GROWING NATIVE GINSENG FOR CONSERVATION AND PROFIT

NORTHEAST SARE FARMER/RANCHER GRANT FNE-03 498

FINAL PROJECT REPORT: DECEMBER 2006

1- Project leaders and contact information

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2- Project goals

In recent years, Dave has become concerned that wild Pennsylvania ginseng is being over-collected since it is becoming more difficult to find on local wild lands. This has led him to want to conserve wild Pennsylvania ginseng genetic stock for future generations of Pennsylvania ginseng growers.

With funding from the SARE program, Dave's goal for this project was to carefully document all of the activities as well as any problems associated with propagating locally sourced ginseng plants for seed. With assistance from Penn State, he wants to use this information to generate basic guidelines and budget information for farmers interested in growing (and conserving) ginseng through forest nursery seed production and sale.

3- Farm profile

The Thompson homestead has been in the family for over 50 years and includes twelve acres of woodland. Dave started "growing" wild ginseng more than twenty years ago on a very limited scale by planting seeds from local plants in small plots on his forestland. He has collected ginseng his whole life. For the past decade, he has continued to expand the amount of ginseng grown and harvested on this acreage to supplement off-farm income. With several acres of ginseng planted in his forest, it continues to be his primary crop.

The forestlands on his farm are typical of the region which is characterized by rolling hills covered by deciduous forest. Much of this land is too marginal for row-crop agriculture and so the application of *agroforestry* practices, such as ginseng cultivation, represents a good land use option. The fact that ginseng grows, or used to grow, throughout much of his region (including his farm) also supports forest cultivation of ginseng as a viable land-use option.

Dave will be eligible for retirement in fifteen years and would like to make ginseng farming and native seed production his principle activity and source of income To accomplish this, he is developing a 'conservation area' on his forestlands where he is planting wild-collected plants into controlled conditions (both within raised beds and non-raised beds) to collect seed for sale, distribution, and restoration.

4- Participants

Dave received guidance and assistance for this project from Eric Burkhart, Teaching/Research/Outreach Assistant for the Penn State School of Forest Resources. Eric guided documentation of activities, arranged and promoted outreach activities, and provided technical assistance when needed. He is also authoring a Penn State extension bulletin on ginseng husbandry for root and seed production (to be published January 2007). This bulletin will contain production guidelines based in-part on this project.

5- Project activities

In 2002, Dave began to set-aside a 'ginseng nursery area' on his forestlands and wild-collected ginseng plants were transplanted into this area beginning in 2003 to monitor growth and document seed yield. Two types of planting arrangements were attempted in the nursery:

1. Altered local forest conditions consisting of raised beds amended with local compost or rotted sawdust (a.k.a. *woods-cultivated* method)
2. Un-altered local forest conditions (a.k.a. *wild-simulated* method)

Dave collected the following information during this SARE project:

-Transplant survival and growth.
-Fruit and seed production
-Pest problems
-Time spent in activities

6- Results

Project results are divided into two categories: (A) plant growth and seed production; and (B) pest management considerations.

A- Plant growth and seed production

▪ Transplant survival

In spring 2004, Dave observed that approximately 500 plants were above soil/mulch line as a result of bed settling (subsidence) over the winter months. These transplants were evidently not planted deep enough to account for settlement of soil and mulch and were exposed during the winter months. All exposed plants were clearly rotten and thus had to be culled.

Based on this incident, Dave recommends that when transplanting ginseng into forest beds:

1- Beds should be pre-made to allow settlement prior to planting.
2- Roots should be planted at least 4-5 inches below the surface of the soil or mulch line after settlement.
3- Beds should be checked for additional soil settling and frost heaving during the first winter after transplanting to ensure that transplants have not been exposed.

▪ Reversion of ginseng stage-classes

Ginseng is known to proceed through a sequence of vegetative forms, or *stage classes*, as the species develops from juvenile to reproductive adulthood. In 2002, all of the transplants were either *three-* or *four-prongs*. In 2003, roughly 10% of these plants came up as *two-prongs*. This reversion of stage classes might have been caused by physiological stress associated with transplantation.

▪ Fruit and seed yields

Fruit collection occurred during August and September in each year.

In 2003, fruit and seed were collected from 2002 accessions and stratified following industry standards. 5,242 fruit were harvested in all, yielding 4,250 seeds. All seeds came from plants grown using raised beds.

There was no fruit and seed yield in 2004 since *Alternaria* blight caused all plants to die-back prematurely or abort fruit during the fruiting period.

In 2005, greater quantities of fruit and seed were produced and gathered from plants grown without the use of raised beds. Approximately 3,900 seeds were obtained from wild-simulated grown plants (i.e., unaltered forest conditions) versus 3,600 from woods-cultivated (i.e., raised beds) There were less plants in the beds which indicates a better yield from this type of production system; however, there was also significantly greater incidence of disease. There was no disease observed in wild-simulated plantings.

In 2006, disease and voles were a problem in raised beds and reduced yields from these plantings. Approximately 4,500 seeds were gathered---2,500 from plants grown in beds and 2,000 from plants grown in adjacent un-disturbed forest. There were less plants in the beds which indicates a better yield from this type of production system; however, there was again notably greater disease problems.

B- Pest and management considerations

- Wireworms

In May 2003, Dave observed root damage to a large number of transplants. This damage consisted of small root holes which in most cases were noted by the stunted or odd appearance of plants. In most cases, damaged roots led to plant death.

Eric suspected that nematodes were responsible and root samples were collected and sent to the Pennsylvania State University Nematode Diagnostic Laboratory. No plant parasitic nematodes were found. The staff entomologist suggested wireworm (the larval stage of click-beetles) might be the problem. There has been no confirmation of this.

We believe that the wireworms were introduced into the nursery through the use of poorly manufactured municipal compost added to several beds in late 2002. The compost was not used on other beds in the nursery and similar damage was not observed in these. Approximately 250 plants were lost to wireworms in 2003. No further problems were observed during 2004-06.

- Jumping plant-lice

During 2003-06, white aphid-like insects were observed aggregating on the inflorescence stalks (peduncles) of a number of ginseng plants throughout the nursery beds. Samples were collected for positive identification and Eric determined that they were jumping plant lice (also known as psyllids).

The occurrence of jumping plant lice on ginseng is problematic because, like aphids, these insects remove sap from plants. For seed growers, their presence on the seed head usually results in fruit and seed losses through fruit abortion.

This is the first known reporting of the potential for jumping plant-lice as pests on ginseng in Pennsylvania. Eric has been able to locate only one other mention of jumping plant lice on ginseng in eastern North America (Kentucky). These insects have also been observed on wild plants state-wide by Eric during various field researches 2003-06.

- Slugs

Slugs were a serious pest in the nursery during this project. In 2004, damage to plants (e.g., defoliation) was significant and so attempts were made to control slug numbers. For slug control, both "beer traps" (i.e., buried cups with beer in them) and "slug bait" (i.e., pesticide pellets) were used and did manage to help prevent defoliation of entire plants.

During 2005-06, slug bait was applied during appropriate times (wet, rainy weather and when scouting revealed evidence of slug defoliation). There were no significant problems following the use of slug bait.

- Alternaria foliar blight (*Alternaria panax*)

Foliar blight caused by *Alternaria panax* was a major problem during 2004. Initial spacing of plantings on 12-18 inch centers in nursery beds was intended to discourage the development of this fungal pathogen but apparently this did not work. The rapid development and spread of *Alternaria* blight in 2004 caused seed crop failure.

During 2005-06, fungicide applications were made every 10-14 days for three applications per year to prevent such losses from recurring. These applications limited disease problems, allowing a seed crop to be obtained.

- Voles

During 2005-06, voles became the primary pest via channeling through raised beds amended with sawdust. The voles consumed approximately 50% of the ginseng plants. There were approximately 6,000 plants being grown in raised beds amended with rotten sawdust; only about 3,000 remain at this time.

Poison bait helped but it was costly and needed to be re-applied frequently. Probably the best option is to not build beds with sawdust (which is loose and provides a good medium for vole channeling).

In late 2006, a mole/vole repellent was applied to raised beds. It is too early to tell if this will help curb vole problems.

7- Conditions

After three years of growing ginseng for seed, Dave feel's that the use of raised beds promotes pest problems. Any increases in seed production from the use of raised beds was more than offset by the fact that so many plants were lost to pests. Plants grown in adjacent woodlands, by contrast, were largely pest free although they did not produce as many seeds.

The annual weather conditions during this project varied from droughty (2003) to wet (2005). There were pest problems in every year, although disease problem were more prevalent in wetter years.

8- Economics

The time spent in various activities related to this project is summarized as follows (listed in descending order from most time spent to least):

A. Gathering local plants for planting into the 'nursery' (includes "search" time):
- 2003: 375 hours
- 2004: 750 hours
- 2005: 115 hours
- 2006: 100 hours
- Total time spent in this activity: 1,340 hours

B. Bed construction and maintenance:
- 2003: 260 hours
- 2004: 100 hours
- 2005: 55 hours
- 2006: 35 hours
- Total time spent in this activity: 450 hours

C. Pest control (includes weeds):
- 2003: 20 hours
- 2004: 40 hours
- 2005: 40 hours
- 2006: 40 hours
- Total time spent in this activity: 140 hours

D. Plant evaluation and monitoring:
- 2003: 15 hours
- 2004: 40 hours
- 2005: 40 hours
- 2006: 40 hours
- Total time spent in this activity: 135 hours

E. Fruit/seed collection and processing:
- 2003: 5 hours
- 2004: 0 hours
- 2005: 10 hours
- 2006: 10 hours
- Total time spent in this activity: 25 hours

The total seed yield in each year was:
- 2003: 4,250 seeds
- 2004: 0 (complete loss to fungal disease)
- 2005: 7,500 seeds
- 2006: 4,500 seeds

Using the costs and yields documented during this project, it would be unprofitable for anyone to grow ginseng solely for seed. However, there are important "lessons learned" that could help make such ventures profitable. These include:

A. The largest amount of time was spent obtaining local plants to use as nursery stock (i.e., seed plants). The first several years of seed produced from the nursery should be planted on site to increase "seed plant" stock. After several years of planting, there would be little need to obtain additional plants off-site and thus the cost incurred by obtaining nursery stock through local collection from forest lands would be eliminated.

B. There was significant loss of fruit and seed production due to fungal disease. If raised beds are used, growers need to be prepared to apply fungicides on a timely and proactive basis. This means that growers need to "scout" their plantings to look for disease symptoms at least bi-weekly (perhaps daily during periods when diseases are inclined to develop). It may also be necessary to apply fungicides proactively every 10-14 days, as a preventative measure depending on the weather conditions.

C. Growers who produce seed from local plants grown in local nurseries should try to command a "premium" for their seed, since most seed available on the market originates from non-local genetic stock grown under artificial shade in the mid-western United States and Canada. Because the quantities of seed may be less, seed producers should also sell their product in small quantities rather than large lots which generally to avoid low pricing due to economy-of-scale (i.e., cheaper prices as the quantity purchased increases).

D. Seed production is just one part of a forest based ginseng operation. Those who grow ginseng for root could harvest seed for sale to others. This would increase the overall profitability of ginseng forest farming, and provide annual income for a crop that takes many years to mature. However, growers need to find a balance between "pushing" plants for seed production and growing root that looks "wild," since the price for root can be significantly lowered by producing "cultivated" product.

9- Assessment

Based on this project, Dave urges those interested in growing ginseng for seed to recognize that the use of raised beds will require extra attention and care, compared to growing ginseng under "natural" (un-altered) conditions. Specifically, he observed many more pest problems when ginseng was grown for seed in raised beds. Pests observed during the project include fungi, insects and voles.

Dave's next step in this project is to re-construct several beds to use for seedling production (from seed gathered on site), abandoning the rotten sawdust that served to attract voles. He intends to grow seed plants under un-altered forest conditions, which will perhaps result in less seed yield per plant, rather than continue to have to invest heavily in pesticides. His goal is to have a nursery that produces a reliable crop of seed every year, and creating an environment less conducive to disease and pest problems are key to achieving this goal.

10- Adoption

A major finding of this project is that "pushing" ginseng to increase seed yields, particularly through the use of saw-dust and compost amended raised beds, creates many pest problems. Dave advises new growers to carefully consider if they have the time, money and desire to manage pests if they intend to "push" plants through the use of raised beds.

In coming years, Dave intends to abandon the use of raised beds and transplant many of the plants presently located in beds to favorable nearby un-altered forest locations. He will maintain several beds for seedling production and will annually plant freshly stratified seed into them. Plants will be grown for 2-3 years in these beds and then transplanted to nearby forest locations for seed and root production. He anticipates that he will lose some seed production through this method but would rather not deal with the losses and pest problems incurred by producing seed in raised beds.

Dave also wants to experiment with allowing jewelweed/touch-me-not (*Impatiens spp.)* to grow interspersed with his ginseng plants. From observations made during 2006, he believes that the jewelweed may provide beneficial shade in areas with too much sunlight as well as cover against deer browsing (the deer tend to eat only the jewelweed). The jewelweed does not appear to be over-competitive.

11- Outreach

Dave hosted a number of outreach events for this project with the support of SARE funds. Additionally, there were frequent visitors to the farm during each project year. Formal project-related outreach events include:

A. In each year (2003-06), the nursery was visited by students from the Penn State School of Forest Resources *FOR 418 Agroforestry* class. Students helped plant ginseng seed and were involved in other hands-on activities.

B. On May 29, 2004, a group of 15 international scholars and participants from an Indigenous Knowledge conference held at Penn State University visited the facility as part of a post-conference tour arranged by Eric.

C. On July 24, 2004 a full-afternoon workshop was held at PMG in cooperation with the Penn State School of Forest Resources and the Pennsylvania Association for Sustainable Agriculture (PASA). A total of 45 individuals attended this event.

Supporting materials are included with this report. These include a newspaper article about the July 27, 2004 workshop produced by Associated Press writer Dan Lewerenz. Also included are a copy of the flier for this workshop and exit survey results that PASA conducted of participant opinion of the workshop.

Eric (Penn State) is using information and experiences from this project in an extension bulletin that will be widely available free-of-charge to the public. This bulletin, entitled *Opportunities from Ginseng Husbandry in Pennsylvania*, will be available beginning mid-January 2007. Copies of this bulletin will be furnished to SARE at that time.

12- Report Summary

With funding from the SARE program, the goal for this project was to carefully document all of the activities as well as any problems associated with propagating locally sourced ginseng plants for seed. With assistance from Penn State, this information was used to generate basic guidelines and budget information for forest farmers interested in growing (and conserving) ginseng through forest nursery seed production and sale. SARE funds received for this project were used to cover labor costs associated with establishment of a privately-owned ginseng seed nursery (incorporated December 2003 as '*Pennsylvania Mountain Ginseng*' or PMG). Funds were also used to pay for costs associated with five public outreach events.

At the time of this final report (December 2006), the PMG forest nursery consists of nine raised beds containing approximately 3,000 ginseng plants. Additionally, several acres of forest with minimum site alteration/preparation contain an additional 7,000 plants. This collection comprises 30 accessions from 8 counties in Pennsylvania, with the bulk of the accessions coming from Central Pennsylvania forestlands.

Observations of transplant success, growth and seed yield were made during 2003-06. These observations suggest that while seed production may be enhanced through use of raised beds and soil amendments, these methods also tend to promote disease and pestilence resulting in significant losses. Ginseng planted in un-altered forest conditions tended to produce seed more reliably, primarily through minimizing disease and pest problems, than plants grown in beds with amendments. Based on this project, those who would grow ginseng for seed are advised to either adopt a "wild-simulated" production method or be prepared to aggressively attend to pest problems (likely requiring use of pesticides, particularly fungicides).

Report written by Eric Burkhart, in consultation with David Thompson, December 2006.

5

Forest Finance

Opportunities from Ginseng Husbandry in Pennsylvania

PENNSTATE

College of Agricultural Sciences

Agricultural Research and Cooperative Extension

Introduction

American ginseng (*Panax quinquefolius*) is a native forest plant whose root has been collected for centuries in Pennsylvania and the surrounding region. Much of the ginseng presently entering the marketplace is grown in field conditions under artificial shade, but the most sought-after and valuable ginseng root still comes from plants grown in the forests of eastern North America. With abundant forestlands and a climate well suited to ginseng, Pennsylvanians have a unique opportunity to produce some of the finest ginseng root in the world.

Ginseng husbandry as a business or hobby offers the following benefits:

- It can provide supplementary income.
- Depending on the individual commitment of time and labor, it may require little investment.
- It increases the productivity of forestlands.
- It helps restore and conserve a native plant species threatened by over-collection and other pressures such as land development and deer browse.
- If proper planning and care are taken, it will not damage the integrity, function, or aesthetics of the forest ecosystem.

In this publication, we provide basic information for landowners interested in ginseng husbandry on their forestlands. Included is a discussion of financial costs and returns associated with commonly followed methods for propagation and culture of ginseng on forestlands.

Ginseng as a Native Forest Resource

Although timber is typically considered the principal forest resource in Pennsylvania, the state's forestlands also harbor many other economically valuable resources whose encouragement (or cultivation) can provide landowners with additional income, as well as an interesting diversion.

Pennsylvania has a rich assemblage of native medicinal forest plants that have long been commercially exploited. In addition to American ginseng, other economically important species include goldenseal (*Hydrastis canadensis*), black cohosh (*Actaea racemosa* syn. *Cimicifuga racemosa*), and bloodroot (*Sanguinaria canadensis*). These species have been abundant throughout the Commonwealth, but diverse pressures including over-collection and land development have placed many of them in peril. Cultivation or other forms of husbandry (planting, tending, encouraging) on forestlands is a way for Pennsylvanians to help wild plant resources survive and thrive.

The practice of integrating woody and herbaceous plants into a single cropping system, referred to as *agroforestry*, can have multiple economic and ecological benefits, such as providing additional income, protecting soil and water quality, and enhancing biological and crop richness. The agroforestry practice of growing crops in established forest ecosystems is known as *forest farming*. Besides medicinal plants such as American ginseng, other forest-farmed products from Pennsylvania include maple syrup, craft materials (grasses, ferns, mosses, branches, pine cones, etc.), mushrooms, fruits and nuts, and vegetable plants such as wild leek (*Allium tricoccum*).

Although ginseng husbandry is a great opportunity for Pennsylvanians, it also has two major risks associated with it. First, ginseng reacts poorly to crowded circumstances. In dense plantings, fungal diseases develop and either halt growth for the season or kill plants. Establishing ginseng in dense plantings, therefore, requires frequent and costly pesticide use. Low-density plantings, however, are largely disease free and are, therefore, an alternative for the small grower or hobbyist who does not want to expend a lot of time, money, and effort. Second, it takes time to produce forest-grown root. The most prized roots are provided by plants ten years and older, and the age of a plant is easily determined in the marketplace by the appearance of its root. Consequently, forest husbandry requires many years of patience and attention since a great deal can go wrong between the time of establishment and harvest.

Despite these risks, ginseng is a native forest resource worth investigating if you are interested in the outdoors in general and in native plant propagation in particular. It is a fascinating and informative hobby with the potential to provide a significant source of income.

Ginseng Culture on Pennsylvania Forestlands

Biological Considerations

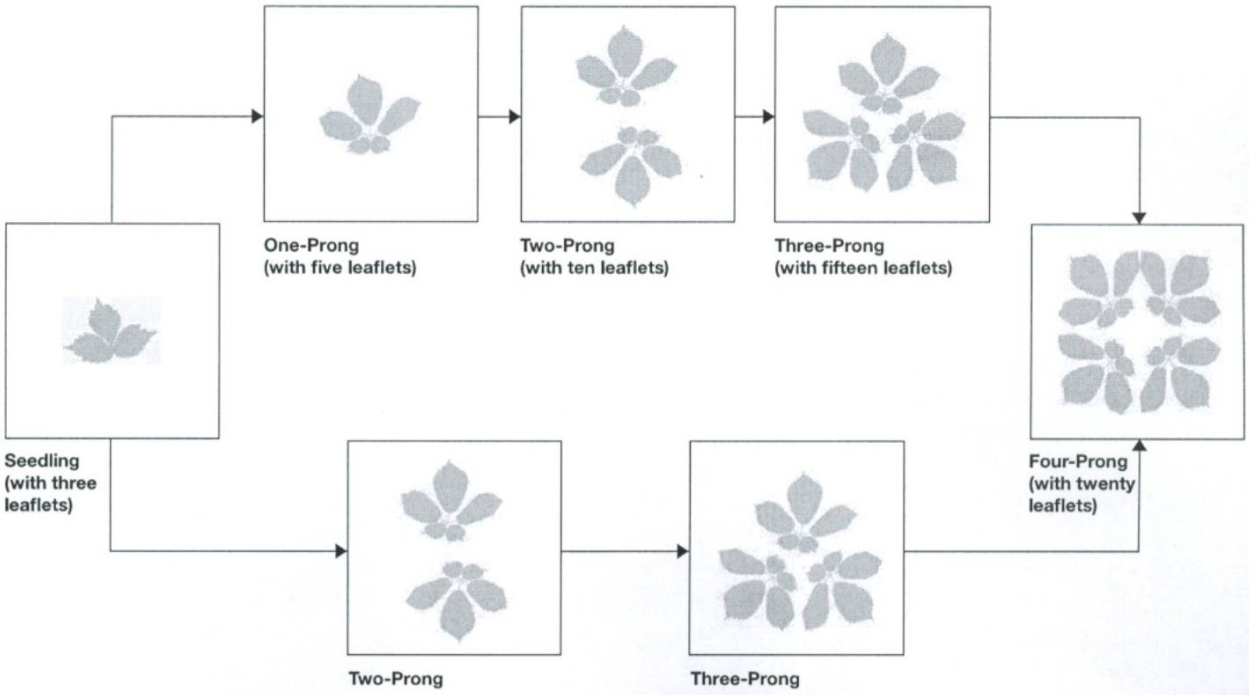
Vegetative

American ginseng is a perennial herbaceous plant, meaning that it grows for many years, but any aboveground portions (stems, leaves, etc.) do not persist over the winter months. As a plant ages, it progresses through a series of distinct stages (Figure 1). Since ginseng produces *palmately compound* leaves in which each leaf consists of one to seven smaller leaflets arranged around a central axis, each of its stages are identified by the total number of leaves (rather than leaflets) on a plant. In ginseng trade, a palmately compound leaf is commonly referred to as a *prong*. Through the course of development, the number of compound leaves increases. Thus, the stages in ginseng development are called *one-prong, two-prong, three-prong*, and so on, depending on leaf number.

Following germination, ginseng seedlings appear as small, three-leaflet (trifoliate) plants and remain in this growth stage for the entire first year. In subsequent years, the plants add leaflets, entire leaves, or both. Generally, the progression of vegetative growth is from seedling to one prong (with five leaflets); from one prong to two prongs (with ten leaflets); from two prongs to three prongs (with fifteen leaflets); and from three prongs to four prongs (with twenty leaflets). This progression may occur on an annual basis, or the plant may take many years to evolve from one stage to the next. Older ginseng stages are considered to be the three- and four-prong stages. It is rare to encounter more leaves than this on a plant, although five- , six- , and even eight-prong plants, for instance, have been documented from Pennsylvania forestlands.

While distinct growth stages are characteristic of ginseng development, they do not necessarily reveal the plant's specific age. For example, it is common to find old plants in the forest that are only in the two-prong stage and young plants that are in the four-prong stage. Many ginseng plants cultured under forest conditions attain the three-prong stage by the fifth year; however, the rate at which an individual plant proceeds through the vegetative stages of growth depends on the favorability of the site and climate. Under the best cultural conditions, plants attain more advanced growth stages in as little as four years. Given less favorable conditions, it may take as many as thirty years for plants to develop three or four prongs.

Figure 1. Growth stages in American ginseng.



Note: Illustrated here are two pathways of ginseng development. In the first, top, ginseng develops from a seedling to the one-prong stage. In the second, bottom, ginseng "skips" the one-prong stage and moves directly to the two-prong stage. Both pathways may be observed, although the latter is more common where better growing conditions exist. Plants may also develop more than four prongs, but this is uncommon.

The ultimate stage a plant attains is largely irrelevant in ginseng commerce; the age and appearance of the root are most important. Therefore, you should not become preoccupied with growing the "biggest" plants if root production is the primary goal. If, on the other hand, you are interested in seed production or establishing self-seeding populations, then it is desirable to encourage the rapid development of advanced stages because ginseng does not begin to flower (and fruit) until the two-prong stage. Advanced stages, such as three- and four- prong, contribute the most to population maintenance and growth through their relatively greater fruit and seed production. As a result, it is advisable to leave a number of these "seed plant" stages when harvesting wild-simulated plantings to ensure a supply of seeds.

Flowering and Fruiting

In Pennsylvania, the flowering period begins in early to mid-June and continues through mid-July. Flowers are clustered, and each flower is small with the potential to develop and ripen into a bright red *drupe.* In the ginseng trade, these fruits are referred to as *berries* or *seed pods* and mature during August and September. Ginseng is known to be both self- and cross-compatible, which means that plants do not need to be cross-pollinated for fruits and seeds to develop, although the process is beneficial for adaption to changing conditions over time.

Germination of ripened seeds requires eighteen to twenty-two months on average. During the process of seed dormancy, seeds must remain moist (not wet) and must be exposed to alternating cycles of cold/warm (simulating winter-summer cycles). If one or both of these *stratification* requirements is not met, seed viability and germination will be low and unpredictable.

Site Selection

Forest farming of native medicinal plants such as American ginseng requires an appreciation of how the *overstory* (the trees) influences the *understory* (the crop). With forest farming, the tree canopy should provide a favorable microclimatic and nutrient-cycling condition for plant establishment, growth, and reproduction. Locating the appropriate habitat is critical to success.

American ginseng is an adaptable plant that tolerates a wide variety of forest conditions. However, the best growth is obtained under a specific set of conditions. For example, ginseng is *shade-obligate* and requires tree and/or shrub coverage of approximately 60 to 90 percent shade. Under relatively low-light conditions (e.g., 90 percent shade), growth and development may be slow and fruit and seed productivity may be low. On the other hand, under relatively high light conditions (e.g., 60 percent shade), growth rate and productivity may be high—perhaps too high since rapid development can result in roots that have less desirable commercial appearance (i.e., they look "cultivated").

Similarly, the soil's specific physical and chemical attributes associated with wild ginseng growth in Pennsylvania vary considerably. Both historical and contemporary documentation of ginseng across Pennsylvania support the notion that the plant may thrive on a variety of soil types. In general, soils that appear most conducive to ginseng culture tend to be loamy, moist, high in organic matter, and slightly acidic (i.e., having a pH of 4.5 to 6.0). Research indicates that high calcium levels (e.g., more than 1,000 lbs per acre) may also enhance ginseng survival and productivity.

It is often the case that the best locations for establishing American ginseng plantings or gardens will be in terrain with a northern and/or eastern aspect. Aspect refers to the compass direction toward which a given topographic feature (e.g., hill or mountainside) is oriented. Aspect largely determines the duration and intensity of sunlight exposure and these, in turn, dictate temperature and moisture regimes in an area. In Pennsylvania, a north- or east-facing hill or mountainside will generally be cooler and moister than a south- or west- facing one since the latter receives more direct sun. Variations are common, such as when a mountainside faces south yet a drainage cutting through it contains northern/eastern-oriented microaspects. These "pockets" can be excellent locations for establishing ginseng plantings, even though the overall aspect of the area is not correct. Generally, such microaspects are recognizable because they differ in vegetation from the surrounding areas.

One of the most convenient and reliable methods for locating favorable ginseng habitats is looking for so-called *indicator species*, which are trees and plants that tend to grow in association with ginseng on forested sites. Table 1 gives the different trees, shrubs, herbs, and ferns that are often associated with ginseng in Pennsylvania—both in the wild and where successful introductions have been made. This information is drawn from field research conducted around the state over the past several years, as well as from grower and collector accounts. It is important to recognize that both overstory and understory indicators are important in evaluating a potential growing site. Choosing a location based solely on one (e.g., trees) or the other (e.g., herbs) is far less reliable.

Table 1. Vegetation "indicators" in Pennsylvania (and the region) that can be useful in identifying forest locations suitable for ginseng introductions and cultivation.

Because common names vary, the scientific name is given in parentheses.
Only the more reliable and easy to identify "indicators" are included in this table. There are many others that are either locally important, difficult to identify, and/or "weedy" (and thus not very reliable) that were not included.

Trees	Shrubs and small trees	Herbs	Ferns
American basswood *(Tilia americana)*	Blackberry *(Rubus spp.)*	Bellwort *(Uvularia spp.)*	Christmas *(Polystichum acrosticoides)*
American beech *(Fagus grandifolia)*	Blackhaw *(Viburnum prunifolium)*	Black cohosh *(Actaea racemosa)*	Ebony sleepwort *(Asplenium platyneuron)*
American elm *(Ulmus americana)*	Chokecherry *(Prunus virginiana)*	Bloodroot *(Sanguinaria canadensis)*	Intermediate wood *(Dryopteris intermedia)*
Big-tooth aspen *(Populus grandidentata)*	Hazelnut *(Corylus spp.)*	Blue cohosh *(Caulophyllum thalictroides)*	Maidenhair *(Adiantum pedatum)*
Black birch *(Betula lenta)*	Ironwood *(Ostrya virginiana)*	Dutchman's-breeches *(Dicentra cucullaria)*	Marginal wood *(Dryopteris marginalis)*
Black cherry *(Prunus serotina)*	Maple-leaf viburnum *(Viburnum acerifolium)*	Enchanter's-nightshade *(Circaea lutetiana)*	Rattlesnake *(Botrychium virginianum)*
Black walnut *(Juglans nigra)*	Musclewood *(Carpinus caroliniana)*	False Solomon's-seal *(Smilacina racemosa)*	Silvery glade *(Deparia acrostichoides)*
Eastern hemlock *(Tsuga canadensis)*	Prickly gooseberry *(Ribes cynosbati)*	Indian-turnip *(Arisaema triphyllum)*	Spinulose wood *(Dryopteris carthusiana)*
Eastern white pine *(Pinus strobus)*	Red elderberry *(Sambucus racemosa)*	Liverleaf *(Hepatican nobilis)*	
Northern red oak *(Quercus rubra)*	Spicebush *(Lindera benzoin)*	Mayapple *(Podophyllum peltatum)*	
Pignut hickory *(Carya glabra)*	Striped maple *(Acer pensylvanicum)*	Ramp/wild leek *(Allium tricoccum)*	
Red maple *(Acer rubrum)*	Wild hydrangea *(Hydrangea arborescens)*	Snakeroot *(Sanicula spp.)*	
Shagbark hickory *(Carya ovata)*	Witch-hazel *(Hamamelis virginiana)*	Solomon's-seal *(Polygonatum spp.)*	
Slippery elm *(Ulmus rubra)*		Squirrel-corn *(Dicentra canadensis)*	
Sugar maple *(Acer saccharum)*		Stoneroot *(Collinsonia canadensis)*	
Tulip-poplar *(Liriodendron tulipifera)*		Sweet-cicely *(Osmorhiza spp.)*	
White ash *(Fraxinus americana)*		Trillium *(Trillium spp.)*	
White oak *(Quercus alba)*		Violet *(Viola spp.)*	
Yellow birch *(Betula alleghaniensis)*		White baneberry *(Actaea pachypoda)*	
		Wild geranium *Geranium maculatum)*	
		Wild ginger *(Asarum canadense)*	
		Wild licorice *(Galium circaezans)*	
		Wild yam *(Dioscorea villosa)*	
		Yellow mandarin *(Disporum lanuginosum)*	

Keep in mind that while the use of indicator species is helpful, the specific plants used to identify favorable growing sites for ginseng will vary somewhat from region to region across the state. It is recommended that you experiment in a number of locations on your forestland to discover favorable areas and reduce the possibility of failure due to placing "all your eggs in one basket."

Ginseng Propagation

The planting of ginseng seed on Pennsylvania forestlands has been a common practice for at least a century; as a result, whether a given plant is truly "wild" is always open to question and speculation. Nevertheless, there are genetic considerations to keep in mind when "commercial" seed is used for planting efforts ("commercial" seed is purchased seed that originates from a nursery or farm—produced at a location distant from the planting site).

In practice, forest farmers should strive to maintain or increase genetic diversity in American ginseng. Where wild plants or populations already occur, it is best to use these preexisting plants for growing stock rather than introduce commercial sources into the area. Cross-breeding following the introduction of "nonlocal" genes could have adverse consequences such as the loss of any adaptive genetic characteristics present in local populations (e.g., disease resistance). Where there are no preexisting plants, and "commercial" stock is therefore the only option, you should seek out local or regional nurseries or farms. From a practical standpoint, the planting of locally or regionally sourced stock may prove more successful since it is generally going to be better adapted to the regional climate.

Ginseng may be grown or propagated from seed, from transplants grown from seed, or, less commonly, from root division (i.e., dividing the "neck"). The simplest and most economical method is propagation from seed since this method requires less time and labor and cost than root division and the results are more predictable.

Whether the seed originates from a local forestland or from a distant supplier, ginseng seed requires *stratification* before it will successfully germinate. Seed stratification in ginseng means that the seed is exposed to alternating periods of cold and warm temperatures over twelve to sixteen months in a manner that replicates seasonal temperature patterns. Most commercial seed suppliers sell only stratified seeds eliminating the need to stratify; however, collected seed must either be planted immediately or stratified if planting is to be delayed for an extended period. Perhaps the most important thing to remember in either case is that *ginseng seed must never dry out; it needs to be kept moist at all times or viability is reduced.*

Two- or three-year-old ginseng transplants, or rootlets, are grown from seed by commercial suppliers for transplanting into forestlands. The advantages of using transplants are that they reduce the production period and growers can better anticipate plant spacing. The biggest disadvantage is the higher cost. When compared to the cost of seed, transplants are much more expensive at $0.50 to $1.50 per root. If you are just starting out, it may be desirable to purchase a mixture of both seed and transplant materials in order for you to realize the advantages of using transplants without incurring large initial investment costs.

A third method for propagating ginseng is to divide the root or rhizome. Ginseng collectors have often propagated plants by separating the rhizome, or "neck," from an existing root and replanting it. While this method is not entirely reliable, research has demonstrated that vegetative propagation by root division is indeed successful much of the time. The largest obstacle to the broad use of this method is a federal requirement that the neck be retained on root sold to buyers because it is used to age the root. Also, because root age is important with respect to its market value, an intact root is also favored by buyers. Thus, while propagation by root division is appropriate for some purposes, such as increasing numbers of genetically identical plants for seed production, it is not recommended if your sole objective is to produce root that is legally and economically acceptable.

Approaches to Ginseng Forest Farming

In ginseng forest farming, there are two approaches: (1) the woods-cultivated approach and (2) the wild-simulated approach. The woods-cultivated approach generally requires more labor and time because it involves more intensive production techniques, such as the use of raised beds, fertilizers, and pesticides. The wild-simulated approach follows a less-intensive strategy that may involve nothing more than planting seed in suitable locations. Depending on grower objectives, both approaches can be useful in forest farming. Moreover, the distinction between these two approaches is one of convenience; your approach may involve elements of both.

Woods-Cultivated Ginseng

The woods-cultivated approach takes advantage of the natural forest ecosystem for shade and microclimate, but it also modifies understory site conditions to provide a more favorable habitat for plant establishment and management. This approach usually involves more investment in equipment, materials, time, and labor than the wild-simulated approach. A common component of the woods-cultivated approach is the use of raised growing beds. Raised beds allow for concentrated plantings around which establishment and maintenance activities are centered. The woods-cultivated approach is often used to establish plantings that provide a source of seed or transplants for wild-simulated stocking efforts.

Before creating raised beds, it is wise to consider the suitability of the terrain for such "improvements," especially if you plan to use farm or garden equipment. For example, beds should not be situated on slopes that would compromise safety or ecological integrity (e.g., the potential for soil erosion). Similarly, areas where many tree roots or large rocks occur at the soil surface are difficult for intensive cultivation since they can create difficult and hazardous conditions for the use of mechanical equipment.

A simple way to create a raised bed is to till or dig an area slightly larger than the desired bed width and use the outside soil to build up or hill the center. For instance, to create a raised bed with a desired width of four feet, you would till or dig an area six to eight feet wide and use the outer one or two feet, respectively, of loosened soil to mound the center of the four-foot-wide bed. The additional soil is necessary to create a rounded or domed bed, which will allow the bed to shed excess moisture more readily during a rainstorm. Ginseng plants are extremely susceptible to a number of fungal diseases where moisture or wet conditions persist.

Once the bed is shaped, the soil can be amended as desired with limestone (for pH adjustment), gypsum (to supply calcium), or organic amendments such as well-rotted sawdust or compost. If a fertilizer is applied, it should be a low-analysis fertilizer (e.g., 5-5-5) since heavy fertilization can encourage disease problems as well as a final product that looks "cultivated."

Raised forest beds can be seeded at any density, but roughly one or two years after seeding, plants should be thinned to one or two plants per square foot or less. If seed production is the primary goal, wider spacing is desirable to encourage plant productivity and simplify berry harvesting. If transplant production is the goal, seedlings should be maintained in dense plantings until about the third or fourth year, at which time they can be transplanted. It is not advisable to maintain dense plantings beyond the fourth year of growth because fungal diseases almost always begin to appear by this time. Nor is it advisable to transplant first-year seedlings since they are often too fragile to endure the stress of handling and relocation.

The woods-cultivated system's primary advantages are that plant and root growth are hastened and cultivation is convenient and organized. The main disadvantages of this approach are its high incidence of disease problems and greater investments in materials and labor. Also note that if your goal is root production, as opposed to seed or transplant production, the ultimate return on the investment depends largely on the ability to manage the crop so that the final root appears "wild" rather than "cultivated." Woods-cultivated root can be discerned on the market by experienced buyers, and its value can be well below wild or wild-simulated product value.

Wild-Simulated Ginseng

The wild-simulated approach to growing ginseng involves thinly sowing seeds in the forest and leaving them to grow with minimal human influence. In this approach, the goal is to establish and maintain "wild" populations. This approach is the easiest and least expensive to follow, but it is also the slowest and, perhaps, most unpredictable. Depending on your preference and motivation, this approach may involve little care or maintenance, and the chief investment will be seed for planting. With wild-simulated plantings, the importance of forest-site selection cannot be overstated.

Once a promising location has been identified, some of the vegetation from the forest area(s) may be thinned before planting. The objective is to remove any potentially interfering plants without adversely altering the site's quality and ecology. You may choose to remove any undesirable overstory or understory trees and shrubs to keep with the overall forest management goals and plans. Exercise caution because removing too much of the overstory or understory may expose the location to too much sunlight. It may also increase germination and competition from other plants. Any thinning should seek to maintain about 65 to 70 percent shade in the vicinity of ginseng plantings.

Little or no soil preparation is required in the wild-simulated approach, nor are there raised beds. Instead, seeds are sown by (1) individually hand-planting by pushing seeds about one inch deep into the mineral soil; (2) brushing aside leaf litter with a rake, scattering seed, and then replacing the leaf litter; and/or (3) using a specialized

seed planter such as a seed spreader or "seed stick" (hand-held, jab-type planter with an attached hopper). If done properly, all of these methods create minimal disturbance to the forest environment and can easily be accomplished without much expense. Methods that require more individual care per seed (such as hand-planting) will require more time, but this care also tends to improve seed survival and establishment success.

Ideally, seed planting is done in autumn just before leaf fall; however, planting can extend from late summer through early winter. Although the plants should ultimately be grown at a low-density spacing to reduce the potential for disease problems, the initial seeding rate can be relatively high since many seedlings will be lost over time. For example, while the final spacing may be roughly one plant per one to three square feet, the initial seeding rate may be as much as four seeds per square foot. In general, you should expect to lose one seedling per year for the first three years following establishment. Where seedling survival is great, plants are moved or thinned as desired.

After planting, wild-simulated plantings are left to "Mother Nature" and thinning and culling generally occur naturally. Any weeds or undesirable plants that appear after planting can be thinned periodically to reduce competition, but avoid the use of herbicides and fertilizers. Additional seeds and seedlings can be planted, perhaps yearly, to ensure a continuous harvest and to replace any seedlings lost to slugs or other pests. On favorable sites, additional seed and seedling recruitment is likely to come from existing plants as they attain reproductive age. Tending these patches by planting berries and seeds will help ensure continuous recruitment and a perpetual harvest.

The wild-simulated approach to growing ginseng has several characteristics that make it especially attractive as a forest-farming venture. First, there is no need to invest large amounts of money or labor. Second, there is a noticeable decline in the incidence of disease in such plantings, thereby virtually eliminating the need for pesticides (an important benefit for those seeking organic certification). Third, the price-per-pound returns for wild-simulated products are generally greater than for woods-cultivated products due to the often "wilder" appearance. Finally, this approach has little or no impact on the forest ecosystem, and you can, therefore, utilize the forest while conserving it at the same time.

The main disadvantages of the wild-simulated approach are the unpredictable results that can come from simply scattering seeds in the woods and the length of time required to obtain harvestable products (often as long as nine to ten years). However, these challenges practically ensure a strong market for such products and, thus, a place for the patient forest farmer as a supplier.

Woods-Cultivated versus Wild-Simulated Forest Farming Methods: Costs and Revenues Compared

Once the decision to grow or husband ginseng on forestlands has been made, the next step is to decide how much time and money to invest. No matter what your depth of interest is, you should begin by considering the following questions:

1. What other income opportunities or activities could I carry out in my forest?
2. Which approach will I use to produce ginseng?
3. Will I make money?
4. Do I have the time, patience, and labor to do it?

As a forest-farming venture, ginseng husbandry can be pursued as a hobby or as a serious income generator. However, before starting a ginseng venture, it is important to gather information about current costs, expected yields and revenues, and other factors that affect profitability. An *enterprise budget* is a simple financial tool to determine profitability. The costs are subtracted from the expected revenues to provide an idea of profitability.

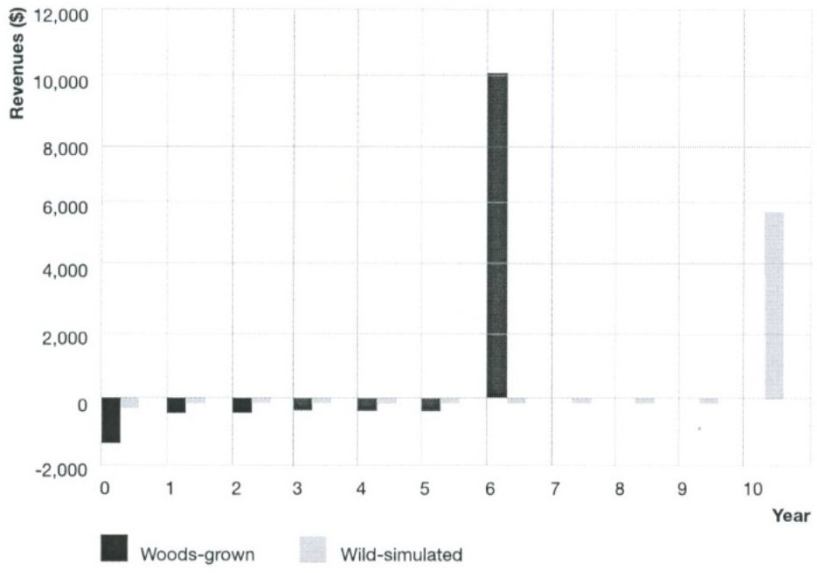
In developing enterprise budgets, revenues occur in future years; thus, their actual value may differ considerably from that of expected revenues. To account for this uncertainty, you can adjust numbers, such as yields or prices, and see how these changes affect profitability. In terms of costs, you should include the time and labor required to prepare the site, plant seeds, maintain the crop, harvest the plants, and dry the harvested product.

The following section provides example enterprise budgets for woods-cultivated and wild-simulated ginseng husbandry approaches on a one-tenth-acre (approximately 4,350 square feet) tract of forestland. Table 2 gives comparative costs and revenues for the two husbandry approaches while Figure 2 is a cash-flow diagram illustrating costs and revenues for both approaches to ginseng forest farming.

Table 2. Comparison of ginseng production methods on one-tenth of an acre.

	Woods-Grown	Wild-Simulated
Number of Years to Harvest	5	10
Costs		
Seed	$225	$225
Labor	$2,300	$1,500
Equipment/Materials	$500	$100
Total Costs	$3,025	$1,925
Revenues		
Yield (lbs)	72	18
Price/lb	$150	$350
Total	$10,800	$6,300
Net Revenue	$7,775	$4,375
Discounted Net Revenue at 4% Interest Rate	$6,390	$2,956

Figure 2. Hypothetical cash flow for the two ginseng production methods.



Woods-Cultivated Ginseng (One-Tenth Acre or 4,350 Square Feet)

Cost Assumptions

Seed: $225

One-tenth of an acre (about 4,350 square feet) allows for nine 5-by-80-foot (width by length) raised beds. Using this arrangement, each bed covers 400 square feet of planting space for a total planting space of 3,600 feet. The remainder of the area (about 750 square feet) is used as walkways and to accommodate tree roots, watercourses, boulders, and so forth.

Woods-cultivated ginseng grown from seed will require at least five years to yield a marketable product. You might want to plant four seeds per square foot, which would require 1,600 seeds per bed (4 seeds x 400 square feet). An average germination rate is 75 percent, meaning that approximately three out of every four seeds should become established.

For a one-tenth-acre plot, 1,600 seeds per bed multiplied by nine beds requires 14,400 seeds. One-pound of ginseng seed contains 6,500 seeds on average and can be purchased at an average price of $90 (range: $45 to $130). You will need 2.5 pounds of seed to adequately plant all nine beds for a total seed cost of $225.

Labor: $2,300

Site preparation and planting will take an estimated 60 hours on a one-tenth-acre forested bed. Maintenance is estimated at 25 hours per year or 125 hours for five years. In the final year, harvesting and preparing the roots for sale (cleaning and drying) is estimated at 45 hours. Assuming labor costs $10 per hour over five years for a total of 230 hours, the total labor costs are $2,300.

Equipment and Materials: $500
Equipment such as a rake, digging tools, backpack sprayer, and drying equipment are fixed costs that are a one-time investment and do not increase with acres planted. A rototiller is another fixed-cost item ($700 to $1,500), which is optional and not included in this example. Materials such as pesticides (e.g., fungicides) may also change the investment because they vary by the amount of land planted and the extent of problems. For this example, costs are estimated at $500.

Total Costs = $3,025

Yield and Revenue Assumptions

Revenue: $7,775 ($6,390 After Discounting)
In this example using the woods-cultivated approach to growing ginseng, an estimated 100 ginseng roots are contained in a dried pound. Assuming survival of two (out of four) seeds initially planted per square foot, yields are estimated at 800 roots per bed. Using these same assumptions for all nine beds, 7,200 roots would be harvested on one-tenth of an acre for a total of 72 dry pounds. Current prices for woods-cultivated ginseng range from $25 to $300 per pound depending on how "wild" the final product looks. Using an average price of $150 per pound, the gross revenues over a five-year period are $10,800. Subtracting total costs of $3,025 leaves a net revenue of $7,775 per one-tenth acre. This translates to $77,750 per acre.

The process of determining the value of an investment over time is referred to as *cost-benefit analysis.* In this process, future values are discounted to the present and provide what is referred to as net present value, which is simply the discounted sum of all costs and revenues incurred over the life of the investment. All future costs and future revenues are discounted to the present by a formula that involves selecting an acceptable interest rate (as is done with a savings account or stock investment). Because costs and revenues from growing ginseng will be realized in the future (five years or more), you should keep in mind that a dollar today is worth more than a dollar in future years. This is simply due to the time value of money and is why we have interest rates. Think about a bank account and the interest you might earn on $100. If the interest rate is 4 percent, you will have $104 in one year. The same process works with investing in ginseng. Future revenues need to account for the value of money over time. In this example, the future value of the investment in woods-cultivated ginseng without discounting is $7,775 on a one-tenth acre. After applying a discount rate of 4 percent, however, the net present value over five years of this investment is actually lowered to $6,390 (Table 2). The venture is still profitable but not quite as profitable when a time factor is included.

Using a larger interest rate, such as 7 percent, would make the investment even less profitable. The question is how much more profitable is it compared with alternative investments such putting money in a bank account and earning a 4 percent return or when compared with the wild-simulated approach to ginseng husbandry? While this deliberation may not be important if ginseng husbandry is simply a hobby, it is something that should be seriously considered when pursuing ginseng husbandry as an investment venture.

Wild-Simulated Ginseng (One-Tenth Acre or 4,350 Square Feet)

Cost Assumptions

Seed: $225
One-tenth of an acre (about 4,350 square feet) provides 3,600 feet of planting space after allowing for have many tree roots, watercourses, boulders, debris, and so forth in the area. Raised beds are not used in this approach to growing ginseng, so seed will be scattered throughout the plot.

Wild-simulated ginseng will require at least eight to ten years to yield a marketable product. You might plant four seeds per square foot for a requirement of 14,400 seeds, with the understanding that one plant per square foot should be the eventual spacing (to avoid disease and other problems resulting from overcrowding). This assumes an average germination rate of 75 percent, meaning that approximately three out of every four seeds should germinate and become established. You will need 2.5 pounds of seed to adequately plant the area; therefore, the final cost for seed is $225.

Labor: $1,600
Preparing the site and planting the ginseng will take an estimated ten hours. Inspection and maintenance will be minimal, but biweekly checks over the ten years will still take about 100 hours of total time. Harvesting, cleaning, and drying the roots will take about fifty hours. This is a slightly longer time estimate for processing the harvested products than for the woods-cultivated approach because wild-simulated roots require more effort to free them from tree roots, rocks, heavy soil, and so on. Therefore, the labor costs at $10 per hour will total $1,600 for this approach.

Equipment and Materials: $100
Again, equipment such as a rake, digging tools, and drying equipment are fixed costs that are a one-time investment and do not increase with acres planted. Total costs are estimated at $100 since little equipment is required for preparation of wild-simulated planting areas. Additionally, the major costs incurred with woods-cultivated culture is due to the likelihood of disease (fungal) problems and the associated need for a backpack sprayer, fungicides, and protective clothing. With the wild-simulated budget projected here, there will be no use of fungicides.

Total Costs = $1,925

Yield and Revenue Assumptions

Revenue: $4,375 ($2,956 After Discounting)
Roots grown via the wild-simulated approach are generally smaller than with the woods-cultivated approach, with about 200 roots contained in one dried pound. The 3,600 roots harvested total 18 pounds. Current prices for wild-simulated ginseng range from $200 to $500 per pound. Using an average price of $350 per pound, the value of the crop in ten years is $6,300 per one-tenth acre. Subtracting costs ($1,925) leaves a profit of $4,375 on one-tenth of an acre. This would be equivalent to over $43,750 for an acre.

Using the same discounting procedure mentioned in the woods-cultivated example, and assuming a 4 percent discount rate over ten years, net present value of the investment on one-tenth acre is $2,956. By comparing the two systems after discounting, the woods-cultivated method would be more profitable, even though the wild-simulated approach is more inexpensive and the product is worth more per pound. This is primarily because of the longer growing period for wild-simulated ginseng, which requires ten years for the investment to "mature" and demands labor and attention (albeit less) during this additional time. Keep in mind that the price paid for wild-simulated ginseng may increase over the growing period as it has done historically. Consequently, such increases may outpace any discount rate you have set, and the investment could be more profitable than anticipated.

Table 3. Estimated yield in pounds of American ginseng per one-tenth acre (about 4,350 square feet) resulting from plant spacing and average final root weight.

Average Root Weight (fresh or dry)	Plant Spacing (number of plants per square foot)					
	6-inch (2)	12-inch (1)	18-inch (< 1)	24-inch (< 1)	36-inch (< 1)	48-inch (< 1)
1.0 gram	19.2 lbs	9.6 lbs	6.4 lbs	4.8 lbs	3.2 lbs	2.4 lbs
2.0 grams	38.4 lbs	19.2 lbs	12.8 lbs	9.6 lbs	6.4 lbs	4.8 lbs
3.0 grams	57.6 lbs	28.8 lbs	19.2 lbs	14.4 lbs	9.6 lbs	7.2 lbs
4.0 grams	76.8 lbs	38.4 lbs	25.6 lbs	19.2 lbs	12.8 lbs	9.6 lbs
5.0 grams	96.0 lbs	48.0 lbs	32.0 lbs	24.0 lbs	16.0 lbs	12.0 lbs
6.0 grams	115.2 lbs	57.6 lbs	38.4 lbs	28.8 lbs	19.2 lbs	14.4 lbs
7.0 grams	134.4 lbs	67.2 lbs	44.8 lbs	33.6 lbs	22.4 lbs	16.8 lbs
8.0 grams	153.6 lbs	76.8 lbs	51.2 lbs	38.4 lbs	25.6 lbs	19.2 lbs
9.0 grams	172.8 lbs	86.4 lbs	57.6 lbs	43.2 lbs	28.8 lbs	21.6 lbs

One pound (lb) = 453.6 grams (g); one ounce (oz) = 28.35 grams
This table can be used for estimating fresh (green) or dry root weight. Fresh weight loses roughly 70 percent weight upon drying (e.g., a 9-gram fresh root = 2.7 grams dried; 21.6 fresh pounds = 6.5 dried pounds).

The Economics of Ginseng Husbandry: The Bottom Line

Comparing the two systems shows clear differences in costs and revenue (Table 2). Woods-cultivated ginseng requires more labor for making beds, greater attention to maintenance, and increased equipment/material costs. However, the woods-cultivated approach receives revenue at around five years as opposed to at least ten years for wild-simulated ginseng, and yields are generally much greater than for wild-simulated ginseng. Although you may do the work yourself, it is important to consider labor costs. Obviously, not including the labor costs makes both investments substantially more attractive, especially the woods-cultivated approach.

Wild-simulated ginseng offers the possibility of turning a fair profit from less investment in labor or money. The trade-off to this approach is that you must generally wait longer (nine to ten years) to harvest. Additionally, yields will generally be lower due to the smaller size and weight of individual roots and less-crowded planting arrangements.

In the enterprise budget developed, revenue was calculated using assumptions about plant spacing and yield. Naturally, yields will vary considerably as a function of individual root weight and plant density (spacing). More roots will be needed per pound as size and weight per root decreases, and vice versa. Similarly, fewer plants in an area, due to wider spacing, will also reduce yields. Table 3 is included for estimating yield potential from a one-tenth-acre planting as determined by plant spacing and weight per root. This table can be used to see how such factors will increase or decrease yields—and, thus, revenues.

The calculations provided are an example and are only a guide to the potential costs and revenue that you might encounter. They do not reflect economies of scale. As the operation increases in size, the costs for certain supplies tend to decrease since quantity discounts begin to apply. Nor do these calculations reflect excessive losses from rodents, slugs, insects, fungal diseases, weeds, and theft. Also note that in terms of revenue, in recent years prices have remained low for woods-cultivated roots that appear similar to field-grown products (i.e., cultivated). At the same time, prices for wild-simulated roots that closely resemble "wild" products continue to climb. Thus, the best investment prospects may actually be found with the wild-simulated approach, even though the discounted returns are slightly lower when compared with the woods-cultivated approach.

Forest farmers selling to domestic consumers in farmers' markets and shops may want to develop value-added ginseng products. Dried ginseng slices soaked in honey or maple syrup, jellies, ginseng beer, and candy are examples of marketable products. Growers can also make teas and tinctures (i.e., alcohol extracts) with low-grade roots (damaged or cultivated in appearance) in order to make the most of their investment. There are also "niche" markets, particularly in urban areas, for fresh root.

Obtaining organic certification may increase market access, but the cost of certification should be weighed against any perceived price gains. Generally, no premium is paid for organically certified roots within the international wholesale ginseng market. On the other hand, many domestic herbalists and consumers seek organically grown ginseng root and care much less about "wild" appearances. Organic certification might, therefore, be a good option for domestic market growers.

Ginseng Husbandry for Planting Stock

Once ginseng plantings are established and begin to reach reproductive stages, they can be tended for seed production and the seeds used for planting. Picking and stratifying your own seed saves money that would have otherwise been required to buy additional planting stock and will, therefore, enhance profitability. If producing your own seed is not important or cost effective, then plants can be *deflowered* (the flower heads pinched off) as they begin to bloom. This tends to favor root weight gain.

Many growers create beds specifically for seed production and encourage or "push" plants to yield large numbers of berries and seeds. In general, plants can be encouraged to produce seed by (1) amending the soil with a

Table 4. American ginseng seed yields resulting

Number of Plants	Single-Seeded Berries 5	10	15
25	125	250	375
50	250	500	750
100	500	1,000	1,500
200	1,000	2,000	3,000
350	1,750	3,500	5,250
500	2,500	5,000	7,500
650	3,250	6,500	9,750
800	4,000	8,000	12,00
1,000	5,000	10,000	15,00

** Ginseng may produce three-seeded berries, but single- and d
One pound (lb) of American ginseng seed contains 5,000 to 8,0
One pound (lb) of American ginseng seed (stratified) typically sel

low-analysis fertilizer (e.g., 5-5-5); (2) thinning the forest canopy layers to allow more light penetration (e.g., 50 to 60 percent shade); and (3) watering or irrigating plants, especially during fruit set. These activities can also encourage disease problems, so a balance must be struck between "pushing" plants and establishing conditions in which plants thrive and are fruitful. Site selection is very important in this regard.

Regardless of how plants are grown, they will need to be protected from seed predators such as turkeys, deer, chipmunks, and mice. All of these animals can "clean out" a patch or garden in days or even hours. How you elect to protect a seed crop will depend on many factors including the scale of the problem, the location of the garden, and time and money needed to do so. For example, a simple deterrent for deer and turkey is made by piling up brush around plants or beds; alternatively, a fence could be erected.

Managing ginseng plantings for seed production can generate annual income if the forest farm is large enough and if seeds are harvested and processed following commercial standards. Most planting stock currently comes from large-scale, artificial-shade operations situated in the Midwest and southern Canada. Forest nurseries offering regionally or locally sourced stock (i.e., "native" to an area) are in demand, and growers of such stock usually have no trouble selling seed and transplants.

Table 4 can be used to estimate seed yield from a forest farm geared toward nursery production. In this table, seed yield is determined by the number of plants in a garden, bed, or area and the number of seeds produced per plant (according to whether berries are single or double seeded). For example, in a garden of 300 plants, 200 plants yielding 20 double-seed berries and 100 plants yielding 15 single-seed berries each would be expected to provide a total seed yield of 9,500 (8,000 + 1,500)—the equivalent of about 1.5 pounds of seed. You can use this table to estimate revenue that could be generated from seed sales by determining the expected number of pounds of seed (seed yield divided by number of seed per pound) and then the economic return (pounds of seed multiplied by price per pound).

ɜ from variation in number of plants and number of berries (and seeds per berry) produced per plant.

	Berry Yield Per Plant**								
				Double-Seeded Berries					
	20	25	50	5	10	15	20	25	50
	500	625	1,250	250	500	750	1,000	1,250	2,500
	1000	1,250	2,500	500	1,000	1,500	2,000	2,500	5,000
	2,000	2,500	5,000	1,000	2,000	3,000	4,000	5,000	10,000
	4,000	5,000	10,000	2,000	4,000	6,000	8,000	10,000	20,000
	7,000	8,750	17,500	3,500	7,000	10,500	14,000	17,500	35,000
	10,000	12,500	25,000	5,000	10,000	15,000	20,000	25,000	50,000
	13,000	16,250	32,500	6,500	13,000	19,500	26,000	32,500	65,000
0	16,000	20,000	40,000	8,000	16,000	24,000	32,000	40,000	80,000
0	20,000	25,000	50,000	10,000	20,000	30,000	40,000	50,000	100,000

ouble-seeded are more common.
)0 seeds (average = 6,500).
ls for $50 to $125.

Marketing and Legal Considerations

Good digging, drying, and handling practices are essential to maximizing product quality; the price received can be greatly reduced by improper or hasty postharvest practices. Care should be taken when digging and cleaning roots to keep them intact. It is not necessary to scrub roots; generally, a good rinsing will suffice. Freshly rinsed root should be dried in a warm location (70 to 95°F), with plenty of air circulation and low humidity. Roots dried too quickly will have a yellow-brown stain inside, which is undesirable. If dried too slowly, mold may form on product. The process of drying roots can take a week or more to complete. Look for roots to break cleanly when thoroughly dried.

There is an established market for forest-grown ginseng, and there is little problem finding a willing buyer. Many buyers aggressively seek out producers through newspaper and magazine ad placements. In this market, it is important for ginseng producers to earn a fair price from their efforts. Because ginseng gains monetary value with age, it can be kept in the ground until market conditions are acceptable or income is needed. Prices will fluctuate annually, but by keeping abreast of the market, growers can wait until prices are satisfactory before making a sale. Current price information can be obtained from ginseng buyers throughout Pennsylvania and the region.

Ginseng buyers use many characteristics to determine the value of ginseng root. The main features assessed are root size, weight, shape, color, and age. Experienced buyers pay less for "cultivated-looking" roots, no matter where they are grown (field or forest). Intensive husbandry practices result in plants that grow faster and more luxuriously, yielding a product that is "cultivated" in appearance. Unlike many conventional horticultural crops, the highest return from ginseng root is based not on its size but on its "wild" characteristics.

American ginseng is presently listed in Appendix II of the Convention on International Trade in Endangered Species of Flora and Fauna (CITES). This listing requires that the U.S. Fish and Wildlife Service (USFWS) monitor ginseng trade and ensure such exports do not compromise ginseng's existence in areas where it is naturally found. At the state level, the Pennsylvania Department of Conservation and Natural Resources (DCNR) is responsible for gathering data on ginseng harvest and trade. To sell ginseng in Pennsylvania, growers should locate an individual or business that has a state-granted vulnerable plant license or obtain a license themselves. A list of currently registered ginseng buyers is available from DCNR upon request or via the Internet (Web address provided at the end of this publication). Growers need to recognize that it is unlawful to transport ginseng across state boundaries for sale elsewhere without first obtaining a vulnerable plant license; this regulation has been established in order to better track the state's ginseng resource, and violations can bring stiff state and federal penalties.

There are also regulations that govern ginseng collection at the state level, and growers should familiarize themselves with these since they can impact harvesting and marketing plans. Ginseng growers can find the most complete and up-to-date information on Pennsylvania ginseng management efforts and regulations via the DCNR's vulnerable plant Web site (see link at the end of this publication). Readers are also encouraged to obtain the companion publication to this, *Nontimber Forest Products from Pennsylvania 1: American Ginseng*, as it reviews and explains Pennsylvania ginseng regulations in considerable detail (see "For Further Information" Section on page 15).

Conclusion

American ginseng has been harvested for at least two centuries in Pennsylvania, and people continue to seek wild plants for sale and personal use. Forest farming is one approach to ginseng stewardship and conservation. Although it is not an easy or risk-free crop to grow, its income-generating potential provides an opportunity for Pennsylvania's forestland owners. Ginseng husbandry is an activity that can help conserve a native plant resource while giving forestland owners a chance to become better acquainted with Pennsylvania's rich biological heritage.

Forest farming of ginseng, as part of an integrated forest management strategy, can supplement forest revenues from other sources (e.g., timber) and offset costs such as annual property taxes. As the American and European public become more aware of ginseng and its health benefits, the demand for ginseng should increase in an already strong market driven by Asian consumption. Root from eastern North American forestlands is especially sought after since these areas have soils and a climate particularly well-suited to growing high-quality ginseng.

For Further Information

The following Web sites provide information related to American ginseng and ginseng husbandry:

- Pennsylvania Department of Conservation and Natural Resources (DCNR)

  Contains information specific to ginseng in Pennsylvania, including regulations, news, educational opportunities, and buyer contact information.

  http://www.dcnr.state.pa.us/forestry/wildplant/vulnerable_plants.aspx

- U.S. Fish and Wildlife Service (USFWS)

  Contains information about ginseng in North America, including CITES participation requirements.

  http://www.fws.gov/international/animals/ginindx.html

The following publications are sources of additional information related to ginseng husbandry:

- Persons, W. S., and J. M. Davis. *Growing and Marketing Ginseng, Goldenseal, and Other Woodland Medicinals.* Fairview, N.C.: Bright Mountain Books, 2005.
- Pritts, K. D. *Ginseng: How to Find, Grow, and Use America's Forest Gold.* Mechanicsburg, Pa.: Stackpole Books, 1995.
- Burkhart, E. P., and M. G. Jacobson. *Nontimber Forest Products from Pennsylvania 1: American Ginseng.* University Park: The Pennsylvania State University, 2004.

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