



Agroforestry Notes

USDA Forest Service • USDA Natural Resources Conservation Service

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Forest Production of Goldenseal

Introduction

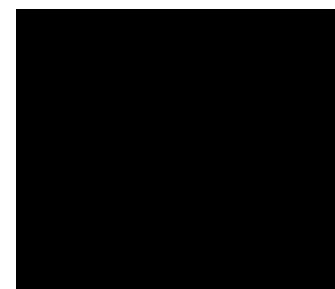
Goldenseal (*Hydrastis canadensis* L.) is a valued medicinal herb which has been collected from hardwood forests in eastern North America for hundreds of years. The historical range for goldenseal is north into Canada, south to Alabama, and west to Kansas. Overharvesting of goldenseal has caused serious reductions in populations reported in Illinois, Ohio, Indiana, and eastern Kentucky. In 1997, goldenseal was listed on Appendix II of the Convention for International Trade on Endangered Species (CITES), an international treaty monitoring trade in threatened and endangered species. Designed to protect the species, this listing imposed controls on goldenseal trade. This has not stopped people from collecting it, however, and populations continue to decrease. Due to this, the cultivation of Goldenseal has proven to be profitable.

Uses

The medicinal properties of goldenseal are attributed primarily to the alkaloids hydrastine and berberine which are present in the roots and leaves. Goldenseal has traditionally been used to treat inflammatory conditions of the eye, mouth, and digestive system. Recently, it has gained a reputation as an antibiotic, immune system enhancer, and synergistic herb.

Plant Description

Goldenseal is a herbaceous perennial which emerges in early spring from a perennial rootstock. The root system is composed of bright yellow, 1/2 to 3/4 inch thick, horizontal rhizomes covered with yellow, fibrous roots. Mature plants are six to 14 inches tall and have two or more erect stems which usually end in a fork with two leaves. The five to seven lobed leaves are three to 12 inches wide and three to eight inches long. Each plant produces a raspberry-like fruit, which turns red and ripens in July. Goldenseal spreads into the surrounding area through growth of the rhizomes and fibrous roots.



Goldenseal in flower.

Forest Site Selection

Goldenseal grows best in a rich, moist, well-aerated loamy soil with good water drainage. Look for a site where there are other woodland plants growing such as mayapple, trillium, bloodroot, and black cohosh. If there are no other plants in the understory, the area is probably too dark or dry for goldenseal. A site with mixed, deeply rooted hardwoods is preferred to a stand of conifers or other shallow rooted trees which could compete with the goldenseal for moisture and nutrients. Plantings established under oak, poplar, walnut, and basswood have been successful.

Soil Preparation

Remove undesirable trees, roots, weeds, and other undergrowth. Till the soil to a depth of about six inches. To promote good water drainage and to warm the soil early in the spring, raised beds should be constructed. Beds should be two to six inches tall and three to four feet across.



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Soil Amendments Several months before planting, collect soil samples for fertility testing and nematode assays. If the soil testing laboratory does not supply recommendations for goldenseal, ginseng or native forest plants, use recommendations for rhododendron or native ornamentals. If soil tests reveal low organic matter, it can be increased through addition of composted material, such as oak leaves. In a study conducted in western North Carolina, highest root yields were obtained when goldenseal was grown in soil amended with lime which resulted in a soil pH of 5.5 to 6.0. In this same study, plant survival and root yields decreased as nitrogen (supplied as ammonium nitrate) rate increased. The addition of superphosphate had no effect on plant survival or growth. Based on these results and grower experiences, fertilizer should be used lightly and preferably be an organic source. A general recommendation is to use the lowest fertilizer rate on the soil test report. Sandy soils may require slightly higher rates applied in split applications. A balanced NPK fertilizer, such as 20-20-20, can also be applied at a very low rate each spring as growth commences.

Propagation Goldenseal is most reliably propagated by dividing healthy rhizomes into 1/2-inch or larger pieces containing a bud and roots. These pieces should be planted in narrow trenches about two to three inches with the bud facing up and covered with soil. It is common practice to plant goldenseal on a 6-inch x 6-inch spacing, however, spacings ranging from 2-inch x 2-inch to 12-inch x 12-inch are being evaluated. This method can be used for fall planting in all areas and has also been successful in early spring in the Southeast.

Propagation of goldenseal from seed can be difficult and unpredictable. Best results are usually obtained when a grower collects fresh seed and sows it immediately. Germination rates of purchased seed can range from 10 percent to 90 percent. Studies suggest that seed, no matter how acquired, should be sown as soon as possible or by late autumn. Seed can be sown in the spring but it must be done very early and germination rates are very unpredictable. Seeds are best planted in a nursery bed in the fall. Sow 10 to 12 seeds per foot in rows three inches apart with seeds 1/2-inch deep. Cover lightly with mulch. Plants can be moved to production beds after one or two seasons of growth.

Mulch Goldenseal should be mulched to retain soil moisture, reduce weed growth, moderate soil temperatures, and provide winter protection. The mulch layer should be several inches deep at time of planting. Depending on the type of mulch, it may need to be replenished every year or two. In areas where the soil tends to freeze and thaw, several inches of extra mulch should be provided to protect the roots during the winter. The mulch should be raked back to a depth of one to two inches before the plants emerge in the spring.

Goldenseal is commonly mulched with whole or shredded leaves, hardwood bark chips, hardwood bark and sawdust mixture, or straw. Although straw is used successfully in many areas of the country, straw has performed poorly in North Carolina where it tends to cause rot by holding excessive moisture near the crown of the plant and attract slugs. In two years of growth, hardwood and pine bark mulches have performed well.

Irrigation When grown under a forest canopy, goldenseal usually does not require irrigation. Under drought conditions, however, the plants will drop their foliage and go dormant earlier than normal unless irrigated. This usually does not harm the plant, but will reduce root growth for that year.

Pests When grown in small, isolated plots in the woods, goldenseal suffers few attacks from diseases or insects. The major problem in many small plots in the Southeast is slugs, which can eat the entire crown of the plant and fruit. Slug control can be difficult, and successful methods are often site specific. Control methods that have been successful at some sites include using beer traps, spreading diatomaceous earth (must be replaced after every rain) or a mixture of lime and woodashes around the plants, or applying a commer-

cially available slug and snail bait. If the populations of slugs are intolerable, it may be necessary to remove the mulch from around the plants. Because root knot nematodes will severely reduce plant growth, the soil should always be tested for their presence before planting. Moles and voles may also damage the beds and should be controlled with traps or by bordering the beds with wire mesh set 8 to 12 inches deep in the soil.

If the field is properly prepared and the beds are adequately mulched, weeds are not often a serious problem and can usually be managed by hand weeding several times during the season. In the early 1990's, the only disease commonly reported on goldenseal was botrytis leaf spot which appeared late in the season. Reasonable control was obtained by removing affected foliage. In heavily infested areas, the mulch was removed and replaced after the plants were dormant. As more goldenseal is cultivated on a large scale in the U.S. and Canada, there have been increasing reports of disease occurring under artificial shade structures, not in the forest. Some of the other diseases known to infect cultivated goldenseal include alternaria, rhizoctonia, and fusarium.

Seed Collection and Storage

To collect seed from goldenseal, harvest fruit when fully ripe. Mash the fruit and ferment for several days in water until the flesh can be easily removed from the seed. Then decant and rinse with fresh water until seeds are clean. Alternately, spread the seeds and pulp out on a fine-mesh screen and spray with a high pressure stream of water. For the large-scale producer there are seed cleaners available that will do all this in one step. Goldenseal seed is small, round, black, and hard and should never be allowed to dry out. If the seed will not be sown immediately, it is common practice to mix it with clean, damp sand; place it in a wooden box with a fine-mesh screen top and bottom; and bury the box in a shaded, well-drained area exposed to natural rain. The seed is usually sown that autumn. In a recent goldenseal seed germination study, highest germination rates were obtained from seeds held at 70 degrees F and sown in late August.

Harvest

Goldenseal roots will be ready to harvest in three to five years. In the fall after the tops have died down measure off a small area for a test dig to determine if the roots have fully occupied the site and if yields will be acceptable. If estimated yields per acre are low, or market prices are depressed, the plants can be left to grow for another year. If a market exists for the leaves and stems, harvest them in late summer while the foliage is still green. Dig roots carefully, keeping the many fibrous roots intact. Small plots can be dug with a fork whereas large fields will require some kind of mechanical digger, such as modified potato, horseradish, and bulb diggers. Select large, healthy plants for replanting and keep them moist and cool or have beds prepared to replant immediately.

Washing and Drying Roots

Buyers require roots to be clean and free of soil and debris. Carefully wash roots by spraying with a hose over a large-mesh screen. Remove all soil, breaking larger roots if necessary, but do not use a brush. There are commercial ginseng root washers available that consist of a drum that turns and tumbles the roots as water is sprayed over them.

Spread the clean roots on screens and dry in a well-ventilated area in the shade or in a forced air drier. Simple driers can be constructed from small sheds or rooms in barns. Bulk tobacco barns and peanut wagons can also be modified to successfully dry goldenseal roots. The key points for drying are to keep temperatures low, around 95 to 100 degrees F, and to provide good air flow around the roots. If the roots are dried too hot and fast, the outside of the root dries first, leaving the inside of the root moist, making it difficult to dry the interior of the root. Those roots will be of a lower quality and bring a substantially lower price than properly dried roots. Roots will lose about 70 percent of their weight during drying. Test for dryness by breaking a large root; it should snap cleanly but not be brittle.

Yields and Packaging

Good yield estimates for forest grown goldenseal are not currently available due to differences among growers in amount and type of planting stock used, plant spacing, bed and row spacing, and years to harvest. Commonly reported yields for goldenseal produced under artificial shade structures are 1000 to 2000 lbs. of dried root per acre. Yields as low as 800 lbs. per acre and as high as 3000 lbs. per acre have also been reported. Dried roots should be loosely packed into cardboard cartons or barrels, untreated burlap sacks, or poly-sacks. Store in a cool, dry, dark area secure from insects and rodents.

Marketing and Economics

Before planting goldenseal, a number of buyers should be contacted to determine the anticipated future market and prices for goldenseal. Some buyers will write contractual agreements with growers and these should be obtained, if possible. The industry is under pressure to buy cultivated goldenseal and since there is only an estimated 200 to 300 acres of goldenseal under cultivation in North America at the present time, the market is expected to be good for the near future. Current average prices paid to growers for dried goldenseal root range from \$30 to \$50 per pound, although wholesale prices of up to \$100 per pound have been reported. Prices received will depend on the quality, cleanliness, and alkaloid content of the roots. There also is a limited market for fresh root and dried leaves. New growers often find it is easiest and most cost effective to work with local buyers. Long lists of buyers of botanicals and natural products can be found by contacting herb associations, State and Federal Departments of Agriculture, the Cooperative Extension Service, and on the Internet.

The economics of goldenseal production are not well-defined at this time. It is estimated to cost between \$3000 to \$5000 to produce a crop of goldenseal under natural shade over a four year period. Potential net returns can be \$19,000 per acre or more. Until goldenseal budgets are developed, projected budgets for wild-simulated ginseng production can be modified for use.

Additional Information

- "Commercial Goldenseal Cultivation." Davis, J.M. 1999. Horticulture Info. Leaflet 131. N. C. Coop. Extension Service, N.C. State Univ. Can be obtained as a hardcopy or on the Internet at http://www.cals.ncsu.edu/hort_sci/comm/golden.html
- "Medicinal Herbs in the Garden, Field, and Marketplace." Sturdivant, L. and T. Blakley. 1999. San Juan Naturals, P.O. Box 642, Friday Harbor, WA 98250.

If you can find them, these old classics contain a wealth of information:

- "The Wildcrafters Goldenseal Manual." Hardacre, J.V., G. Henderson, F.B. Collins, E.L. Anderson, V.M. Harris, B. Fewster, R. Beck, D. Bowman, and E.L. Donzelot. 1962. Wildcrafters Publications, Rockville, Indiana.
- "The Cultivation of Hydrastis." Lloyd, J.U. 1912. J. American Pharmaceutical Assoc. 1:5-12.
- "Goldenseal Under Cultivation." Van Fleet, W. 1914. U.S.D.A. Farmers' Bulletin #613.

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Table 4: Projected Nine-Year Budget for One-Half Acre of Wild-Simulated ginseng

Seed*	10 pounds at \$75/lb.		\$750.00
Labor	Site preparation and planting		
	125 hours X \$10/hr.	\$1,250.00	
	Bi-weekly inspection and trouble shooting		
	200 hours X \$10.00	\$5,000.00	
Materials and Equipment			
	Rakes and shovels or spading forks (assume some tools already on hand)	\$50.00	
	Backpack sprayer (\$125), fungicides, and rodenticides for troubleshooting	\$200.00	
			\$250.00
Drying	Addition of insulation and drying racks to existing room or shed	\$400.00	
	Energy cost to heat (.50/lb. of dried root)	\$40.00	
			\$440.00
Total Cost			\$9,690.00
Expected Yield:	80 lbs. of dried roots		
Gross Profit:	80 lbs. X \$300.00/lb.		\$24,000.00
Net Profit at end of Nine Years			\$14,310.00

* The per pound price of seed varies with quality and quantity, and from year to year with supply and demand. The best seed comes from disease-free gardens of fifth-year and older plants. There are roughly 7,000 seeds in a pound. Eventually, a successful grower will produce his own seed. (From "Green Gold," by Scott Persons).
