Project Title:

Goldenseal Production For Sustainable Woodlot Management
FNE98-213

Project Leader:

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Introduction:

Goldenseal (Hydrastis canadensis) is a North American plant whose native range extends along the Appalachian foothills from Vermont to Georgia and into the mid-west from Minnesota south to Arkansas. It's centers of distribution, and the areas where it is still most abundant, are the Ohio River valley and the Ozark plateau in Arkansas. The root of goldenseal has been used medicinally for centuries. The early European settlers were taught about the medicinal value of this plant by the native American population who used it topically to heal sores particularly of the eyes and mouth and as a bitter tonic for disorders of the stomach and liver. Today, it has been shown to possess antiseptic characteristics acting like an antibiotic with anti fungal properties.

At the beginning of the twentieth century goldenseal was already beginning to feel the pressure of over harvesting. In order to preserve the strained wild populations, the literature of the day encouraged the cultivation and marketing of goldenseal grown in woodland "gardens". With the advent of allopathic medicine, the pressure on the wild populations of this plant declined and these wild patches even recovered somewhat. However, with the recent renewed popularity of herbal medicines, the wild goldenseal population is once again experiencing pressure from over harvesting to the point where goldenseal has recently been added to the Convention for International Trade on Endangered Species (CITES) list of plants whose international trade is regulated.

Goldenseal is a shade-loving herbacious perennial which under natural conditions is found exclusively in mature Eastern and Midwestern forests. The gold-yellow root is comprised of a central rhizome which can vary in size from 1/4" to 1/8" thick with more fibrous yet substantial root hairs extending from it. These rhizomes will usually possess several buds and it is from one such bud that the stem and leaves of a new plant will emerge. The stem is slightly

hairy and forks near the top where it is crowned by usually two palm-shaped maple-like leaves. The smaller of these leaves will carry the green centered white frilly-petaled flower on a small stem extending from the base of the leaf. This flower will be transformed into a red raspberry-like fruit containing 10 to 20 tiny hard black seeds. The plant will persist well into the fall. The dead stem will leave a depression on the rhizome which resembles the imprint of a waxen seal which at one time was used to seal letters- hence the name Goldenseal.

Project Goals:

The stated purpose of this project, which began in the spring of 1998, was to demonstrate that Goldenseal could be successfully grown in Maine under "wild simulated" (woods grown)conditions. And furthermore, that the production of goldenseal could be economically viable having a potentially high market value with minimal investiture of time and resources.

There were two underlying motives behind this project: 1. The recognition that the increased demand for herbal products made with goldenseal is threatening a limited wild population and, 2. The recognition that there is a tremendous number of acres of small to medium woodlots in Maine which are currently underutilized and which might be suitable for growing a crop like goldenseal.

Farm Update and Cooperators:

Goldenseal requires a minimum of three years to reach market size (assuming that the plants are started with two year old rootlets). In this case three years happened to be a very long time. The grant request for this project was written in 1997 (with the first intended planting date for October 1998) for Woods End Farm in Mount Vernon, Maine. However, it became apparent at the end of the 1999 season- only one year after planting- that the situation at Woods End was changing and that I would not be able to continue this project at that location. It also became apparent that the land owner and I could not agree on the disposition of the 275 rootlets that had already been planted there.

Forced to look for an alternate site, I turned to Deb Soule, a collaborator and technical advisor for this project. Deb was more than willing to let me use the wooded area associated with Avena Botanicals an herbal apothecary and public garden located in Rockport, Maine. Avena Botanicals is a women owned and women run medicinal herb business with a one and a half acre organically certified garden. This garden supports a wide variety of medicinal

plants ranging from Angelica to Yarrow. These plants are cultivated, harvested and then processed into medicinal products such as tinctures salves and teas. Over 65% of the herbs Avena Botanicals uses in their products are grown in this garden or are otherwise wild crafted in Maine. Goldenseal, however is currently not being grown in Maine in any quantity. Hence Debs enthusiasm for this project.

For the reasons cited above, the methods and results presented in the body of this report describe the goldenseal planting that occurred in the fall of 1999 at Avena Botanicals. Those rootlets planted in fall 1998 at Woods End Farm have not been harvested and therefore no results from that planting are presented here.

Methods:

In October 1999, 166 rootlets weighing approximately 3 pounds were planted on a wooded site in Rockport, Maine. The canopy at this site was dominated by a maturing stand of beech, red maple, striped maple, red oak, ash, white birch and yellow birch. The understory was primarily striped maple and beech with an herbaceous layer of Christmas fern. The rootlets were distributed between two small plots; one, a raised bed measuring 18ft by 6ft and another smaller plot measuring 9ft by 6ft. Both plots received a heavy application of gypsum- 2 tons per acre equivalent. The rootlets were planted approximately 8" apart 3" to 5" deep; 100 rootlets in the larger bed, 66 rootlets in the smaller plot. After planting the plots were covered with dried leaves 2" to 3" thick.

A test of the soil from this site showed that the plots contained optimum levels of potassium and phosphate and sufficient levels of calcium(60% of CEC) and magnesium(10% of CEC). The organic matter content was over 20%. The pH was 4.9 well into the acidic range. These numbers compared favorably with a soil sample taken from a wild goldenseal plot located in Southeast Ohio. The goldenseal at this site was healthy and abundant and I chose to use the soil from this site as a baseline for determining under what soil conditions goldenseal grows best.. The soils at this site also had a pH of only 4.9. The organic matter percentage was comparatively low, only 5%. There were moderate levels of potassium and phosphorous while calcium comprised 50% of the CEC and magnesium just over 12%. These soil test reports are included as an addendum to this report.

The test plots are located well into the woods and were not amenable to the addition of amendments and water. As a result, after planting very little was done to the test plots other than to inspect them several times during the growing season to insure that the rootlets had sprouted and that the plants were not being

adversely affected by weeds insects or rodents. Other relevant observations such as rates of flowering and fruit set were also noted during these visits although these were subjective notations.

Results:

The spring of 2000 was the first year of growth for the fall 1999 planted crop. Emergence in this first spring was excellent, nearly 100% although not all the plants were of equal quality. Some of the plants were robust while others were spindly by comparison. I judged this difference to be due to the variable quality of the rootlet stock some of which were large and blocky with many nodes others were diminutive by comparison. There were flowers and subsequent fruit formation on the healthiest of these young plants.

During late spring and early summer there was evidence of slug damage- leaves partially eaten and stems chewed threw. This latter damage marked the end of the season for those plants affected. Although the literature suggests that roots can survive such damage to reemerge the following spring, it is possible that the weakest of these rootlets secummed. There was continued slug pressure during the 2001 and 2002 seasons. Diatomaceous earth was spread in and around the plots in an attempt to control slug activity. However, the thick leaf layer covering the plots proved to be an ideal home for slugs. The 2001 and 2002 seasons were also exceptionally dry which resulted in further pressure being placed on the crop. Plant emergence dwindled with each subsequent year as did general plant vitality, and flower and fruit set.

In October 2002 the three year old rootlets were harvested, washed, and weighed. Observations of general root health showed that some of the rootlets remained quite small. Portions of some of the larger roots were rotten. The number of roots harvested was only 47 a loss of nearly 72%. The fresh weight of the harvested roots was 0.85 lb also a 72% reduction in the original planting weight.

Dicussion and Conclusions:

These poor results are not what I had hoped or expected when I began this project. Based on my literature search and, on the similar nutrient status of the soils from this study site and the Ohio site where goldenseal grew profusely, I had concluded that the nutrient requirements of goldenseal could be met by the woodland soils of Maine with little or no amendments. Although, it is still not clear that poor nutrition was the reason for these poor results it is a factor which can not be overruled. Poor nutition may, at minimum, have had a secondary role in the crops failure by making it difficult

for the crop to withstand and/or recover from the damage caused by slugs.

In conversations with goldenseal growers at Nature's Cathedral in Blairstown, Iowa (a supplier of goldenseal and other herbs to many herb processors and the supplier of goldenseal rootlets to this project) it was suggested that the dry conditions created by succesive years of drought, rather than circumstances related to nutrition, were more likely to cause the root rot that I had observed on my harvested roots. This information based on their experience and observations over many years would suggest that the extremely dry weather in 2001 and 2002 had at least some role to play in crop quality.

Proposed Further Study and Revisions:

Since the initial planting in 1999, there have been two subsequent plantings in the fall of both 2000 and 2001. The 2000 planting site is in the vicinity of the1999 site and has shown similar problems and trends to the 1999 crop. The crop from this site is scheduled to be harvested in October 2003. The 2001 rootlets (scheduled for harvest in 2004) were planted in a more accesible shaded garden site where water and compost were available. These plants received compost at the time of planting. Although no soil tests have been performed at this site it is believed that the pH is less acidic and that the soils are generally more fertile. Soil tests will be performed this spring. During the 2002 growing season (one of the driest on record) the plants at this site remained strong and vibrant throuout the season. There was no pressure from slugs. Flowering and subsequent fruit formation were reletively good. This 2001 planting will hopefully provide more positive results. If this proves to be the case it would suggest that the woodland sites of Maine would need to be amended with compost and lime in order to produce a healthy goldenseal crop. This in itself may limit many of Maine's woodlands from being employed for goldenseal propogation simply for reasons of accesibility.

Resources:

Cech, Richo; Growing at-risk medicinal herbs: cultivation, conservation and ecology; Horizon Herbs Publication; Williams, Oregon; 2002.

Davis, Jeanine M., Bir, Richard E. and NC State University; Medicinal Plants with a Potential Niche Market for Propogators; Suffolk County Agricultural News; Dec 1997.

Harding, A. R. ; Ginseng and other medicinal plants; A.R. Harding Publication; Columbus, Ohio; 1908.

McKinney, Lavinia; Goldenseal; Biodynamics *Farming and Gardening in the 21st Century* ; Nov/Dec 1997.

Woods End Research Laboratory, Inc.

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Code: 90 91 92 Project: 540

Date Received : 10/06/1998
Date Reported : 11/ 9/1998
Lab ID Number : 4256.3

SOIL QUALITY REPORT

Soil Sample Identification: Soil: north slope goldenseal plot

Your Estimated Crop Category: 2 Low-Feeder

TRAIT	Unit	Result	Rating	TRAIT	Unit	Result	Rating
pH in Water		4.89	V. acid	Water Stable Aggregates	%	18	V. low
pH in $CaCl_2$		4.20	V-Low	Free Carbonates (CO_3)		1	Low/None
Organic Matter	%	5.1	Good	Gravel, >2mm	%	37	High
Biological Respiration	%C/wk	0.51	Med-Low	Sand Content	% of <2mm	63	–
Total CO_2 Output,	mg/kg/wk	516	Med-Low	Clay Content	% of <2mm	10	–
Est. Nitrogen Release	lb/a	46	Moderate	Silt Content	% of <2mm	27	–

Salts and Available Anions

Conductivity	$dS \cdot m^{-1}$	0.11	Low				
Available (P1) Phosphorus	ppm	0	Reserve Phosphorus	ppm	¡0.5		Absent
Nitrate (NO_3-N)	ppm	9	Low		Chloride	ppm	20
Nitrite (NO_2-N)	ppm	<1	V. Low		Sulfate	ppm	8

Total Exchangeable Cations

		Result	% of CEC	Rating			Result	% of CEC	Rating
Potassium	ppm	188	2.4	Moderate	Calcium	ppm	1984	48.9	Low
Sodium	ppm	91	2.0	Medium	Magnesium	ppm	297	12.2	Med-High
Total Acidity		–	34.5	V. High	Total Base	ppm	2560	65.5	Moderate
Total CEC	$cmol^+/kg$	20.3	–	Good					

Avena Botanicals

DATE	LAB NO.	SAMPLE IDENTIFICATION	COUNTY	ACRES OR SQ. FT.
12/31/1999	8151	WRGLDNSL	KNOX	

· SOIL TEST REPORT FOR:

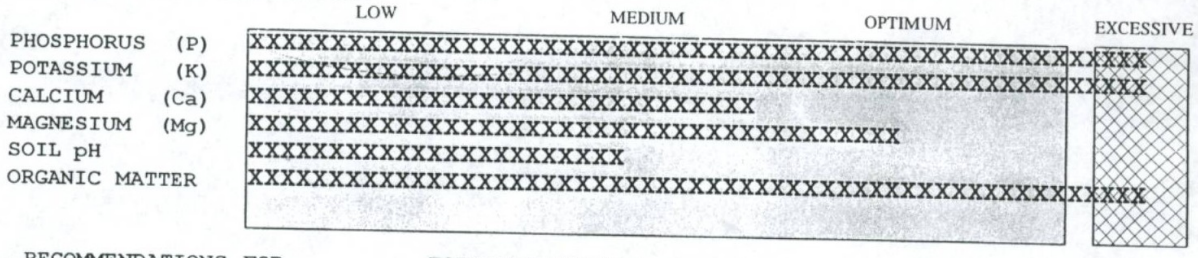
TOM GRIFFIN

PO BOX 107

W ROCKPORT ME 04865

MAINE SOIL TESTING SERVICE
UNIVERSITY OF MAINE
5722 DEERING HALL
ORONO,MAINE 04469-5722

· RELATIVE SOIL TEST LEVELS



· RECOMMENDATIONS FOR FORESTRY-GENERAL - Crop Code # 601

To raise soil pH to 5.2, apply 2000 pounds of lime per acre.

Lime recommendation assumes a calcium carbonate equivalence (neutralizing value) of 100 %.
Magnesium level is sufficient. Use a calcitic (low magnesium) lime.

Recommended major nutrient application rates as follows:
100 pounds nitrogen per acre
0 pounds phosphate per acre
0 pounds potash per acre

· LABORATORY RESULTS

CEC and nutrient balance calculations assume a pH management level of 5.2

	Soil pH	Lime Index	P (lb/A)	K (lb/A)	Mg (lb/A)	Ca (lb/A)	CEC (me/100gm)	K	Mg	Ca	Acidity
Level Found	4.9	5.0	15.4	249	302	1862	8.1	3.9	15.3	57.2	23.6
Optimum Range	5.0-5.5	N/A	9-13	see % Saturation levels			> 5	2.1-3.0	10-25	60-80	< 10
									(% Saturation)		

	Organic Matter (%)	Zinc (ppm)	Sodium (ppm)	Soluble Salts (mmhos/cm)	Nitrate-N (ppm)
Level Found	22.4	N/A	N/A	N/A	N/A
Optimum Range	5 - 8				

Additional Results

Full payment received for the analysis of this sample. Thank you.