Cost Guides for Wild-Simulated Production Models in Tennessee Mountainous Terrain

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Introduction

Asian ginseng (*Panax ginseng*) is a fleshy root plant that has been used for millennia in Asian medicines. American ginseng, or *Panax quinquefolius*, is the North American cousin to Asian species and both are members of the ivy family. Both the Asian and American species have been valued throughout history, and collected or cultivated for use. Overseas sales records date back to colonial times in the United States. These sales have led to a change in the natural growing range of the plant. The three most prolific producers for consumption as of 2014 are China, the Korean Peninsula and North America. The market has placed a premium on wild and wild simulated roots, and typically they fetch a much higher price. Because of that, this article is detailing out the costs for producing ginseng in the wild simulated model. The reasons for this are twofold. First, wild simulated models of production require less maintenance and inputs. Secondly, wild simulated roots have been shown to fetch higher prices than row cropping methods. This guide draws heavily on Agricultural Extension sources, the Department of Labor Statistics, our partners in the Agricultural Extension programs research and the work of the Tennessee Center of Botanical Medicine Research.

Background

The following guide relies on these assumptions relating to site selection, preparation, maintenance and security.

Site Requirements

American ginseng is a shade-loving plant, and its preferred habitat reflects that. Locations with full shade, in deciduous hardwood forests are typically the best choices for sites when employing the wild simulated method of production. Ginseng is a plant that naturally grows in established hardwood forests, with trees that have deep roots. Deep-rooted trees will compete less for water with ginseng plants than shallow-rooted trees, while still providing cover. In addition to the light filtering, the trees deciduous nature will also give the added benefit of seasonal mulching due to leaf drop. Hilly areas with slight to moderate slope will allow for good drainage, another positive trait for the site. Since there is

little tillage required in wild simulated production, slope will not be as difficult a problem as it would be for crops requiring a row cropping method. Soil types that are favored by the plant are typically loamy, well drained, and moist with high organic matter. Southern or western facing slopes can be problematic if in low elevations due to temperature differences, however at higher elevations this is less problematic.

One method of seeing if the soil has the proper nutrient and soil profile is to use of scout plants. These are plants that prefer conditions that ginseng prefers.

Common Name	**Scientific Name**
Bloodroot	*Sanguinaria canadensis L*.
Solomon's seal	*Polygonatum biflorum*
Jewel weed	*Impatiens capensis Meerb.*
Galax	*Galax urceolata*
Trillium	*Trillium pusillum*
Wild yam	*Dioscorea villosa L.*
Hepatica	*Hepatica nobilis Schreb.*
Black cohosh	*Actaea racemosa L.*
Wild ginger	*Asarum canadense L.*
Mayapple	*Podophyllum peltatum L.*
Spikenard	*Aralia racemosa L.*
Ferns	*Varies*

Preparations

Two macronutrients whose levels have been shown to have an impact on ginseng quality are phosphorus and calcium. Soil quality, nutrient levels and pH can be accessed via soil testing, which can be performed by your local agricultural extension agency. One test can cover a half acre field, and should cost about $15. Soil studies performed in both New York and in East Tennessee showed calcium deficiencies led to stunted growth, and sites that had higher concentrations of calcium produced healthier, better quality plants. Calcium levels around 4000 lbs. of availability per acre and phosphorus levels of at least 95 lbs. availability per acre are advised to improve plant health. One should also take care to apply a calcium fertilizer that does not adversely affect the pH levels of the soil in the region. *To avoid raising the pH of the soil* it is recommended to use calcium sulphate, commonly called gypsum,

instead of calcium carbonate, commonly called lime. This is due to the chemical reactions resulting from adding lime to the soil, raising pH levels.

Ginseng has been shown to grow in a wide range of pH levels in the soil, but traditionally, growers have been advised pH values near 5 to 6 should be sought. Ginseng production has been shown to be optimal at these pH levels. There are many reasons that this could be the case. Acidic soils may suppress certain pathogens and diseases. Soil acidity also affects micronutrient availability. Micronutrients are often abundant enough already in the soil as to make it unnecessary to add more. However, soil pH does affect nutrient availability, making some nutrients less available for uptake by the plant. This is because the pH can affect the soil's ability to release the nutrients in a form that the plant can absorb. Therefore, if the soil pH is too high or too low, plants can suffer from micronutrient deficiencies, which can lead to stunting and dieback. As studies have shown that pH levels of 5 to 6 produce healthy ginseng plants, it can be surmised that these pH levels are the optimum for micronutrient uptake by the plant.

Seed Choice

The American ginseng plant produces white flowers in the summer, which will produce a cluster of green fruits after germination. As the fruit ripens, it will take on a red color. Each fruit will contain one to three seeds, however they are not stratified. As with several plants, the seeds of American ginseng have to go through a period of dormancy before they will grow. During this dormant period, the seed must be exposed to some form of stimuli to begin the processes that allow for germination and growth. For American ginseng, seeds must overwinter and be exposed to cold temperatures for at least a season before they will be able to germinate. This period of dormancy can last for one or more seasons, therefore it is in a farmer's best interest to always purchase stratified seeds from reputable seed sources. Contacting a local ginseng cooperative is an excellent source for information on vendors. In the wild simulated model for ginseng production, plants will be allowed to reseed the bed, however due to natural thinning, predation, and harvest, a farmer should plant new plots to help replace the ones that will be harvested.

Market price for striated seeds varies, but the current price per pound (as of 2017) of striated seed is between $130 and $170 with the average price being around $150.

Bed Construction

Once the site is chosen, and the seeds are prepared, site preparation can commence. It is recommended to use stakes and twine to keep track of bed outlines without permanently marking the

area. In the wild simulated model of production, there is much less tilling and fungicidal applications, as the model attempts to simulate the conditions the plant would experience in nature. Planting should occur in the fall after leaf drop. Beds should be five to eight feet wide and forty to fifty feet long. This cost analysis will use the assumption that your beds have rows eight feet wide and forty feet long. The following diagram illustrates the bed layout.

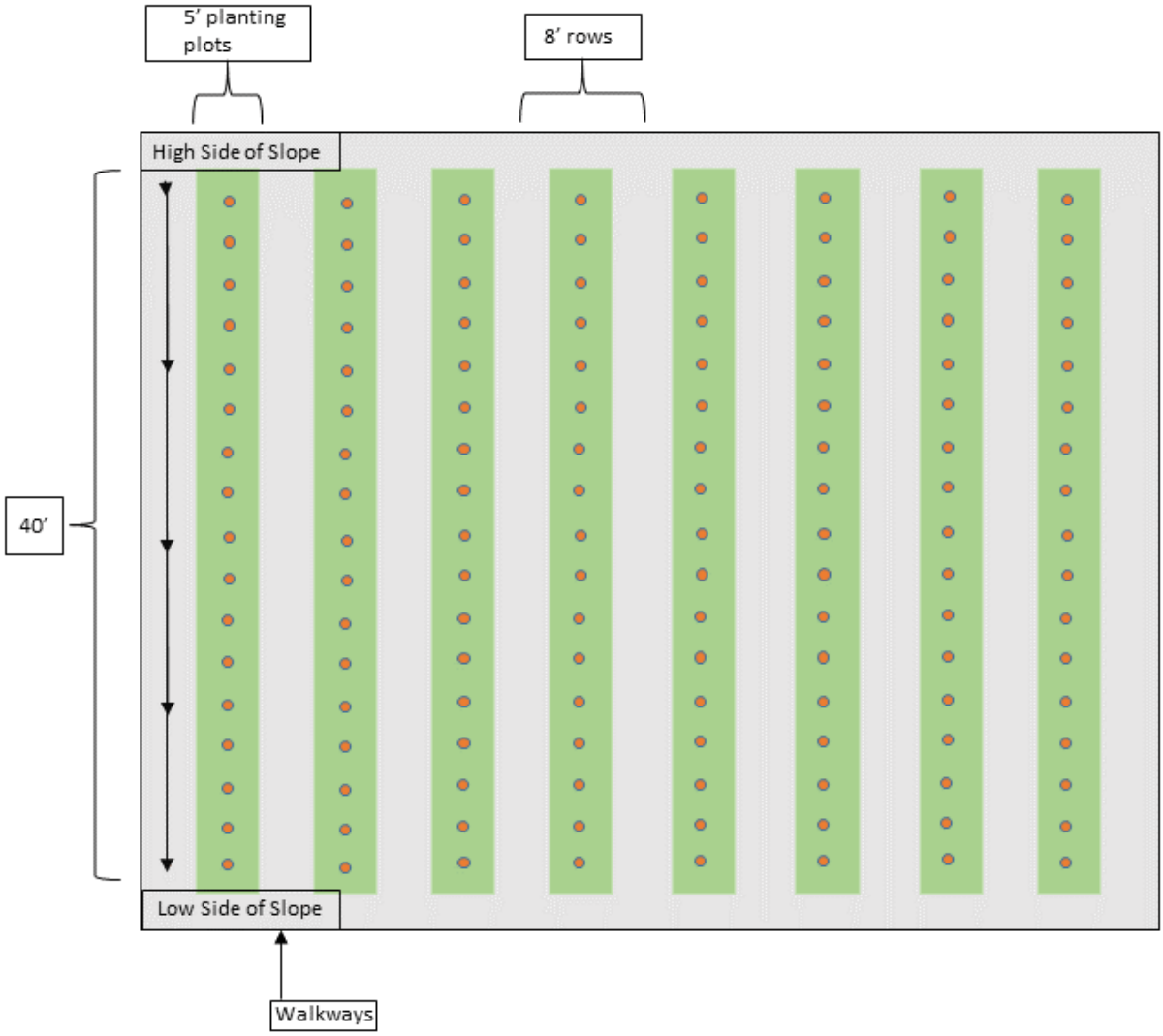

Figure 1

This will result in a layout in which approximately 6500 square feet per quarter acre of farm will be converted to ginseng production.

Sowing strategies

Seeding can be done one of two ways, depending on the level of labor you wish to employ. In method one, seeds are planted 6 to 10 inches apart in the row, ½ to ¾ an inch deep using a dibble stick to dig. This should result in approximately 1 oz. of seed per 200 square feet being sown which should result in approximately 2 lbs. of seed for every quarter acre, assuming 6,500 square feet of planting per quarter acre. This method is more labor intensive, however it does utilize seed more efficiently and results in a higher germination rate than the second option.

The second for sowing requires you to prepare the beds in the same manner as the first. However instead of using a stick to dig a series of holes, first take a tough leaf rake to clear aside the leaf debris from the planting rows. Then take a garden rake to rough up the surface of the soil. After the rows are roughed up, evenly cast 2 oz. of seed per plot in the rows, and incorporate the seeds via the garden rake. After incorporating the seeds, walk the rows to pat the seed down. Finally, rake the leaf debris back onto the freshly sown areas.

The second sowing method requires less man hours for labor, however it results in almost double of the seeds being sown to ensure germination rates (approximately 4 lbs. of seed per quarter acre in comparison to 2 lbs. of seed per quarter acre in the previous sowing method). The following table sums up the cost analysis of the two methods of sowing ginseng seed. Price for seed is assumed to be $150 a pound for the average and the mean hourly rate for farm labor was assumed to be $10.26, as reported by the Tennessee Department of Labor Statistics for the year of 2017. Average hour estimates were derived from agricultural extension research.

Method	Unit	Qty	$/Unit	Total
Method 1				
Seed	lb.	2	$ 150.00	$ 300.00
tools	dibble stick	2	$ 8.00	$ 16.00
Labor	hour	47	$ 10.26	$ 482.22
totals				**$ 798.22**
	Unit	**Qty**	**$/Unit**	**Total**
Method 2				
Seed	lb.	4	$ 150.00	$ 600.00
tools	Rakes	2	$ 15.00	$ 30.00
Labor	hour	33	$ 10.26	$ 338.58
totals				**$ 968.58**

Table 1

The difference in cost between the two systems of sowing is $170.36, with method two being the more expensive choice. This is due to the increased amount of seed required for method two. Actual costs can vary, depending on your labor efficiency or market value fluctuations on both labor and seed price. We will use method one for calculations for the rest of the paper.

Security

A key risk for ginseng farmers, and wild ginseng populations, is poaching. Farmers have followed several strategies, including but not limited to planting in low traffic areas, limiting access to the property via fencing, using game cameras and even more exotic methods. This paper assumes the property is 1) owned by the farmer 2) traffic onto and off the property is restricted 3) the plots are unmarked and unadvertised and 4) the farmer has relative ease of access to the plots. Also, the guide will assume that, for purposes of calculating costs, the farmer has installed one trail camera to record traffic. The equipment is estimated to cost $150-$220 and should be able to monitor one quarter acre. The farmer can also rely on GPS tracking to record plot locations on their farms, to limit signage in the field.

Maintenance

A key benefit in wild simulated ginseng is low maintenance requirements for the production model. Other than initial soil amendments (and those are only to correct any severe deficiencies), fertilizers and pesticides are to be avoided. Wild simulated methods avoid fertilizers to more accurately

simulate wild conditions. Pathogen suppression via careful site preparation is preferred over pesticide use, as pesticide costs can impact the final profit margin greatly for farmers.

Therefore, maintenance should be limited to once every few weeks, to scout for either signs of damage from herbaceous predators like deer or disease outbreaks. About eight hours a year is estimated for inspecting and maintaining for every quarter acre of property (an annual labor cost of approximately $82 dollars). This is mostly to be done preventatively, for example if one witnessed a fungal blight on a plant the plant should be removed and destroyed, the bed should not be sprayed. Bait traps or bucket traps can be deployed if forest rodents are causing too much herbivory damage, however these costs are not calculated in the report.

Fungal diseases thrive in tightly packed areas with little drainage and low air flow. Making sure to plant beds in loamy moist, but well-draining soil, and running up and down with the slope instead of perpendicular will allow for better drainage and air flow. The lack of intensive tilling disturbs the soil less, giving fewer opportunities for fungal spores to be spread. Hence, the reason for the site selection and preparation in the two sowing methods. Also, the lack of intensive tilling disturbs the beneficial microbes in the soil less. Spreading the beds out over an area, insures against a single infection wiping out the entire crop. The biodiversity and the compartmentalized design of the beds will make it more difficult for a single infection, predator or thief to wipe out the crop. Also, allowing the crop to experience stressors is a key aspect to the wild-simulated methods.

Yield

Both planting methods should result in a yield of 1 to 2 roots per square foot. A farmer can expect this to occur even though far more seeds were planted in the beds, and this is due to natural attrition rates in this environment. With these attrition rates, 6500 square feet of cultivation should result in 9750 roots. As a rough guide, for every three pounds of green tissue a farmer can expect one pound of dried. Using data from the US Department of the Interior, Tennessee farmers and hunters can expect to need around 250 roots per pound. With this data then, we can expect about 39 pounds of roots per quarter acre as a baseline.

Harvest

In Tennessee, the minimum level of development for harvest is three prongs with mature fruit. The seeds also must be replanted near the location of harvest. This requirement will actually benefit you as a farmer, as the planting of your own seed will help regenerate your beds. As per the Department of the Interior, Tennessee's harvest season is from August 15th to December 31st. Harvest should be done via hand tools (approximately $40 for things such as spades, forks and shovels). Harvest should be

careful, and one should minimize root damage. Due to the care required, it should take an experienced digger three hours of labor to harvest three green pounds of root. So an area of 6500 square feet could take 90 or more hours to harvest. Roots should be rinsed, but one should not over wash them to the point of causing root damage. Drying should be performed immediately if the roots are not stored in a refrigerated environment. In the kiln-drying phase of post-harvest conditioning, studies have been performed to see optimum temperatures that dry out the root without negatively affecting the overall ginsenoside content of the tissues. The temperature ranges for optimal drying with the least impact on final ginsenoside content was 38° to 44° Celsius (89° to 111° Fahrenheit). Temperatures beyond 111° Fahrenheit were shown to greatly negatively impact the final levels of all but one of the compounds ginseng is valued for, and therefore are not advised. A key factor for the drying process is a stable temperature, having a drying kiln that varies several degrees over the drying process can drastically harm the quality of the dried product just as having the drying process being too hot. One should shoot for a drying temperature that is +/-1 degree of 90° Fahrenheit.

Cost analyses

Labor

For the purpose of calculations, unskilled manual labor costs for farmers in Tennessee are being estimated to be $10.26. This is being taken from the Department of Labor Statistics for Tennessee labor costs in 2017.

Salvage value for equipment purchases

In accounting, the salvage value of an investment is the estimated value one can receive after its useful life. While there is no reason to sell and repurchase this equipment with each cycle, for farmers who wish to the following table can be used for estimates.

			Salvage values	
	cost ($)	**year purchased**	**% of cost**	**Value ($)**
Cameras	200	7	25%	50
Drying Equipment*	150	10	50%	75

* This does not include drying racks, just equipment

Table 2

Returns

Ginseng is rather easy to sell, however in Tennessee one must sell to licensed dealers and market fluctuations can greatly impact prices per pound. The recorded average price per dry weight pound of ginseng sold in 2014 and 2015 in Tennessee was $550-$570.

Summary of costs

The total estimated costs per 6500 square feet of cultivation is calculated to be $2444.52, with 39% of the cost being related to harvest costs and 18% of the costs being related to the drying and processing of the root. The following table breaks down the costs in detail.

	Unit	Quantity	$/unit	year			
				0	1..9	10	
Investments							
Land Prep							
Soil Test	Test	1	15	15			
Labor (site prep)	hours	7	10.26	71.82			
Sowing							
Seeds	Lb.	2	150	300			
Tools	tool	2	8	16			
Labor	hours	47	10.26	482.22			
Operating Costs							
Maintenance	hours	8	10.26		82.08		
Security camera	tool	1	200		200		
Harvest							
Hand tools	tool	2	20			40	
Labor	Labor	90	10.26			923.4	
Drying							
Building of Drying Room	room	1	400			400	
Heating costs	per lb. ginseng	39	1			39	
Salvage Value			-125			-125	
Totals				885.04	282.08	1277.4	**2444.52**

Table 3

The largest percentages of costs for a farmer using the wild simulated method of production is the initial investment of sowing and the labor and expenditure for drying. The seed cost is accrued during the first season, with the harvest work accruing sometime between the seventh and the tenth seasons. In Tennessee, ginseng cannot be harvested until it has reached reproductive maturity, which is to say you cannot harvest ginseng until it can produce red berries. Hence, the variability in harvest times.

Also, some farmers will prefer to sell their ginseng green to their dealer, to avoid the cost and difficulty of building a drying rig. While this is feasible, it should be noted that green ginseng typically fetches a lower price on the market in comparison to properly dried ginseng. These cost estimates however can be used as a guide for farmers to calculate their break even points for the pricing of their ginseng, thereby allowing them to maximize their profits. The guide also does not count the cost of obtaining the property, as it is assumed that the farmer is attempting to convert non-productive land, *i.e.* sloping wooded terrain, to a source of income.

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