following growing season. The ginseng population recovered only to one half of the original number. Researchers suggested that goldenseal may benefit from gathering due to the shape of the root and number of root hairs. Unlike with the smoother ginseng roots, parts of the rhizome are likely to be left behind after harvest, leaving plant matter that can regenerate into new plants. The high value of fully intact ginseng roots creates another incentive to leave nothing behind that could continue the propagation of the ginseng plant. Ginseng plants also have a one to two year gap between growth from seed and reproductive status, creating a gap in the regeneration found in the plants following successful harvest. (Van der Voort et al., 2003)

Theft

The major threat to ginseng cultivation in many areas is theft or poaching of mature plants. An acre of mature ginseng can be worth thousands of dollars, creating a strong incentive for them to be stolen. Years of work can be wiped out in one night. This threat is greatest in areas where wild ginseng is widely sought after. An advantage to the lack of this market in western Massachusetts is that since wild-crafting of ginseng is illegal and wild populations uncommon, there is not a culture of gathering that would make it more likely that hunters would stumble across a cultivated patch in the forest.

To avoid this, many cultivators maintain secrecy about the location of their ginseng patches or about the fact that they have a ginseng growing operation at all. However, remote sites with no regular traffic are vulnerable to theft due to the lack of oversight possible. Many cultivators use alarms and cameras, and signs warning of prosecution to deter thieves. Signs or fences may be used to minimize casual discovery. Use of force is highly discouraged since it can cause injury, and also opens the landowner to prosecution. One of the best deterrents is strengthening local enforcement of legal consequences for theft of ginseng by raising fines for theft. (Chenango County Extension Course, 2007)

Goldenseal can be cultivated in areas similar to those beneficial for American ginseng. It does best in rich, loamy soil which has good amounts of moisture, but which is well-drained. Goldenseal does not do well in wet, poorly drained areas. It prefers more neutral conditions than ginseng, however. Its range for soil pH is 6-6.5 (slightly acidic). Planting them on a slope will assist with drainage in the area. A shade loving species like ginseng, goldenseal grows in deep canopy cover, though it has been found to do well in sunnier places such as the edges of woods by some growers (Bateman Interview, 2007). Best quality plant growth was found to occur in shade from 63% to 80%, while highest plant count was found to occur in shade from 47% to 63%. (Davis, 2000) Indicator plants of conditions positive for goldenseal are trillium, bloodroot, mayapple, and black cohosh. The shallow roots of conifers may compete with goldenseal to its detriment, making hardwoods more compatible with their deeper roots.

Beds for goldenseal may be prepared in the forest understory. Rake away leaf litter, remove root, debris and weeds. Till the soil six inches down, with care to avoid negative impact on surrounding trees. Do not compact the soil, this may damage surrounding trees. Raised beds may be constructed to increase drainage and to increase the temperature during the early spring. Beds two to six inches high, three to four feet across are recommended, leaving space in between for access. (Davis, 2000) Test soil to for composition. If low in organic matter, add additional shredded hardwood leaves. Fertilizer, if used, may be applied in small doses. A Forestry Service Agricultural Note on the propagation recommends a balanced NPK fertilizer, such as 20-20-20, in small amounts to be applied in the spring as needed. (Davis, 1999)

Goldenseal may be propagated from the rhizome, seedling or seed. Rhizome is the most reliable method. Cuttings from the rhizome of ½ inch or more may be planted in narrow trenches two to three inches deep (Davis, 1999). Cuttings with buds grow best. Plant with the bud pointing up. Space six inches apart. For propagation from seeds, plant as soon as possible or in the following growing season. If needed, store in moist sand in a place where it will be exposed to rain. Germination rates are highly variable, sometimes ranging from 10 to 90% (Davis, 1999) Gather seeds when berry is ripe, mash and put in water until flesh of berry comes off easily. (Davis, 2000) Begin seeds in nursery beds in the fall. Plant 10 to 12 seeds per foot in rows three inches apart, ½ inch deep. Transplant to production beds after one to two complete growing seasons. (Davis, 1999)

Mulching is recommended to help the soil retain moisture and minimize weed competition, as well as to protect the plants from extreme cold in winter. Rake several inches of mulch over the plants when they are planted. More can be added before winter sets in. In the spring, reduce the level to one to two inches to assist the small plants in coming forth. (Davis, 1999)

Goldenseal may be affected by slugs. Treatments as for ginseng are recommended. Removing some mulch around plant discourages slugs as well. If moles or voles dig the roots, wire mesh can be placed in the earth surrounding the bed 8 to 12 inches deep. The primary pathogen threatening goldenrod are root rot nematodes (small round worms) found in the soil. The soil can be tested for these nematodes prior to planting. During site selection screen for this parasite. (Davis, 1999) However, they are more common in areas with short winters.

Harvesting

The rhizome of goldenseal is harvestable in three to seven years from planting depending on the method of propagation. From seed, the plant will harvestable in five to seven years; from rhizome, three to five. (Davis, 2000) Seeds can be saved for cultivation of the following crop. Yields of 1,000-2,000 lbs have been reported for intensive cultivation from seed on 5 acres of land. However, threats of disease such as alternaria, fusarium and rhizoctonia increase with density of plants and scale of cultivation. (Adam, 2004) Artificial shade may increase chance of disease due to dripping from rain.

After three to five years, the goldenseal may fully occupy the area in which it grows. The plant spreads rapidly. Plants should be harvested and the bed thinned or plants will crowd each other out and start to die. Leaves and stems may be harvested in fall while the plant is still green. Harvest the roots in the fall, after the foliage has died back. Dig out the root, keeping root hairs and fibers intact as much as possible. Pitch forks are often used for small plots to dig out roots. Tools used for harvesting potatoes and other root crops are useful for large plots. If replanting some plants, choose the largest and best looking specimens. Keep moist, and if possible replant immediately. (Davis, 2000)

Processing

Ginseng and goldenseal are washed and dried for sale. The process for each is similar. Wash the roots with care to keep the roots intact. Damaging the skin or breaking off lobes of the root reduce the value. Do not scrub. Wash gently with a soft brush, removing the loose dirt but leaving residue in folds or wrinkles on the roots. Small amounts may be sprayed with a hose. (Carroll and Apsley, 2004—Ohio)

Goldenseal and Ginseng reduce by 70% or to one third of their original weight when dried. (Davis, 2000; Beyfuss, 1999) It takes 100 to 300 fresh ginseng roots to produce 1 lb of dried root. (Chenango County Extension, 2007) Steady temperatures, even humidity and free flow of air around plants while drying are important to allow the roots to dry evenly. A room with good ventilation and temperatures between 70 and 100 degrees Fahrenheit may be utilized, in which it may take up to six weeks for larger roots to dry thoroughly (Persons, 1999) By maintaining a temperature of 90 to 95 degrees Fahrenheit, the roots may be dried in two weeks. (Carroll and Apsley, 2004). Drying boxes or closets may be constructed with screen racks on which the roots are lain. Make a single layer of the roots with space between them to allow the air to reach all parts of each root. A fan may be included to keep air circulating. The roots are dry when they break cleanly. If they may be bent, the roots are not sufficiently dry. (Davis, 2000; Carroll and Apsley, 2004) If goldenseal is dried too quickly, or at too hot a temperature the outside becomes dried while the inside remains moist, ruining the crop. (Davis, 2000)

Packaging

Package the roots of goldenseal loosely in cardboard box or a barrel. Clean untreated burlap bags or synthetic sacks with perforations for air flow may also be used. Store in a dry, dark area free from insects or rodents. (Davis, 2000) Ginseng may be stored similarly.

Marketing

Ginseng

Markets for American ginseng go back 300 years in the United States. China, in which the growing and harvesting of Asian ginseng go back over 4,000 years, has been importing American ginseng since the American Revolution. (Persons, 1998) The value of ginseng sold in Pennsylvania is estimated to be over $11 million between 1989 and 2005, although volumes sold have declined by 50% since 2000. (Burkhart and Jacobson, 2004) As of 1998, 85% of the high value ginseng consumed was sold to persons of Chinese ethnic descent living in Japan, Taiwan, Malaysia, Indonesia, the Phillippines and other countries of the Pacific Rim. (Persons, 1998)

Both cultivated and wild ginseng have been sold to China since that time, but the market for field cultivated ginseng has diminished greatly in the last 10 years. 95% of cultivated ginseng that was sold in China was grown in Marathon County, Wisconsin. But now Chinese growers, as well as those in New Zealand, Australia, Ecuador and Chile are major suppliers. (Adams, 2004) As of 2000, Chinese field grown American ginseng has been imported to San Francisco. (Adams, 2004) The demand for field grown ginseng at this time is similar to those for goldenseal.

Ginseng is sorted into over 40 different grades, with which few growers are likely to be familiar. The highest value American ginseng is extremely long-grown wild roots. These can be sold for prices above $600 (Beyfuss, 1999) These gnarled looking long-grown roots (up to 20 years old), with dark rings and wild appearance. Complete "hands" as these roots are called are highly prized. However, collection pressures have made it near extinct in most of the United States, and in most states it is unlawful to wild craft the roots. Wild simulated roots offer a sustainable way to supply these markets with high quality roots. They may bring $200 to $300 per pound.(Beyfuss, 1999; Persons, 1998) Growers are concentrating on providing higher quality, older roots which resemble wild grow using fewer cultivation techniques, such as omitting the use of fertilizer. (Beyfuss, 1999)

These roots are sold to buyers who have connections to markets in China or southeast Asia. Buyers advertise in local papers where ginseng is grown. Once having established a relationship with a grower, they often visit annually in the fall when roots are harvested to look over the product first hand.

There is also an opportunity for cultivators interested in providing small plants and seeds to local growers interested in growing ginseng. The closest suppliers are in New York state and Pennsylvania. Cultivating a strain of ginseng suited to being grown in the Massachusetts countryside may be useful to growers and a way to fill a marketing niche.

The hillsides of western Massachusetts are well-suited to growing this plant, but have yet to find those interested in the enterprise due to the lack of historical involvement in the industry in this area. That is an advantage that this area has since it means there is not a well-establish group of people who hunt the woods looking for ginseng. The protection of wild plants can extend to cultivated patches grown by landowners.

A tagging process developed in North Carolina has been used to deter poaching of ginseng in the Great Smokies National Park. Wild populations were seen to triple in these areas. (Toops, 2005)

Ginseng exporters have agents who operate in the various regions where Ginseng can be cultivated and grown wild. Buy bids can be solicited by mail, but once relationship has been established, agents visit growers in fall to grade and offer bid on harvested roots as they are drying. (Persons, 1998) Grading and pricing are subjective, based on resemblance to prized wild Chinese ginseng roots. Cultivation techniques effect growth

greatly (tilling etc. speeds up growth, competition with wild plants and trees slows) so will affect price accordingly.

Goldenseal

Goldenseal and field cultivated American ginseng roots have similar markets. They may be marketed directly or indirectly to consumers through herbal or health food stores, as well as through the internet. A steady supply and high quality roots would be needed, as well as adequate packaging for sale or delivery. Wholesale markets include brokers or large scale operations.

Selling the live plant opens up new markets. Landscapers may be interested in ginseng and goldenseal as attractive additions to native shade gardens (see Native Shade Plants for Landscaping section of this report). Other cultivators or farmers may be interested in one, two or three year plants to speed their own production. Health and vigor of the plants would be especial concerns. Plants could be sold directly at farmstands, farm markets, directly to landscapers, or indirectly at garden centers.

Table 6: Example Budget for Ginseng Cultivation (wild simulated)

GINSENG ENTERPRISE BUDGET (wild-simulated)					
Plot size 0.5 acre					
Production time frame 9 years					
INCOME					
Price per pound		$260			
root yield (lb)		gross income			
50		$13,000.00			
75		$19,500.00			
100		$26,000.00			
COSTS			**UNIT**	**AMOUNT**	**PRICE ($)**	**TOTAL COST ($)**
Ginseng seed			lb	10	$80.00	$800.00
Planting labor			hr	160	$6.00	$960.00
Inspection/troubleshooting labor			hr	500	$6.00	$3,000.00
Harvest labor			hr	270	$6.00	$1,620.00
Drying labor			hr	16	$6.00	$96.00
Gypsum			50 lbs	16	$4.00	$64.00
Rock phosphate			50 lbs	16	$8.00	$128.00
Fungicide, rodenticide				1	$75.00	$75.00
Backpack sprayer			sprayer	1	$125.00	$125.00
Hauling labor (150 mi. each way;			hr	16	$6.00	$96.00

2 trips)				
Energy ($0.50/lb)			$37.50	$37.50
Insulation, drying racks			$400.00	$400.00
Miscellaneous (tools, chlorine bleach, heat, phone, etc.)		1	$100.00	$100.00
Interest on costs	$	7501.5	5%	$375.08
Total costs				$7,876.58

Net income over costs

root yield (lb)	$
50	5,123.43
75	11,623.43
100	18,123.43

Income derived from growing 0.5 acre of wild-simulated ginseng depends on yield and future price.
A low price of $260/lb was assumed. Note the variation in net income under different yield scenarios.

Used by permission. As appears in the publication *A Forest Landowner's Guide to Evaluating and Choosing a Natural Resource-Based Enterprise,* 2004, NRAES-151, by Jonathan Kays, regional extension specialist—natural resources, Maryland Cooperative Extension and Joy Drohan, faculty extension assistant, Maryland Cooperative Extension. Sample budget developed by Andy Hankins, Virginia Experiment Station, 1999.

Section 3: Native Shade Plants for Landscaping

Introduction

A ten billion dollar industry as of 1998, plant nursery businesses accounted for 10% of the agricultural business in the United States. (Barton, 2002) A growing industry that supports nurseries, lawn and garden centers and independent landscape designers, the landscape nursery industry grew an average of 4% to 5% from 1990 to 2000. (Barton, 2002) A growing trend in this industry is demand for native shade plants. There are many native plants that are useful for decorative purposes, which grow naturally in western Massachusetts woodlands. These plants are suited to the climate in this region and often provide habitat and forage for native wildlife. For the landowner interested in an agricultural endeavour, starting a nursery of native shade plants for use by other landowners, gardeners and landscape designers may be an attractive and profitable venture.

Characteristics

Native shade landscaping plants fall into various categories that occupy niches at different levels of the forest canopy. At the highest level, creating the crowning shade of branches, are forest trees such as red oak (*Quercus rubra)*, paper birch (*Betula papyrifera*) and sugar maple (*Acer saccharum*). These trees vary in their tolerance of shade. Below this, in the upper understory level beneath the towering trees are smaller trees which can tolerate the shade shed by the canopy. Beneath this is the shrub layer. Here small bush-like trees and saplings grow. Beneath that is the herbaceous layer of small plants at ground level. Perennials, grasses, ferns and mosses make up the herbaceous layer. Beneath all of these layers is the soil, the root zone of the plants and trees, in which there is competition for water and nutrients rather than light. (Burrell, 1995)

Light levels required for growth of landscaping plants varies. Plants that grow in the forest understory must be tolerant of shade. The levels of shade range from deep shade in the forest interior where less than 10% of light pierces the leaves, to part-shade at the edge between forest and meadow or open area, with dappled shade and light occurring beneath forest trees with open canopies. Trees with multilayered branches and knotched or compound leaves such as elm, walnut and hackberry allow more light beneath them, allowing from 15% to 45% of light to reach the forest understory. Beech, maple, oaks, hickory, spruces and firs create deep shade. (Burrell, 1995)

Soil variables determine which plants can be grown in a given area. Plants that thrive in a forest setting will often require or grow well within acidic soils. Organic matter deposited by trees (such as leave, twigs and branches) breaks down slowly and adds to the acidic nature of the soil. Evergreen needles especially create a highly acidic environment. Soil texture varies based on its composition. Loamy soil consists of a mixture of course (sand) and fine (clay) particles, along with decayed organic matter.

These soils retain adequate moisture while generally being well-drained. Clayey soils retain water and often form wet depressions or wetlands. Sandy soils tend to lose moisture, creating overly-drained, drought prone conditions.

Many forest plants have special characteristics that make them desirable for landscaping. Shade loving shrubs and small trees like wild raisin (*Viburnum lentago*) and shadbush (*Amelanchier canadensis*) produce edible berries. Joe-pye weed (*Eupatorium purpureum*) and foam flower (*Tiarella cordifolia*) are examples of wetland plants, used for plantings in landscape areas with wet soils. Wild bleeding-heart (*Dicentra eximia*) and wild ginger (*Asarum canadense*) make excellent ground covers under very different soil conditions, while spicebush (*Lindera benzoin*) and cardinal flower (*Lobelia cardinalis*) are striking decorative plants which also attract butterflies.

Cultivation

When investigating the potential of cultivating native shade plants, some good guidelines are to research your resources and markets extensively prior to beginning the enterprise, start small and factor fiscal risk and benefit into choice at every step of the way.

The following are recommended steps:

1) Site Assessment: vegetation inventory, soils, climates, shade levels, water and drainage
2) Create map with zones of use and identify areas of cultivation
3) Choose plants based on site conditions, market choices and niche marketing
4) Learn about cultivation through experience and research
5) Choose cultivation type: container or bed
6) Remove unwanted vegetation: invasives and competing brush
7) Prepare soil: create beds, amend soil, mulch
8) Plant and maintain beds
9) Harvest
10) Process and sale of plants
11) Ongoing information gathering, research and sharing
12) Adapt choices each year based on experience, changing markets and new information gathered.

Site Assessment and Map Creation

As with medicinal plants, conducting a thorough site assessment will help you identify the resources available to you for growing native shade plants. Vegetation present, soils and climate will tell you what types of plants may be suited to cultivation on your land. If container cultivation is desired, proximity to water, sheds or greenhouses for processing and winter storage as well are all important variables.

Once information has been gathered via the site assessment, a map showing zones of use can be created. Zones of use reflect ease of access, proximity to habitation and site conditions and resources. When choosing zones of use, area unsuited for cultivation of other crops may be found to be an excellent area for container cultivation. Other areas may be suited to cultivation as they are, or may be improved for growing landscaping plants.

Choice of Plants

Once information about growth sites has been gathered and recorded, plants to be cultivated may be chosen. Choices may be prioritized by looking at these and other criteria: viability in given sites, market factors, and niche marketing. Given the light, soils, moisture and vegetation in your growing sites, draw up lists for each area of plants that are suited to cultivation in these conditions. Research the competitive nature of the different plants in your market place. See list of popular selling plants below, and sample prices of plants listed in Appendix E: List of Native Shade Plants. Consult local producers to determine if there are current favorites. Information from state agencies may provide information about plants recommended for wetland or other reclamation sites. For niche marketing, you may choose a category of landscape plant in which to specialize. Native shade plants is a niche market with growing demand. Other niche markets include wetland plants, butterfly plants, ground covers, organic or naturally grown plants, permaculture or edible plants.

Learn about Cultivation

Growing plants for landscaping purposes has a long learning curve. Different plants have unique needs, and many variables such as disease, irrigation and fertilizer levels have to be sorted out and accounted for. Beginning small is an excellent way to learn about the ways that plants grow in your land. Research and knowledge about plants is a beginning which must be continued and furthered by hands on growing of plants to understand their needs and the full range of practices needed to create a nursery. Working with experienced growers is a way to acquire information through their wealth of experience. Hiring an experienced worker to manage nurseries and gardens may be another way to get ahead on the learning curve. Agricultural ventures are always risky, so it may be best to delay the commercial aspects of a venture until the techniques for production have been well experimented with and implemented. Another major issue is timing of propagation to be sure to have a steady supply of needed plants at the times required for market.

Cultivation type

Plants may be grown in beds in the ground or in independent containers. Prior to 1950, all nursery production of plants was field grown. At this time, 80% of all ornamental plants are grown in containers. (Diver and Greer, 2000) Field (or forest) grown plants are planted in beds in the ground. Container grown plants are grown in pots.

There are advantages and disadvantages to the field and container methods. Container cultivation can be an excellent way to produce plants in a small area of hard to utilize land. It can be accomplished in 5 or less acres of land. Since the plants are not grown in

the ground, the grower is not limited to the soil types available on their land. Plants may be grown more densely, with yields from container growth giving ten times more sales per acre than field grown. (Diver and Greer, 2000) Plants raised in containers have higher transplant survival due to reduced shock to plant roots. Land unsuitable for field cultivation can often be used for container cultivation.

Disadvantages to container cultivation include higher need for soil fertilization and watering. Greater labor to pot and maintain the plants is required for container production. Plants may become root bound due to the confines of the pot, and the plants are more susceptible to extremes of temperature which can stress the roots. (Diver and Greer, 2000)

Field cultivation is well suited to large scale plant production in areas with land well-suited to cultivation. Soils best for field cultivation are characterized by being fairly level with fertile soil, having an organic matter content of 3% to 5% (a high level). The organic matter helps it have a good capacity to retain water, but it should be well-drained as well. (Sellmer and Dana, 1994) It may require up to 15 acres of land. (Diver and Greer, 2000) Mass plantings are best accomplished in field cultivation. Small plants can be easily sown in a field, as opposed to being planted in many small containers which require watering and transplanting when outgrown. Large plants such as small trees cannot be feasibly grown in containers. These high value specimens are best grown in the ground, or harvested from natural or overgrown plantation settings. Bare root production, harvesting small plants live but free of soil, is another good use of field cultivation.

Problems involved in field cultivation include high mortality rate with transplanting, the need for larger areas of land, and the loss of soil when plants are taken from the ground. The shock of being dug from the ground through damage done to roots can kill or stunt growth of plants. Beds and plots in the ground require more space, and are not mobile without great labor. Soil loss or conservation is a major consideration. Two hundred to two hundred and fifty tons of top soil is commonly removed per acre in field production. Bare root production reduces this loss. (Diver and Greer, 2000)

Shade levels

Cultivating plants in the forest has specific issues related to it that are very different from traditional field cultivation. Field cultivation in the shade may be accomplished through the use of artificial shade which reduces the need for much of the care and special attention to details that is needed in cultivation under the forest canopy.

Temperature changes over course of day: higher in later afternoon, cooler in morning. Direction of sun matters: more light from south west. The sun's path changes over the course of the year, it is lower in the winter. Areas on the edge of woodlands receive more light due to the light coming into the forest at an angle beneath the forest canopy. Judicious pruning can be used to create more open space. Shade plants can benefit from having a certain amount of more light available to them. Some good guidelines for

pruning the understory are to do so on a sunny day when the leaves are fully open. It may be done slowly, over the course of several growing seasons. (Burrell, 1995)

Forest beds

Creating beds for plants in the forest understory involves different issues than cultivating plants in the field. The many-layered nature of the forest gives aspects to be aware of across the vertical length of the forest, unlike growing in a field in which the growing takes place at one plane with most vegetation kept under control of the growers. Growing in a forest requires working with more aspects of what is present, and manipulating them in a variety of subtle to overt manners.

The trees of the forest make up the framework of the forest garden. The type, number and density of the trees determines the amount of light available and affects the nutrients and growing room available to the plants growing beneath them. In a natural forest understory, you may notice that there are far fewer plants than grow in a meadow or other open area. The plants that grow beneath a forest canopy are specially suited to those conditions adapted to do well in low light. Many of those which grow in the depths of the durable evergreen leaves which only need to be grown once, allowing the plants to invest their resources efficiently. Other plants take advantage of spaces left open by other plants which require more sun.

There are several approaches to making nursery beds under forest shade. One way to open space beneath the trees by clearing brush beneath the trees, and preparing beds under the trees. Another is to clear trees, opening up larger areas in which the plants can grow. At Project Native in Housatonic, they are establishing a new set of shade plant beds to grow seed for shade plants. They have taken an acre of forest, cleared smaller trees and underbrush and are in the process of establishing plants that will grow beneath this shade in order to sell seed. Another possible arrangement would be to utilize the edges of the forest. Where meadow and forest meet is a highly productive area with a wide variety of species flourishing there. Transition zones often have the highest biodiversity due to the different conditions available for plants and animals. Plants that do best in partial shade can be planted at the edge of the forest, or beneath smaller shrubs and shade trees at the meadow's edge. Plants requiring deeper shade can be planted deeper into the woods. Another way to create a shade nursery is to take open space and plant fast growing trees such as aspen, or small shrubs like persimmon and pawpaw. Which way makes the most sense will depend on the type of cultivation the individual grower is interested in doing, as well as the needs of the plants that are being grown.

Testing soil

Full composition of your soil may be acquired for a modest fee by sending soil samples to the Soils Testing Lab at University of Massachusetts Amherst. However, various factors can be tested simply and easily at home. A pH test is used to test the acidity or alkalinity of soil. Purchase a pH test kit available at farm or garden stores. Texture of soil is determined by the ratio of the three types of materials from which soil is composed: clay, loam, silt and sand. A simple test can be used to determine this ratio.

Take two cups of soil from the top 6 to 8 inches of the soil. Put into a clear glass jar with a top and fill with water. Place cap on tightly and shake until the soil is well mixed with the water. Allow to sit for 24 hours and then observe the contents. The components will separate into layers. The organic matter of the loam will float on the top of the water. Sand will settle to the bottom. The layer on top of sand is the silt from the soil, and above that is clay. The relative amounts tell you about the mixture found in your soil. (Burrell, 1995)

Irrigation

Daily watering of growing plants is a necessity for nursery production. Three methods may be utilized: overhead, drip (or trickle) and subirrigation. The first two are most commonly used. Overhead irrigation is the least expensive option. It is intended to cover large areas. The distribution of water through this method is often uneven, risking runoff or disease, and it requires a large amount of water, from 15,000 to 40,000 gallons of water per day during the growing season. Drip irrigation uses up to 60% to 70% less water than overhead. The equipment used for drip irrigation is more expensive and requires more maintenance, but is allows plants to be handled while being watered and produces less waste of water due to evaporation and wind loss. The third type, subirrigation is less commonly used. In subirrigation, sloped sandbeds are created beneath plants. Water is introduced at the top of the slope and water trickles throughout to the plants from below. This method is relatively inexpensive and easy to maintain, but is laborious to establish. Weed growth may also occur in the sandbeds increasing need for maintenance and weeding. (Diver and Greer, 2000) Drip and overhead irrigation are suited to both container and field cultivation. Subirrigation can only be implemented in field beds.

Mulching

Mulching is highly recommended for nursery production of native shade plants as a practice with many benefits that emulates the natural cycles of the forest. Mulching improves the soil in which the plants are growing by adding organic matter. Matching the appropriate medium may be necessary to create conditions in which plants will flourish. For example, if a plant required moderate pH levels, using pine needles may increase the acidity excessively. Mulching reduces water loss and stress to plants roots due to extremes of temperature. It also discourages the growth of weeds. Many woodland plants require the addition of mulch in order to grow properly as they would normally do in the forest understory. (Burrell, 1995)

Easily acquired local materials that may be used for mulch include shredded leaves, pine needles, woodchips, ground corn cobs and shredded bark. Pine needles are recommended if the soil pH needs to be reduced. Hay, straw, green grass cuttings and peat moss are not recommended. Grass, straw and hay may introduce weed seeds, and peat moss creates a crust that can be detrimental to plant growth. (Burrell, 1995)

The depth of mulch may depend on the needs of the individual plants. Three to six inches are standard. Too deep a layer may encourage the roots of the plants to grow up into the

mulch layer. This will expose the plant to heat or freezing in summer or winter. Mulch should not touch the stem of a plant. Contact may increase risk of fungal infection.

Pests and disease
Pathogens, insects and vermin can cause the loss of an entire crop in a small amout of time. With larger scale cultivation, risk of infection increases. Use of multiple cultivars is helpful in order to maintain genetic diversity and increase potential for resistance to disease. Look for information specific to the species you are cultivating on diseases and pests which commonly afflict them.

Processing and Storage

Native shade plants can be sold in a variety of ways. The most commonly used commercial methods are listed below.

Small containers (1-2 gal)
If grown in a container, plants may be sold when at full growth. Quality of plant form and attractiveness of appearance are important. A regular watering regime is needed in order to ensure growth and keep the plants looking good for sale. If grown in the field, plants will be dug up with an amount of dirt enclosing their roots and then put in a container for sale. This can cause root shock, so care must be taken in preparing the plant. Transplanting is best done when the plants are dormant or at a time of day when they will not suffer from exposure to heat which would cause wilting.

Large containers (3-5 gal)
Large containers are used for larger plants. Similar issues apply as for smaller containers.

Starts/shoots/plugs
Starts are small plants grown in flats or small containers.

Seeds
Seeds are gathered at different times depending on the plant. Books like Growing and Propagating Wild Flowers by Phillips give detailed information for when to gather seeds and how to propagate plants from the wild seed. The seeds of most wild plants require a period of dormancy and exposure to extreme temperatures called stratification. In order to ensure that the seeds begin growing at the right time of year, rather than during an aberrant warm spell in the winter or fall, seeds often require having experience with both lows and highs. Seeds are often stored in a box covered with metal net to keep out animals, filled with sand or other medium. The box is left outside so that the seeds can be exposed to the elements and experience the cold of winter, and heat of summer.

Bare root plants
Selling plants as bare roots reduces the loss of soil associated with selling plants in containers from field cultivation. This form of product is best when the plant is small in

size. Sandy to sandy-loam soils are best for bare root production, since the dirt will part easily from the roots at harvesting. (Sellmer and Dana, 1994) The plant is dug up with soil surrounding the roots, then the dirt is shaken free gently from the plant. The plant should be sold quickly, or may be stored temporarily or "heeled" by layering plants laid on their side with moist soil. The roots should not be allowed to dry out completely. They can be soaked for 2 hours before planting. Roots should be trimmed and spread out, then buried in the soil when planted.

Balled and Burlapped (Large size plants/small trees)
When larger plants are to be sold the roots must be kept intact or the plant will die. A large ball of roots and dirt is required since the plant is so large and the root system has developed. Balled and burlapped plants are best planted in sandy-clay or clay-loamy soils which will have high integrity and hold together when dug up. In order to keep the roots together with the dirt, a large round area is dug up creating a "root ball". Roots at the edge are cut, but the majority of them are retained. The root ball is then covered by permeable fabric such as burlap and tied to hold it together. This form of storage is commonly known of as "B&B", balled and burlapped. When planting the root ball is not broken up, but planted as it was. The burlap is removed and the plant is buried.

Containers are generally 1 to 2 gallons for smaller size plants, 3 to 5 gallons for slightly larger perennials or annuals. Small trees and shrubs are often sold in "balled and burlapped" or "B&B" form, with the root ball tied and covered by burlap sacking. Starts, often referred to as "plugs" are small plants, one or two year growth are purchased by growers who wish to have a head start on growing a given plant. Seed is good for those who wish to propagate plants on their own. Larger plants, such as those in large containers or balled and burlapped are in demand by landscapers who when creating a landscape design would like to have the complete garden look like a finished product. Landowners will prefer to have trees or plants look established rather than having to wait several years for them to reach full growth. Smaller containers are often preferred by landowners who are gardening for themselves due to their lesser expense and ease of handling. The roots should be stretched out when planted. Containers are more likely to create root bound conditions, when the roots grow in a circle rather than being able to reach out into new areas to gain water and nutrients. Stretching out the roots helps counteract this effect. Using light colored pots, or containers with copper in the paint has been found to reduce root binding, as well as using bottomless plants. The roots self-prune on exposure to air. (Davis & Greer, 2000)

Storage
When storing containers over winter they need to be protected from the cold. Roots in a small amount of dirt as those in containers or B&B, are more vulnerable to damage from cold (and also heat). Placing the plants in a covered or heated space such as a green house or store room will protect the plants. They may also be buried in the ground to over winter. Planting plants in containers in the ground is another strategy for cultivation—it reduces the loss of soil, and minimizes shock to roots since the plants are already contained.

When storing plants for sale, attention to watering is important to maintain the quality of the plant. How you market them may determine aspects of this storage. If your plants are sold through another vendor, they may or may not take appropriate care of your plants which will reflect on you and the perceived quality of your product. Situations like this might include selling small plants to a large plant center or garden center. Direct sales such as through farmer's markets, roadside stands or with visits to your nursery give you the most control over the status of your plants. However, travel can take a toll on plants damaged during transportation to and from a market place.

Marketing

When beginning the process of creating a new nursery doing an analysis of the market and your ability to produce plants is a necessary place to start. The site assessment and plant/product choice outlined above are one part of that process. Looking at the surrounding markets, trends, customer demographics and marketing outlets is the next stage of the process. Doing market analysis before investing in plants can help producers avoid costly miscalculations.

Steps for Outreach and Marketing:

1) Pick your desired consumers
2) Determine size and type of plants they want to purchase
3) Research current trends in buying (popular plants, niche markets)
4) Choose plants that will maximize profits (ease of cultivation, price)

Starting small

A modest start allows a new producer to learn and take small risks. For container cultivation, less than five acres are needed for a starting business, while for field or forest cultivation, up to 15 acres can be adequate. In starting small, the real potential of areas can be gauged. Experience with smaller areas can then be spread to larger areas as techniques are found to be effective and the needs of plants are known. Keeping good records is a tool useful to help create continuity and gain deeper knowledge about the process.

Another advantage to starting small is the smaller financial costs incurred. Less area requires less labor, and fewer plants to purchase and maintain. Most businesses require an investment of five to seven years before showing a profit. In the case of a nursery business, accounts and clients must be contacted, relationships made and product quality and reliability proven. When beginning a business, it is best if the income from it is not essential to one's livelihood. It is also best to not commit to being a provider of plants to other businesses until sure of your ability to carry through. Failures of entire crops happen, especially when beginning an agricultural business. Begin by selling small amounts through venues where people can take or leave the product. Wait to form larger scale contracts until later.

Market trends

The nursery business increased by 10% to 20% between 1999 and 2000. (Diver and Greer, 2000) In general, the nursery plant business follows the national economy. When the economy is up, people tend to invest more in landscaping and gardening. When down, less is spent in these areas. The nursery industry is strongly tied to the building industry as well. When more building is occurring plantings are needed to beautify land surrounding new office buildings or homes. When building slows down, landscaping plants are less in demand. Local economics and employment fact in strongly in how much demand there will be in a given area.

Niche markets

Specializing in plant types or selling to niche markets is a good way to help your business stand out from others in your area. Niche markets are specific types of products that consumers seek out for their unique qualities. Having an unusual or specialty product or line of products gives you a competitive edge. Landscapers also appreciate being able to go to a nursery and know that they can find certain products or plants that will fit a certain need.

Native shade plants is a particular niche, which builds upon demand people are expressing for plants that are part of the local natural environment. This is a trend counter to the main stream of landscaping plant production, which tends to have a set of common plants used such as azaleas, lilac, pachysandra and others which are widely available but not necessarily native to the areas in which they are grown. Since native plants have developed or spread naturally to the region in which they are sold they are often more suited to the natural set of climatic and physiological variables present than those which developed elsewhere. Using native plants avoids much of the threat of introducing a new, unknown element into the ecosystem which may become invasive and threaten to push out currently existing plant life or degrade habitat for animals. Local sustainable goods have become desirable in the marketplace and native plants are coming more into demand. Native shade plants are those which grow in forested areas. Shade plants are another niche or specialty.

Other niche markets include organically or naturally grown plants, permaculture, edible, ornamental, butterfly or hummingbird and wildlife forage plants, bulbs, and ground covers. Some nurseries specialize in growing a wide selection of varieties of certain types of plants, such as lilies, orchids, bamboos, or lilacs.

Business type

There are various strategies available to people interested in beginning a nursery business. The best choice will depend on the size of your potential operation, your ability to take part and resources available to you. The type of nursery you begin will determine what products you will carry, and also will determine or may depend on what type of customers and clientele you wish to appeal to and work with.

The three types of nursery are landscape nurseries, retail nurseries, and whole sale nurseries. A landscape nursery supplies landscaping contractors, or may be part of a landscaping business. The plants grown are used to create decorative plantings around homes, office buildings, municipal spaces and other areas of outdoor design. A retail nursery markets to homeowners directly, as well as selling to landscape and gardening professional. Whole sale nurseries provide large scale quantities of plants to garden centers, landscapers or other nursery businesses. (Sellmer and Dana, 1994)

Marketing Strategies

A new nursery business will do well to find a successful strategy for entering the marketplace. Three strategies found to be successful are cost leadership, differentiation and focus. (Barton, 2002) Cost leadership involves marketing large quantities of product at low cost. A company pursuing a strategy of differentiation will choose products and accomplish marketing that creates a unique profile for the business. With focus, a nursery concentrates their marketing efforts on one part of the overall market, choosing people with a certain set of preferences to target. (Barton, 2002) Appealing to niche markets is an example of focus marketing.

Doing analysis of your business's strengths and weaknesses will help you to identify the right strategy for you.

Customers

An important step is determining who your customer base will be. Factors that may influence this are the scale and type of business begun, the products best grown at the nursery site and characteristics of the local market place. Initial markets for small nursery businesses will be within a 50 mile radius. (Diver and Greer, 2000) Different marketing outlets will allow the grower to reach different groups of customers. Potential customers fall into several groups: mass merchandisers, lawn and garden centers, landscapers, mail order or internet customers, and home owners.

Landowners/homeowners

Landowners or homeowners are the final consumer for landscaping plants. They will be individuals, couples or families who are likely to not have specialized knowledge about plants and their needs. Selling to homeowners involves a great deal of customer service to help them find the plants that will be suited to their land and needs. Small container plants are often desirable for these customers. Appearance of the individual plant is extremely important, and they are generally looking for popular species and varieties. Incorporating education about native shade plants into marketing and sales efforts would be very beneficial for this group. Information about the benefits of native shade plants can help to differentiate a business from others and give it more appeal. Sales to this group is very seasonal, during the summer months when gardening is desirable.

Landscapers

Landscapers are professionals who design and install gardens and lawns for homeowners and businesses. Due to the nature of their business, they look for large, high quality specimens of plants which can be planted and make the garden look complete as is. Small

trees and large container plants in a larger volume than needed by homeowners are in high demand for landscapers. A good selection is key when appealing to this group, with specializations and specialized products being selling points to allow them to find plants suited to specific sites or to offer unusual or targeted plants to their customers. Landscapers generally have a large body of knowledge about plants and their requirements, so less customer service is needed on site. Landscapers come to the nursery directly, which can save costs and damage due to transportation of plants to a sales site. Sales to landscape professionals can continue throughout the year, though the busiest time of year is the spring planting season. (Diver and Greer, 2000) Prices to landscapers may be retail with a bulk discount of 10% to 20% offered.

Mass Merchandizers

Another type of customer are mass merchandizers. They may be wholesale distributers or large garden chains that will supply other outlets. Plants must be supplied in large volume. Reliability of supply and quantity of popular, highly marketable types of plants is more important for this group than high quality or age of individual specimens. Low prices are paid for the plants purchased in this way. The demand for plants is seasonal, and the plants once purchased may receive minimal care, reflecting poorly on the supplier. (Diver and Greer, 2000)

Lawn and Garden Centers

Lawn and garden centers are medium sized businesses which sell plants at retail prices to homeowners, landscapers and others. Selling to these centers is done at wholesale prices, but they offer access to markets not available to individual growers since they are located at busy commercial centers, employ workers to provide customer service and are often open year round. These businesses vary greatly, so researching the business is needed to determine if they would be good to establish a business relationship with, and whether their care of you plants would be adequate in order to spread a good impression of your nursery. Reliability and quality of individual plants are also important. Volumes needed will be less than for mass marketers. (Divers and Greer, 2000)

Mail Order and Internet

Mail order and internet is a growing market. Nurseries with specialities can reach markets all over the country or the world through these marketing venues. Having a web presence is fairly well assumed by consumers of a business today. Shipping involves costs and loss or damage in transit. A large inventory may be needed in order to be able to fill needs by the larger market of the internet. Marketing on the internet also involves registering with internet search engines.

Farmer's Markets

Farmers' markets are a vibrant source of marketing in western Massachusetts. There are many weekly markets during the growing season, with booths available for a nominal fee. The market available is local homeowners, though some producers travel long distances to reach popular markets. An advantage of these markets is that growers sell their plants at retail prices. The quality of individual plants is critical since buyers will base their purchase on the selling powers of the plants they see there right then and there.

When selling directly, it is important to keep up to date with trends in plants preferred by consumers.

Outreach
There are many different ways to reach a broader public and do outreach for your business. Catalogs give purchasers detailed information about your products. Websites are fast and efficient ways for people to locate your nursery, see your schedule for farm market or fair appearances, and to publish pictures of your plants or provide in depth information about your business, philosophy or land. Signs bring in traffic from the road and allow those looking for your site to be able to locate it on site. Attending agricultural and ethnic fairs is a way to reach a broader audience. Giving presentations for garden groups and clubs, or at conferences is a way to establish yourself as a member of the community and offer the insight and knowledge gathered during the course of creating your business. (Bateman Interview, 2007)

Competition:
Major competition for nursery plants comes from large scale producers. These growers often sell the most popular types of plants for landscaping. The massive scale on which they are grown reduces the price they need to charge, leaving the small producer outcompeted for price. These producers are using the "cost leader" strategy for business. Differentiation and specialization are the strategies which are open to small producers to counter this issue.

Table 7: Best Selling Native Shade Plants: Trees and Shrubs

Common Name	Latin Name
Balsam Fir	*Abies balsamea*
River Birch	*Betula nigra*
Black huckleberry	*Gaylussacia baccata*
Witch hazel	*Hammemelis virginiana*
Sheep's laurel	*Kalmia angustifolia*
Mountain laurel	*Kalmia latifolia*
Pussy willow	*Salix discolor*
Lowbush blueberry	*Vaccinium angustifolium*
Mapleleaf viburnum	*Viburnum acerifolium*
Northern arrowwood	*Viburnum dentatum*

Source: Project Native and Tripplebrook Farm catalogs, 2006 and 2007.

Table 8: Best Selling Native Shade Plants: Ferns and Mosses

Maidenhair fern	*Adiantum pedatum*
Haircap moss	*Atrichum undulatum*
Hayscented fern*	*Dennstaedtia punctilobula*
Jumbo ostrich fern	*Matteuccia struthiopteris*
Royal fern	*Osmunda regalis*

Christmas fern	*Polystichum acrostichoides*

Source: Project Native and Tripplebrook Farm catalogs, 2006 and 2007.

Table 9: Best Selling Native Shade Plants: Herbaceous Perennials and Grasses

Doll's eyes	*Actaea pachypoda*
Wild columbine	*Aquilegia canadensis*
Wild ginger	*Asarum canadense*
Orange butterfly weed	*Asclepius tuberose*
Blue wood aster	*Aster cordifolius*
Harebell	*Campanula rotundifolia*
Pennsylvania sedge	*Carex pennsylvanica*
Purple joe-pye-weed	*Eupatorium purpureum*
Wild strawberry	*Fragaria virginiana*
Woodland sunflower	*Helianthus divaricatus*
Goldenseal	*Hydrastis Canadensis*
Blue flag	*Iris versicolor*
Twinflower	*Linnaea borealis*
Great blue lobelia	*Lobelia siphilitica*
Canada mayflower	*Maianthemum canadense*
Partridgeberry	*Mitchella repens*
Creeping phlox	*Phlox stolonifera*
Black-eyed Susan	*Rudbeckia hirta*
Little bluestem	*Schizachyrium scoparium*
Wool grass	*Scirpus cyperinus*
Wild stonecrop	*Sedum ternatum*
Purple trillium	*Trillium erectum*
White trillium	*Trillium grandiflorum*
New York ironweed	*Vernonia noveboracensis*

Source: Project Native and Tripplebrook Farm catalogs, 2006 and 2007.

Section 4: Evergreen Boughs for Wreaths and Holiday Decorations

Introduction

A traditional holiday decoration is the evergreen wreath. This and many other decorations are sold by Massachusetts Christmas tree growers, as well as others who market just the decorations. Tips and brush may also be sold. If a landowner has desirable evergreens such as eastern white pine (*Pinus strobes*), balsam fir (*Abies balsamea*), mountain laurel (*Kalmia latifolia*) or others, they may wish to market evergreens. The Christmas tree industry has expanded greatly since the 1950s. However, the market has reached a down turn in recent years due to competition with artificial trees and mass produced products. In some ways a lost tradition, the part time wreath making industry has come under much competition from plain wreaths made in mass quantities in Canada and Maine. Markets that are strongest for the small producer are for value added, natural and locally marketed wreaths which appeal to the values of those who buy them.

Characteristics

There are a variety of holiday decorations which may be made from evergreen boughs: wreaths, sprays, kissing balls, coffin boxes, garlands, swags, and table centerpieces. Unprocessed tips and branches may also be sold. Evergreen boughs must be harvested after two hard frosts have occurred in the winter, which hardens the branches and makes them retain their needles for a much longer period. Certain types of evergreens are more suited to making decorations than others.

Types

Native trees used include eastern white pine, balsam fir, red spruce (*Picea rubens*), mountain laurel and princess pine (*Lycopodium obscurum*) and other clubmosses. Non-native evergreens include the highly sought after Fraser fir (*Abies fraseri*), english holly (*Ilex aquifolium*), noble fir (*Abies procera*), Scotch pine (*Pinus sylvestris*), Norway spruce (*Picea abies*) and Doug fir (*Pseudotsuga menziseii*). Eastern Hemlock (*Tsuga canadensis*) cannot be used since it does not retain its needles. In depth cultivation information for two major species found in Massachusetts forests follows: eastern white pine and balsam fir.

Cultivation

<u>Eastern White Pine *(Pinus strobus):*</u>

This attractive evergreen tree is commonly found in the forests of western Massachusetts. Part of the historical indigenous old growth forests of New England, enormous specimens were reserved for harvest as masts for ships of the British Navy until the American Revolutionary War. Land clearing by European settlers removed the virgin forests and opened the land for agriculture. Farm abandonment in the late nineteenth century

allowed the forests to return: hardwoods dominating where pastures had been, white pines often entering where open fields laid bare the soil which speeds pine regeneration.

White pine has long, smooth needles held in bundles of five. A fast growing tree, the branches form in widespread whorls grown annually which can be counted to find the age of a specific tree. The open form of the tree makes it less desirable as a Christmas tree, but the branches are highly desirable for decorations. The trees enhance wildlife values, providing nesting sites, thermal cover and wind breaks for forest animals.

White pine grows best in soils which are deep, slightly-acidic, light-textured and well-drained. (Lassoie et al., 1996) However, it is often associated with sandy, well-drained soil on which it has a competitive advantage over hardwoods. A relatively shade intolerant tree, it is a pioneer species (grows soon after disturbance of forest canopy) in New England. Needing bare soil with much light to propagate by seed, abandoned fields are better for white pine cultivation than cleared hardwood forest stands. Many hardwoods sprout from cut sprouts which grows faster than seedlings, causing the hardwoods to grow faster than the seedlings, shading out and killing the pines.

White pine can be cultivated through forest management or plantation growth. To bring about white pine regeneration in a forest, a harvesting method called a shelterwood treatment is often used in conjunction with scraping or scarifying the ground to expose bare soil. A shelterwood treatment involves harvesting trees in an existing pine stand in three stages: first removing smaller trees to create growing space for seedlings and saplings, second harvesting mature trees of low quality, leaving intact large, high-quality trees which will act as seed source and provide some shade for growing seedlings, third a final removal cut in which all remaining large trees are harvested. The shade from the remaining seed trees has been found to minimize damage done by the white pine weevil. The weevil eats the top or lead branch of white pines causing them to form with forked main stems which reduces their timber value substantially.

If growing white pines in a plantation setting, seedlings should be planted close together. This allows the seedlings to develop with a straight stem, and also accounts for mortality caused by white pine weevils. Plant in the spring to avoid drought while the trees are establishing themselves. Prune the trees for best form. Thin the trees at 15 years, removing the poorest specimens. White pine timber rotations are long, lasting 60 to 80 years for the growth of best quality wood. If growing for Christmas trees, seedlings are often re-planted after two or three years' growth into rows with adequate space for access between the trees to prune, fertilize and eventually, cut for harvest. (Lassoie et al., 1996)

Balsam Fir *(Abies balsamea):*
Balsam fir, the most fragrant of evergreens, is found in colder, wetter sites than the eastern white pine. It is at the southernmost reach of its range in southern New England, and is more often found in the hills of western Massachusetts than the lower lands to the east. The short, flat needles give off a pungent resinous smell when crushed, synonymous in many people's minds with the holiday season. The needles may be used as potpourri or scented pillows when gathered and dried. The pleasant smell and

attractive deep green of the branches make this a highly desirable tree for holiday decorations.

Balsam fir tolerate a wide range of types of soils in cool climates, but do best on well-drained, moist soils with a loamy texture. They may grow in swamps or rocky mountainsides, and are often found in association with red spruce in our region. These trees may be raised from seed in beds and plantations or using regeneration techniques similar to those for eastern white pine. Regeneration through planting or seeding in a forest setting has been found to be not very successful. (Lassoie et al., 1996) The seeds germinate in late May through early July and do best for the first 6 to 8 years under some shade. Trees with open crowns such as paper birch (*Betula papyrifera*) or aspen (*Populus spp.)* work well to shade the saplings.

Balsam fir can live to 150 to 200 years, but face various challenges to continued growth. The shallow roots of the tree make, along with disease from butt rot fungi common at 40 years of age, make the tree susceptible to wind throw. The balsam wooly aphid (*Adelges piceae*) which attacks twigs and stunts growth of new buds is spreading south from Maine. This insect also effects fraser fir, another of the most valuable evergreen species for holiday decorations. Extreme low winter temperatures check the growth of the insect, and infected stands may be treated by cutting affected trees in the winter.

Harvesting and Processing

Evergreen boughs may be made into raw materials or value added products. Raw materials are used by others to create the value added products. It is less time consuming to produce them, but give a lower return over all and require much larger quantities to be economically viable. Value added products give a higher return on each product sold, but require higher investments of labor, materials, marketing and sales.

Raw materials include cutting evergreen trees into branches or tips. Branches with a diameter of ½ inch or less are useful for making wreaths and holiday decorations. Tips are the ends of branches, from 8 to 10 inches long. Tips are of a size that makes them ready made to craft wreaths and other directions directly from them. Branches require cutting into tip length before they can be utilized. Prices paid for branches were reported to be $450 per ton. Tips should garner higher prices. (Cranstons P.R., 2007)

To process tips or branches for commercial sale, they are gathered either from living trees or from cut sub-par specimens that have been grown for Christmas trees. When cutting from living trees, a rotation of one to three years can be established between cutting a given tree. The limbs are gathered into bundles weighing 30 to 50 pounds. The bundles are weighed and wrapped two or three times around with twine. Roughly the size of a bale of hay, these bundles are easy to transport.

Sustainable Harvesting Practices

In Minnesota, the Balsam Bough Partnership formed a voluntary association of private industry which adopted standards for sustainable harvest. Standards included a 36 inch

limit for brush, and recommended that pickers take the ends of branches and leave branchlets below to grow for the following season. Also recommended was a five to six year rotation on harvesting from individual trees. The Association coordinated the acquiring of permits to harvest on public lands, assisting producers to follow regulations. (Krantz, 1999)

Evergreen clubmosses may be used for decorations, however these plants are vulnerable to excessive or damaging harvesting practices. The varieties traditionally collected include princess pine, tree ground pine (*L. dendroidium*), ground cedar (*L. complanatum*), running clubmoss (*L. clavatum*) and shining clubmoss (*L. lucidulum*). All of these species are slow growing, patches should be left to regenerate for several years after being disturbed for harvest. Ripping or tearing up branches from princess pine and tree ground pine cause damage to the plant, disturbing its ability to rebound from the disturbance. Clipping fronds at the base minimizes damage, and may stimulate rhizome growth in the remaining plants. Harvesting the oldest individuals leaves younger fronds to reproduce in the future. In the case of running clubmoss and ground cedar, tearing or ripping up lengths of the plant is desirable since it exposes bare dirt in which spores can colonize. (Nuerertz and Zasade, 1999)

For all species of clubmosses, harvesting should be practiced only during the early spring or late fall, when the plants are not reproducing. More than 75% of a patch should be left intact, and in the case of running clubmosses care must be taken to not remove the entire lengths of a plant which would destroy its ability to reproduce in the future. Selective harvesting from very densely growing patches is recommended for these plants. (Neuertz and Zasade, 1999) Commercial prices offered for these plants is reported to be $.40 per pound. Sustainable harvesting on a commercial level would require access to a large area populated by these mosses. Smaller scale harvesting for use in value added operations is more likely to match amounts that can be realistically gathered. (Forest Stewardship Information Exchange, 2003)

Value Added Products

There are various products that people create from evergreen boughs to decorate homes and businesses during the winter holiday season. Descriptions of how to fabricate the most common follow:

Wreaths

Wreaths are generally made by laying tips onto a round metal frame. Metal frames and machines for forming wreaths are available from suppliers such as Kelco Industries of Maine. Arms from the frame are bent around the tips, holding them in place. Decorations such as ribbons, bows, pine cones, seed pods, dried flowers or other man-made or natural objects are attached by tying on with wire or hot melt glue. Inexpensive plain wreaths can be purchased from Canadian or Maine producers. Large operations often purchase

pre-made wreaths to decorate or supplement what they can produce with the imported wreaths.

Sprays
A small bundle of tips is tied together. Decorative items such as a ribbon, pine cones or berries are added to make the bundle festive. These are often hung on doorways.

Kissing balls
Tips too small for a wreath are thrust densely into a spherical 6 inch Styrofoam form. A ribbon or string is strung through the center. A bow or other decorations are often hung from below the ball. These may be hung from doorways or above windows. Balls may have the traditional mistletoe to encourage kissing beneath them.

Coffin boxes
A rough made wooden box is filled with dirt. Evergreen branches are poked into the dirt, along with other pointsettias, holly berries and pine cones or other materials, to make decorations for grave sites during winter. The box is watered, then left outside to freeze which then holds the greens in place and preserves for use. A Styrofoam form may be used in place of dirt.

Garlands or swags
Long ropes of greens, used to decorate house eaves, railings or fences. The greens are tied or lashed together in a long string. Long tips or branches work best. Garland making machines are available, which quickly speeds the process and reduces wear and tear on hands. However, getting the knack of making it can be difficult and commercially produced garland is available at a low cost. The large amount of labor required to make garland versus the amount which can be charged for it makes it a less attractive option.

Table centerpieces
A wreath may be used to encircle one large candle, or have smaller candles held above the greens. Tips, cones, berries and other decorative materials may be arranged in a Styrofoam or other form to be used as a decoration for holiday gatherings and meals.

Decorations
Many items can be used to beautify wreaths, sprays and other holiday greens. Ribbons are important elements of decoration, and may be expensive items. Purchasing them wholesale after the holiday season is over is a good way to get a good deal. Some producers, such as the highly regarded Emily's Wreaths of New Hampshire specialize in selling high-quality ribbons. Using their pre-tied bows allow a wreath maker to charge a premium price. Natural items can be used such as pine cones, berries, dried flowers, seeds and seed pods, as well as manufactured decorative items.

Items can be tied onto holiday greens with wire or attached using hot melt glue.

Storage
Storage for holiday decorations is short term. Time between harvesting, processing and selling can be between a few days to a few weeks. In order to preserve needles and increase "keepability" (length which needles will be held on branches), storing in a cool environment such as a barn or out of doors is helpful.

Transportation
Transportation may be needed to bring brush to a processing site, or decorations to a sale site. Care should be taken to avoid damage to decorated wreaths if they need to be moved, but greens are fairly durable for transport. Delivery of greens can add extra cost if they need to be purchase to make decorations. Harvested brush is generally delivered by the truckload when harvest is complete, or in large shipments.

Marketing

Market Trends
The market for holiday evergreens has changed dramatically over the last fifty years. In the middle of the 20th century, there was little commercial industry. As of 2005, $1.374 million were spent annually on live Christmas trees in the United States, with 32.8 million purchased in that year. Twenty-two percent of these trees were purchased at cut-your-own or farm sites. Sales of artificial trees have increased, from 7.1 million in 2001 to 9.3 million in 2005, but sales of natural trees and products far outweigh those of artificial. (National Christmas Tree Association, 2007)

According to Cynthia and Thomas Cranston, of the MA Christmas Tree Association, over the last 10 to 12 years industry standards and consumer preferences have changed. A wider variety of trees are now available and higher quality is demanded. Gone are the days of inexpensive "Charlie Brown" trees, with sparse foliage. (Cranston P.R., 2007) Competition is noticeable from consumers choosing artificial trees in order to avoid falling needles, or for those concerned about environmental impact of cutting down trees for the holidays. Wreaths have to be high quality and decorated to compete with mass produced wreaths.

Another change that has occurred in the last 20 years has been the loss of small producers. Many families in the past would grow a small number of trees to sell from the roadside during the holiday season for extra income. Families would harvest brush and then assemble wreaths together. These small producers are few and far between at this time. There are few young operators starting up businesses of this type, part of a slowing of agricultural production in the nation, perhaps.

Competition

Sales of evergreens are very different for raw materials as opposed to value added items. Competition is strong against lower investment items. Identifying outlets for marketing prior to beginning a business operation is important to ensure being able to recoup what is spent on producing the items.

Plain wreaths are currently being produced and imported seasonally from Canada and Maine to New England. Large discount stores such as Home Depot and Sam's Club carry simple wreaths for low prices ($10 to $12 or less). According to members of the Massachusetts Christmas Tree Assocation quality of these mass produced has improved recently. However, there is no way to know when these boughs have been harvested, and in the experience of some growers, mass produced wreaths sometimes lose their needles immediately. This is likely if the branches were harvested before sufficient frosts have occurred.

Large wreaths, garlands, sprays and other simple items can be found at these retail outlets. Consumers have a strong incentive to shop at a large store if they are looking for an undecorated wreath. Due to the costs of materials and labor involved it is next to impossible for a small producer to compete with these prices. However, these stores offer few decorated options, and those that are offered are generally minimal quality, with artificial decoration added in a standard pattern. Another question about the large scale operations would be the impact on the natural landscape.

Hand-decorated wreaths or other evergreens using high-quality or natural items have a higher sales cachet than mass-produced inexpensive ones. Small local producers can also add value to their products by giving purchasers information about the story behind their operation. Farms can be a destination for consumers to visit during the holiday season.

Raw Materials

Brush is sold by the ton, delivered by truck to producers who are making items from the raw evergreen boughs. There may be other producers in your region or large producers who are looking for materials from a larger area. If possible, it is best to identify contacts for sales prior to making a harvest. Running an advertisement in the Farm Bureau newsletter or the Massachusetts Christmas Tree Association (MCTA) newsletter are ways to contact purchasers. Cynthia Cranston, past president of the MCTA recommended contacting members of the board in the association who may know of growers looking for brush. The best time of year to advertise is immediately preceding the holiday season, in September or October, in order to reach producers when they are looking for materials.

Prices:
1999 brush $.14-$.17/lb
12 to 36 inch boughs, in 25 to 35 lb bundles.

Pickers harvest 1,000 lbs on a good day.

Value Added Marketing
Making greens into wreaths and other decorations allows a producer to charge higher prices, and to better compete with mass market producers by providing high-quality, unique products. Plain products that can easily be mass produced may be a loss due to the labor required versus the prices that can be charged. Decorative items and the form make up half of the cost for a wreath, however, the decorations greatly increase the value of the wreath and place the producer into a market in which they are able to compete.

In order to be able to capture this value, appropriate marketing outlets must be found. There are many options for the producer. Christmas tree lots can be rented or reserved in public spaces during the holiday season. Farm stands or roadside stands can be created at home if your land is on a busy public roadway. Grocery stores and garden stores may sell wreaths. Floral stores, landscaping stores and farm stores are also other possible options. Many producers sell on the internet, shipping wreaths to purchasers all over the country.

Table 10: Wreath Prices

Product	Price
Decorated 12 inch wreath	$20-26
Decorated 16 inch wreath	$26-40
Four foot diameter wreath	$35-40
Wholesale plain wreath	$6.50
Cemetary box	$17

As reported by Cynthia and Thomas Cranston and Debbie and Shane Emerson.

It's important to charge enough for prices. Undercharging costs you in labor and materials for limited profit and can put you out of business. It is better to get fewer larger sales. Large wreaths need to appropriately priced: a lot of effort and a large amount of materials go into them. High prices also prohibit people from buying casually, and you only get those who really want a large wreath. Producing fewer wreaths can lead to greater profits.

Publicity
It may take some time to establish a market at a given outlet. Word has to spread about the availability, and people need to come to know about your presence. Publicity is critical for connecting your desired audience with your product. Advertising by placing an ad or classified listing in newspapers, local magazines, and newsletters are ways to reach a broader audience. Signage is critical. It brings in passing traffic, as well as allowing those who find your information on the internet or through print advertisement to locate your site. Websites are a critical tool for marketing at this time. It gives space for product background and for the story of your farm or operation to be told. A space for personal connection to be made between the consumers and the producers—giving a human face to what would otherwise be an anonymous product. This is what differentiates local products from mass produced and communicating that message is an important part of reaching the public. Internet advertising also allows you to contact

people in distant markets, and those who may be traveling for vacation. If your site has a "destination" cachet, it will bring them to visit.

Membership in associations give growers and producers access to information, community networks and help support the local (or national) industry through group advertising. The MA Christmas Tree Association meets regularly across Massachusetts. During the off season they conduct their meetings on site at various farms and related sites (such as a research site in Connecticut studying growing different types of Christmas trees), giving the meeting a more social air, while at the same time allowing producers to meet one another, share experience and advice. They also publish a directory, and maintain a website which is a clearinghouse for information for producers and consumers in Massachusetts. Other agricultural associations such as CISA and the MA Tree Farm Program give similar benefits. National associations offer further resources and exposure for the industry as a whole, as well as being able to conduct television advertising on major networks. CISA spotlights producers through their local hero program, as well as publishing a guide for local products and their producers in the western Massachusetts, Connecticut River valley area. Berkshire Grown offers similar outreach in the Berkshire Region.

Gaining coverage in the media though articles or appearances is another way to gain exposure. Offering workshops or presentations at conferences is a way to become known.

Continuity is an important part of marketing. For example if you sell at a site during the holiday season, people will come to rely on seeing you there, and look for you from year to year. Developing a relationship with consumers brings you long term repeat business. That is an aspect of being a local business.

Word of mouth is an important way that people hear about your product. Excellent customer service and personal connection, as well as professional appearance and publicity materials help make a good impression on consumers who may recommend you.

Table 11: Example Budget for White Pine Holiday Wreath Production

WHITE PINE HOLIDAY WREATHS ENTERPRISE BUDGET				
Production time frame: 9 years				
INCOME (3-year average for years 7, 8, 9)				
	Unit	Amount	Price Per Unit ($)	Avg $/yr
Sale of wreaths, retail	pieces	250	20.00	5,000.00

(16" wreath)				
Sale of wreaths, wholesale (16" wreath)	pieces	150	6.50	975.00
Total Income				$5,975.00
VARIABLE COSTS (3-year average for years 7, 8, 9)				
Transportation to market	miles	500	$0.35	$175.00
Packaging (boxes)	per 25 lb	293	$0.50	$146.50
Labor-tip harvesting	hr	63	$6.00	$378.00
Labor - hauling	hr	12.5	$6.00	$75.00
Labor - equipment maintenance	hr	10	$6.00	$60.00
Labor - wreath making	hr	50	$6.00	$300.00
Wreath rings	12" ring	300	$1.00	$300.00
Bundling wire, 24 gauge, galvanized steel	250' roll	3	$4.50	$13.50
Advertising	hr	70	$6.00	$420.00
Equipment maintenance costs	acre	3	$70.00	$210.00
Subtotal variable costs (years 7, 8, 9)				$2,078.00
VARIABLE COSTS (yearly average for years 1 through 9)				
Yearly maintenance (stand)	acre	3	$25.00	$75.00
Labor-stand maintenance	hr	50	$6.00	$300.00
Subtotal variable costs (years 1-9)				$375.00
Total variable costs (years 1-9)				
FIXED COSTS (1st year establishment)				
Building (10-yr life)		2500	10%	250.00
Site preparation costs	acre	3	$100.00	300.00
Trees (500 trees/ac; $57/ac)	acre	3	$57.00	171.00
Planting costs	acre	3	$50.00	150.00
Tools (clippers, etc.)	pieces	3	$25.00	75.00
Miscellaneous equipment		1	$100.00	100.00
Subtotal fixed costs (1st yr establishment)				1,046.00
FIXED COSTS (6th year establishment)				
Wreath-making machine (purchase in yr 6)			$200.00	$200.00
Storage space (cool box)			$250.00	$250.00
Total fixed costs				$450.00

(This assumes 7% annual interest rate, 1%annual inflation rate & equal revenue/yr.)

Assumptions for Enterprise Analysis:

1) All costs and revenues were averaged over the 3-year production of wreaths.

2) Wreath revenues occurred in years 7, 8, and 9.

3) Variable costs occur in yrs. 7-9, except stand maintenance/labor, which occurs every year.
4) The volume of tips produced was based on a 3-acre white pine plantation.
5) Six pounds tips per wreath. Plantation produces 4000 lbs. tips/acre/year (x 60% cull rate).
6) All tips gathered from landowner's Christmas tree farm. None are purchased.
7) Calculations do not account for cost-share payments or taxes.

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Appendix A:Understory Crops and their ProductsViable in Western Massachusetts

Food

Category	Plant/Animal	Products
Maple syrup	Sugar maple	Syrup, candy, cream, sugar powder, sap
Nuts	Acorns, Beechnut, Hickory, Butternut, Pecan, Chestnut, Hazel nut	Nuts, flour, breads
	Black Walnut	Nuts, shell for: metal polish, seals for oil well drilling, paints, explosives, cosmetic cleaners
Fruits/berries	Blackberry, raspberry, elderberry, blueberry, crabapple, apple, currant, gooseberry, huckleberry, strawberry, black cherry, rose hips	Berries/fruit, jellies, preserves, fruit leathers
Edible plants	Amaranth, angelica, asparagus, burdock, cattail, dandelion, daylily, fiddlehead fern, milkweed, mustard, nettle, oxalis, peppergrass, plantain, pokeweed, sassafras, sheep sorrel, violet, watercress, wild onion, wild garlic	Variously: roots, leaves, seeds, shoots, buds, etc. Preparation: fresh, dried, candied, cooked
Herbs/spices	Bay, chervil, chicory, thyme, ginseng, licorice	Dried herbs, soups, flavored cooking oils
Teas	Beebalm, mints, raspberry leaves, rose leaves and hips, elder flower, dandelion, Echinacea, ginseng, goldenseal, wintergreen, yarrow	Variously: roots, leaves, seeds, hips, shoots, buds, etc. Preparation: dried, fresh
Honey	Bee hives	Honey, bee pollen, bees' wax, candles
Mushrooms	Chanterelle, morels, boletus, chicken of the woods (maitake), puffball, shiitake, matsutake	Fresh, dried, soups, spore
Game animals	Deer, turkey, grouse, pheasant, rabbit, fish	
Silvopasture	Oaks, hickories	Forage for livestock

Medicinal or Nutraceutical

Medicinal plants	Witch hazel, ginseng, black & blue cohosh, goldenseal, slippery elm, black cherry bark, mandrake, stinging nettle, pokeweed, st. john's wort, sassafrass root bark, mullein, yarrow, tansy, Echinacea, horsetail, bloodroot, wild ginger	Teas, tinctures, flower essences, salves, ointments, balms, bath mixtures
Aromatic Oils	Cedar, hemlock, wintergreen,	Essential oils, incense, bath

	sweet birch, balsam fir, spruce	salts

Decorative & Handicraft

Holiday greens	Hemlock, pine, mtn. laurel, spruce, fir, holly, cedar, mistletoe, princess pine	Wreaths, centerpieces, floral arrangements
Cones	Alder, hemlock, larch, pine, spruce	Wreaths, arts & craft supplies
Landscaping plants	Hosta, ivy, rue, clematis, gentian, bunchberry, foam flower, sensitive fern, Canada mayflower, sedge, elderberry, oakleaf hydrangea, cohosh, blood root, ostrich fern, cardinal flower, black-eyed susan, paper birch, etc (See Appendix E)	1-4 gallon container plants, seedlings, seeds/seed mixes, large shrubs/trees, ground covers
Floral greens	Baby's breath, alder and birch tops, ferns, cattails, cedar, boughs, club moss, dogwood, pine boughs, pussy willow, rhododendron, scotch broom, smilax, sphagnum moss, sumac, white birch bark, ivy	
Rustic furniture	Grapevine, mountain laurel, willow, white birch, *bittersweet stems*, various tree saplings and branches, burl wood	Chairs, bureaus, tables, frames, arbors, clocks
Weaving and dyeing	Alder bark, hemlock, lichens, oak wood and bark, black walnut, willow, goldenrod, aster, curly dock, *fireweed*, horse tail, milkweed, pokeweed, plantain, mullein, oxalis, thistle, yarrow, sumac, *wild rose*, sunflower, more..	Natural dyes, dyed wool

**Species in italics are listed in the State as exotic invasive plants.*

Appendix B:Native Shade Plants for LandscapingViable in Western Massachusetts

Trees/Shrubs

Common Name	Latin Name	Light	pH	Soils	Other features	Price (for 1 gallon container unless noted)
Balsam Fir	*Abies balsamea*	Deep shade to 8 yrs; Full sun 8 yrs to maturity	4-6	Cool, moist, well-drained acidic soil.	Favored for Christmas trees and green.	$13.95
Striped maple	*Acer pensylvanicum*	Part to full shade		Cool, moist, acidic forest understory.	Rare/endange red in MA	$19.95/1.5-2.5 gal.
Shadbush	*Amelanchier canadensis*	Sun to part shade		Varied light and soil conditions.	Wildlife berries.	$13.95
Pawpaw	*Asamina triloba*	Sun to part shade		Moist, rich, somewhat acidic soils.	Edible fruits butterfly plant	$19.95
Yellow birch	*Betula alleghaniensis*	Sun to shade		Cool, moist, moderately well-drained sandy soils.	Timber tree, "birdseye" valuable.	$13.95
Black birch	*Betula lenta*	Sun to shade	4-5	Deep, fertile, well-drained upland sites.	Timber tree.	
River Birch	*Betula nigra*	Sun to light shade				$13.95
Paper birch	*Betula papyrifera*	Sun to part shade	5-8	Variety of sites, less common on wet sites. Prefers cold climate.		
New Jersey Tea	*Ceanothus americanus*	Sun to part sun	6-7	Poor, nitrogen-deficient, sandy or well-drained soil.	Flowering.	$13.95
Alternate-leaf or pagoda dogwood	*Cornus alternifolia*	Sun to part sun		Cool, moist, acidic soils.	Wildlife berries.	$11.95/ 4 ¼ inch pot
Bunchberry	*Cornus Canadensis*	Part shade	4-5	Moist, acidic, rich soil with high organic matter content	Wildlife berries.	$9.95/4 ¼ inch pot
Red osier dogwood	*Cornus servicea*	Sun to part sun		As paper birch.	Dramatic coloring	$13.95
American hazelnut	*Corylus Americana*	Sun to part shade		Moist to dry, sandy soil.	Edible nuts	$19.95/1.5-2.5 gal.
Black huckleberry	*Gaylussacia baccata*	Sun to shade, requires light for berry production	4-5	Acidic, sandy soil.	Edible nuts. Dioecious (need 2 to flower).	$12.95/4 ¼ inch pot
Witch hazel	*Hammemelis virginiana*	Part sun to shade		Variety of conditions, ideal soils are rich and moderately rich.	Medicinal qualities. Late, unusual blooms.	$13.95
Winterberry holly	*Ilex verticillata*	Sun to part shade		Wet, acidic boggy soils ideal, tolerates moist acidic soil.	Colorful wildlife berries. Dioecious.	$13.95
Sheep's laurel	*Kalmia*	Sun to shade		May grow in sterile	Poisonous to	$13.95/4 ¼ inch

	angustifolia			wet or dry (sandy) soil.	livestock. Flowering.	pot
Mountain laurel	*Kalmia latifolia*	Sun to part shade	4.5-6	Acidic, sandy or loamy well-drained soil.	Flowering. Slow growing.	$16.95/4 ¼ inch pot
Spicebush	*Lindera benzoin*	Part sun to shade		Moist acidic soil.	Flowering, wildlife berries.	$13.95
Wild black cherry	*Prunus serotina*	Sun	6-7.5	Deep, rich, moist soils.	Berries (wildlife forage and edible), high value timber tree.	
White swamp azalea	*Rhododendron viscosum*	Sun to part shade		Wet and moist sites, well- or poorly drained.	Flowering.	$12.95/4 ¼ inch pot
Staghorn sumac	*Rhus typhina*	Sun to part shade		Variety of soils.	Wildlife berries.	$11.95
Pussy willow	*Salix discolor*	Sun to part shade		Moist soil.	Decorative catkins.	$13.95
Sweet elderberry	*Sambucus Canadensis*	Sun to light shade		Moist, rich well-drained soil.	Edible berries. Dioecious.	$11.50
Sassafras	*Sassafras albidum*	Sun to part shade		Moist to moderately dry soil.	Butterfly plant.	$13.95
Steeplebush	*Spirea tomentosa*	Sun to part shade		Moist to moderately dry soil.	Flowering.	$13.95
Lowbush blueberry	*Vaccinium angustifolium*	Sun to part shade		Rocky or dry sandy soil with good drainage. Bears fruit best in full sun.	Edible berries	$15.95
Highbush blueberry	*Vaccinium corymbosum*	Light sun or Light shade		Moist, acidic soil. Bears fruit best in full sun.	Edible berries	$15.95
Mapleleaf viburnum	*Viburnum acerifolium*	Sun to shade			Wildlife berries	$12.95/4 ¼ inch pot
Withe-rod viburnum	*Viburnum cassinoides*	Sun to shade			Wildlife berries	$11.95/4 ¼ inch pot
Northern arrowwood	*Viburnum dentatum*	Sun to light shade		Tolerates poorly-drained sites.	Wildlife berries	$11.95/4 ¼ inch pot
Nannyberry (wild raisin)	*Viburnum lentago*	Sun to shade		Moist, rich soil or varied sites.	Edible berries	$11.95/4 ¼ inch pot
Black haw	*Viburnum prunifolium*	Sun to light shade		Dry soil.	Rare and endangered in MA.	$19.95/1.5-2.5 gal.
Highbush cranberry	*Viburnum trilobum*	Sun to part shade		Moist soils.	Edible berries.	$11.95/ 4 ¼ inch pot

Ferns/Mosses

Northern	*Adiantum*	Part to full shade	6-7	Rich, moist		$10.95

maidenhair fern	*pedatum*			deciduous forests.		
Ebony spleenwort fern	*Asplenium platyneuron*	Part shade to full sun	5-7.5	Rocky, well-drained soils.		$7.95/4 inch pot
Maidenhair spleenwort fern	*Asplenium trichomanes*	Sun to part shade	4.5-7.5	Rocky, moist soil.		$7.95/4 inch pot
Haircap moss	*Atrichum undulatum*	Part shade				$5.95/4 inch pot
Hayscented fern*	*Dennstaedtia punctilobula*	Part sun to shade	4.5-6	Dry woodlands or sandy pastures.	Spreads quickly.	$6.95/4 inch pot
Wood fern	*Dryopteris marginalis*	Part sun to shade	4-5	Cool, moist woods.		$10.95
Tree club moss	*Lycopodium obscurum*	Part to full shade		Moist well-drained soil, high in humus.		$7.95/4 inch pot
Ostrich fern	*Matteuccia struthiopteris*	Sun to shade	5-7.5	Rich wet soil.	Edible fiddleheads	$11.95
Sensitive fern	*Onoclea sensibilis*	Sun to shade	4.5-7.5	Wet soil.		$10.95
Cinnamon fern	*Osmunda cinnamomea*	Sun to shade	4-6.5	Moist, acidic soils.		$10.95
Royal fern	*Osmunda regalis*	Part to full shade	4-7.5	Wet acidic soil.		$10.95
Christmas fern	*Polystichum acrostichoides*	Shade to sun	4.5-7	Rich, sandy or rocky soil.	Evergreen foliage.	$10.95
Common haircap moss	*Polytrichum commune*	Sun to part shade		Moist, acidic soil.		$6.95/4 inch pot
Soft haircap moss	*Polytrichum piliferum*	Sun to part shade		Dry, sandy, gravelly soil.		$6.95/4 inch pot
Bracken fern	*Pteridium aquilium*	Sun to part shade	4-5	Dry or sandy sites.		$10.95
Sphagnum moss	*Sphagnum spp.*	Sun to part shade		Moist, acidic, boggy soil.		$7.95/4 inch pot

Herbaceous Perennials and Grasses

Common Name	Latin Name	Light	pH	Soils	Other features	Prices (per 1 gallon pot unless noted)
Red baneberry	*Actaea rubra*	Part sun to shade	5-6	Moist, rich soil.	(Poisonous)	$8.95/quart
White baneberry, or doll's eyes	*Actaea pachypoda*	Part sun to shade	5-6	Moist, rich soil.	(Poisonous)	
Black cohosh	*Actea (Cimicifuga) racemosa*	Part sun to shade	5-6	Rich, well drained soil.	Medicinal	$10.95
Big blue stem	*Andropogon gerardii*	Sun to part sun		Moist soil or varied sites.	Grass	$10.95
Wild columbine	*Aquilegia canadensis*	Sun to shade	5-7.5	Well-drained soils.		$10.95
Wild ginger	*Asarum canadense*	Part shade to shade	4.5-6	Rich, moist soil.	Edible	$10.95
Blue wood aster	*Aster cordifolius*	Sun to shade		Average to dry soil.		$10.95
White wood aster	*Aster divaricatus*	Part sun to shade	5-7	Varied sites.		$6.95/4 inch pot
New England aster	*Aster novae-angliae*	Sun to part shade		Rich, moist soil.		$10.95

Big leaf aster*	*Aster macrophyllus*	Part sun to shade		Average to moist soil.		$10.95
Harebell	*Campanula rotundifolia*	Sun to part shade	6-7	Well drained soil.		$10.95/ ½ gal. pot
Pennsylvania sedge	*Carex pennsylvanica*	Part shade to shade		Varied sites, wet to dry.		$10.95
Blue cohosh	*Caulophyllum thalictroides*	Part sun to shade.	4.5-7	Moist soil.	Medicinal	$10.95
Wild bleeding heart	*Dicentra eximia*	Part shade to shade	4-6	Rich, light soil.		$10.95
Wild rye	*Elymus riparius*	Sun to part sun		Moist soil to average.	Grass	$10.95
Mayflower, trailing arbutus	*Epigea repens*	Sun to part shade	4-5	Sandy or gravelly, acidic soil.	State flower of MA, ground cover	$11.95/4 inch pot
Purple love grass	*Eragrostis spectabilis*	Sun to part sun		Dry, sandy soil.	Grass	$10.95
Boneset	*Eupatorium perfolatum*	Sun to part sun		Moist soil ideal.	Medicinal, endangered in MA	$10.95
Purple joe-pye-weed	*Eupatorium purpureum*	Sun to part sun		Wet soil.	Medicinal	$10.95
Wild strawberry	*Fragaria virginiana*	Sun to shade		Varied sites. Bears fruit best with more sun.	Edible	$9.95
Wintergreen	*Gaultheria procumbens*	Part to full shade	4-6	Acidic, dry, well-drained soil.	Edible, ground cover	$11.95
Woodland sunflower	*Helianthus divaricatus*	Sun to part shade	5-7	Sandy, well-drained soil or varied sites.		$10.95
Ox-eye sunflower	*Heliopsis helianthoides*	Sun or part shade		Moist or dry soil.		$10.95/ ½ gal. pot
Goldenseal*	*Hydrastis Canadensis*	Part to full shade	6-7	Rich, moist, slightly acidic soil.	Medicinal, endangered in MA	$8.95/quart
Crested dwarf iris	*Iris cristata*	Sun to shade		Moist, fertile soil.	Ground cover	$6.95/4 inch pot
Blue flag	*Iris versicolor*	Sun to part shade		Wet or moist soil, also drier conditions.		$6.95/4 inch pot
Canada lily	*Lillium canadense*	Sun to part sun		Moist, rich soil. Varied sites.		$12.95
Pink ladyslipper	*Cypripedium acaule*	Part shade	4-5	Dry forest soils.		
Twinflower	*Linnaea borealis*	Part sun to shade	4-5	Moist, rich, acidic soil.		$8.95/quart
Cardinal flower	*Lobelia cardinalis*	Sun to part sun		Moist, rich soil.	Hummingbird plant.	$10.95
Great blue lobelia	*Lobelia siphilitica*	Sun to part sun		Moist, rich slightly alkaline soil.		$10.95
Canada mayflower	*Maianthemum canadense*	Part to full shade	4-5	Strongly acidic, humus rich soil.		
Partridgeberry	*Mitchella repens*	Part shade to shade	4-5	Moist to dry, acidic soil with high organic matter content.	Ground cover, medicinal, edible	$8.95/quart
Wild bee balm	*Mondarda fistulosa*	Part sun to part shade		Moist soil.	Hummingbird plant	$10.95
Wild blue phlox	*Phlox divaricata*	Sun to shade	6-7	Varied sites.	Hummingbirds, butterflies	$7.95/4 inch pot

Wild sweet William	*Phlox maculata*	Part sun	6-7	Humus rich soil.	Hummingbirds, butterflies	$6.95/4 inch pot
Creeping phlox	*Phlox stolonifera*	Part sun		Humus rich soil.	Butterflies	$6.95/4 inch pot
Mayapple	*Podopyllum peltatum*	Sun to shade	4-7	Moist soil.		$7.95/4 inch pot
Solomon's seal	*Polygonatum biflorum*	Shade to part shade	4.5-5.5	Moist to dry, rich soil.	Rare and endangered in MA.	$8.95
Mountain mint	*Pycnanthemum muticum*	Sun to part shade		Moist to average soil.		
Black-eyed Susan	*Rudbeckia hirta*	Sun to part shade		Varied sites.	Butterflies	$10.95
Bloodroot	*Sanguinaria Canadensis*	Part shade.	6-7	Moist, rich soil.	Ground cover, medicinal, dye	$4.95/4 inch pot
Little bluestem	*Schizachyrium scoparium*	Sun to part sun		Poor, dry soil.	Grass. Rare and endangered in MA	$10.95
Wool grass	*Scirpus cyperinus*	Sun to part shade		Moist to wet soil.	Grass	$10.95
Three-square bulrush	*Scirpus pungens*	Sun to part sun		Wet soil.		$10.95
Wild stonecrop	*Sedum ternatum*	Sun to part shade		Well-drained, sandy soil.		$10.95
Indian grass	*Sorghastrum nutans*	Sun to part sun		Varied, non-wet sites.	Grass. Rare and endangered in MA	$10.95
Meadow rue	*Thalictrum dioicum*	Part sun to shade		Rich, moist soil.		$10.95
Foamflower	*Tiarella cordifolia*	Part to full shade	5-7	Rich, moist to dry soil.	Wetland	10.95/ ½ gal. pot
Purple trillium	*Trillium erectum*	Part shade	4.5-6	Moist, humus-rich, acidic soil.		
White trillium	*Trillium grandiflorum*	Part to full shade	6-7	Moist, slightly acidic soil.		$12.95/pint
Blue vervain	*Verbena hastate*	Sun to part sun		Rich, moist or wet well-drained soil.		$10.95
New York ironweed	*Vernonia noveboracensis*	Sun to part sun		Moist to average soil.		$10.95

*Rare or threatened in Massachusetts.
Plant names in bold were identified as popular or best selling by Tripplebrook Farm or Project Native.

Prices where available from Project Native and Tripplebrook Farm catalogs, 2006 and 2007.

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