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Costs and Returns of Growing Selected Medicinal Herbs in New Mexico Indicate Positive Return to Land and Risk Likely

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SUMMARY. Cost and return estimates are presented for selected medicinal herbs grown in a plant-spacing study at two sites in New Mexico. The selected herbs were echinacea [*Echinacea purpurea* (L.) Moench], valerian (*Valeriana officinalis* L.), and yerba mansa (*Anemopsis californica* Nutt.). Significant returns to land and risk were observed in the crops grown at the closest plant spacing, 12 inches (30 cm). Return to land and risk after two growing seasons from echinacea was estimated for a 10-acre (4-ha) farm to be \$16,093/acre (\$39,750/ha) in Las Cruces and \$14,612/acre (\$36,092/ha) in Alcalde.

The search for viable alternative crops is an ongoing process as saturated markets, demand changes, and increased competition reduce returns to farmers. In New Mexico, urban growth puts increasing pressure on remaining farms to find high value crop alternatives. Medicinal herbs are becoming popular worldwide in the treatment of common ailments. Retail medicinal herb sales in the U.S. approached \$4 billion in 1998 (Brevoort, 1998). Interest in medicinal herbs as alternative crops has increased in the southwestern U.S., where a long cultural tradition exists in the use of plants to treat common ailments (Moore, 1990).

The purpose of this study was to generate cost and return estimates for selected medicinal herbs grown in a plant-spacing experiment. The herbs in the study were echinacea (*Echinacea purpurea*), valerian (*Valeriana officinalis*), and yerba mansa (*Anemopsis californica*). Mullein (*Verbascum thapsus* L.) was also grown in this experiment at both sites, but was not included in this report because the commercial market

is small, and the plant is easily harvested in the wild over much of the U.S. Little economic analysis has been published regarding medicinal herbs, although the potential for commercializing echinacea as a cut flower has been studied (Starman et al., 1995).

Echinacea is widely used as an immune stimulant and has achieved popularity for its antiviral properties (Foster, 1991). Valerian is used to treat nervous tension, particularly anxiety and insomnia (Hobbs, 1993). Although not well known outside of the southwestern U.S., yerba mansa is used for healing small infections, intestinal and urinary tracts, and sore throats, and has been suggested as an alternative to goldenseal (*Hydrastis canadensis* L.) (Moore, 1989).

Echinacea (which includes *E. purpurea*, *E. angustifolia* DC, and *E. pallida* (Nutt.)) was the top selling medicinal herb in 1997 through all marketing channels, accounting for 9% of the \$3.6 billion in consumer herb sales (Brevoort, 1998). Valerian was ranked 10th in 1998 and 18th in 1997 in natural food market sales. Mass market sales of valerian for the 52-week period ending in mid-July 1998 were an estimated \$8 million (Brevoort, 1998). The size of the yerba mansa market is unknown as it has only recently begun to appear in herb industry publications. Yerba mansa has been recommended for increased commercial production because its native range is limited or threatened (Knight, 1999).

Materials and methods

Two growing sites in New Mexico were chosen for the experiments. In northern New Mexico, the herbs were grown at the Alcalde Sustainable Agriculture Science Center in Alcalde on a Fruitland sandy loam, [coarse-loam, mixed (calcareous), mesic Typic Torriorthent] at an elevation of 5,690 ft (1,730 m). Alcalde had an annual average 152 frost-free days from 1994–98 (New Mexico State University, 1998). In southern New Mexico, the plots were located at the Fabian García Agricultural Science Center in Las Cruces. The soils there are Glendale loam [fine-silty, mixed (calcareous), thermic Typic Torrifluvent] and the elevation is 3,900 ft (1,186 m). The average frost-free growing season is 220 d (Herrera, 1989).

The experiments started in early spring 1995 and continued through fall 1996. All species were established

Table 1. Key cost assumptions for wages, taxes, utilities, interest, employee benefits, and management/supervision.^z

Description	Unit		
		Alcalde	Las Cruces
		\$ / unit	
Wage rate	Hour	5.15	5.85
Water	Acre ^y	10.00	34.00 ^x
Property tax	1000 Acres	23.88	25.14
Electricity, processing	Kilowatt hours	0.10	0.02
Electricity, irrigation	Acre-inch of water ^w	N/A	1.41
Diesel fuel	Gallon	1.20	1.10
		%	
Interest rate	Annual	9.61	9.61
Supervision/Management	% of Gross sales	10	10
Employee benefits	% of Labor costs	25	25

^zSources: Libbin and Hawkes, 1996; Libbin and Hawkes, 1997.

^y1 acre = 0.4047 ha.

^xAdditional water over 2 acre-ft costs \$14/acre-ft; 1 acre-ft = 43,560 ft³ = 1,233 m³.

^w1 acre-inch = 3,630 ft³ = 103 m³

through transplants started from seed in a greenhouse, except yerba mansa, which was established using crowns harvested from the wild. Although these crops were not planted on land certified as organic, no synthetic fertilizers or pesticides were used. In the first year of the experiment, valerian was planted at both sites. However, valerian did not survive in Las Cruces. Therefore, yerba mansa was substituted for valerian in the second year of the trial in Las Cruces. The crops harvested in this experiment for the purpose of recording yield data were 18-month echinacea and valerian roots, and 1-year yerba mansa roots.

In Las Cruces, all plant material was weighed fresh and weighed again dry, while in Alcalde, fresh and dry weights were based on sampling. Samples of fresh material were weighed, and then subsamples were weighed fresh. The subsamples were dried in an oven for 48 h at 160 °F (71 °C) and reweighed. The dried to fresh weight was converted to a percentage, and used to estimate total dry weights of the sample, before being projected to a per-acre basis.

Although not part of the experiment, echinacea seed from both sites was harvested in the second year to sell. All of the valerian, yerba mansa and echinacea roots were sold. No attempt was made to sell the echinacea tops or aerial part of the plant even though an active market exists for them. Although the flowers were harvested in the first summer in Las Cruces (but not sold), the flowering echinacea tops were left in the field in the second summer so that entomologists could examine an invasion of sunflower moth (*Homoeosoma electellum* (Hulst)). Because of low market demand, the leaves of yerba

mansa were not harvested for either yield information or sales even though traditional use of the plant includes preparation of teas with leaves. With the exception of minor quantities of fresh valerian and yerba mansa roots, all herb sales were of dried material.

At both sites, a randomized complete block design was used, with six treatments (two crops × three spacings) and four replications for each plant spacing. Within-row spacings were 12, 18, and 24 inches (30, 45, and 60 cm). In Las Cruces, each replication was in a bed 4 ft wide by 30 ft long (1.2 × 9.1 m) and there were two rows of plants in each bed. At harvest time the border plants at the end of each bed were ignored and the harvest area was 100 ft² (30.4 m²) in the case of the 12-inch spacing, and 90 and 80 ft² (27.4 and 24.3 m²) in the case of the 18- and 24-inch spacing. In Alcalde, the experiments were set up on rows typical for furrow irrigation in northern New Mexico. Each plot consisted of two 36-inch (91 cm) rows on raised beds that were 30 ft long (9.12 m), or 180 ft² (54.7 m²). The harvested area was 20 ft long (6.08 m²), or 120 ft² (36.5 m²) per treatment plot. The yield data were analyzed using the general linear model procedure of SAS version 6.11 (SAS, 1990). An analysis of variance test for randomized complete block design was conducted. A more detailed presentation of the experiments is found in Kleitz (1998).

Costs were classified as purchased inputs and transplant costs, preharvest, harvest, and postharvest operations. In addition to these categories of expenses, supervision and management and capital interest expense were estimated. Key cost assumptions are in Table 1. More detailed discussion of equipment and

labor cost assumptions are found in Van Voorthuizen (1997).

Two-year cost and return estimates were prepared for echinacea and valerian, because the root harvests took place after the second growing season. One-year cost and return estimates were prepared for yerba mansa as the root harvest took place after one growing season. Costs which required doubling for the 2-year estimates were water, weeding, and irrigation depreciation in Las Cruces. Input costs such as seeds, greenhouse supplies, Alaska fish fertilizer and manure were incurred in year 1. Although no additional fertilizer was applied in year 2 of the experiment, annual application of fertilizer may be necessary in perennial herb production.

Valerian and echinacea were grown from transplants started in a greenhouse, while yerba mansa was grown from crowns transplanted from the wild. However, the yerba mansa cost and return estimates include greenhouse costs for growing the crowns to a larger size, which may ensure greater survival rates. To the extent that crowns are taken directly from the wild (or another field) and transplanted immediately, greenhouse costs would be saved. The input costs were projected to 1 acre (0.4 ha), based on the amount used in the experiment, adjusted for the area of the plot.

Equipment usage costs were also estimated, although no field equipment was used in the experiments in Las Cruces. The type of equipment assumed in the cost and return estimates were based on the equipment small farms tend to have available (50 horsepower tractor or less, transplanter, vegetable cultivator) or can be hired for custom work (disc, chisel, plow, bed shaper,

Table 2. Cost assumptions for specialized postharvest equipment and facility, and purchased field equipment.

Equipment	Purpose	Purchase cost ^y (\$)	Installation cost (\$)	Useful life
Nursery lifter ^x	Root harvests	500		
Barn conversion ^w	Batch dryer	5,000		
Conveyor, 0.75 horsepower	Take herbs to loft in barn	500–2,000	250	
Fan, 15 hp	Dryer	4,500	2,250	
Tractor, 50 horsepower		14,500		20
Vegetable cultivator		3,000		15
Roller bed shaper		800		15
Transplanter		11,000		15
Planter		2,500		15
Porterway harvester		8,000		15
Tool bar		1,250		15
Hauling trailer		700		16
Combine		3,500		40
Irrigation system ^v		3,141; 7,829		25; 8

^zSources: R. T. Johnson, personal communication; B. Maier, personal communication.

^yWhere provided, ranges include used prices (low end) and new prices (high end).

^xAssumed manufactured on farm.

^wAssumes farm has existing barn with hay loft that is converted to a dryer.

^vPolyvinyl chloride pipes, valves and flush ends; drip lines, injector pump and installation.

lister, rolling cultivator, swather). Equipment in the cost and return estimates also included equipment for washing, drying, and cutting the harvested crops (Table 2). The farm was assumed to be 10 acres (4 ha) for the purpose of selecting appropriate equipment.

To determine field equipment fixed costs (depreciation plus taxes), accomplishment rates were estimated (Sullivan et al., 1986) using the following equation: $AR = 1 / (ESP \times W \times 5280 \times (1 / 43560) \times FE)$ where AR = accomplishment rate, ESP = equipment speed in miles per hour, W = width in feet, 5280 = ft in 1 mile, $1 / 43560$ = acres per 1 ft², and FE = field efficiency rate.

An accomplishment rate is the proportion of total performance hours each machine has for every pass across the field. Equipment speed and efficiency rates were obtained from Libbin and Hawkes (1996). The accomplishment rate is multiplied by the sum of depreciation and taxes to determine the fixed costs of using the field equipment. Fuel and repair costs were also included in the equipment cost estimates.

Postharvest equipment costs (Table 2) were depreciated using straight line over a 7-year life with no salvage value. These costs were divided by 10 to get the per-acre estimates.

In the Las Cruces experiment, a surface drip system was used and weeding was done by hand. In Alcalde, furrow irrigation was used and both hand labor and a rolling tine cultivator were used for weed control. Since surface drip is not practical for farming opera-

tions which cultivate with tractors, in the Las Cruces cost and return estimates, the drip lines were assumed buried to allow mechanical cultivation for weed control. In large scale commercial culinary and medicinal herb production near Las Cruces, significant weed problems have occurred. The irrigation system was depreciated in two parts; the drip lines and injector pump costing \$7,829 including installation were depreciated over 8 years, and the polyvinyl chloride (PVC) pipes, valves, and flush ends estimated to cost \$3,141 were assumed to have a 25-year life (B. Maier, personal communication). Annual depreciation was divided by 10 to get the per-acre estimate (Table 2).

A sensitivity analysis for each cost and return estimate was also performed. Sensitivity analyses are important because often yields from experimental trials exceed those in commercial production because research teams usually can offer greater care to small plots to minimize any yield losses due to weeds, drought, postharvest handling, etc. The yield ranges were chosen to begin at approximately the lowest level that would result in a negative return to land and risk with the price range selected, not to indicate how low yields could fall.

The prices in the cost and return estimates were those actually received in the project and are free on board (f.o.b.), or loaded at the packing house. The range of sale prices of herbs used in the sensitivity analysis were based on those published by Frontier Herb Cooperative wholesale price catalog (Baker, 1997).

The products from these experiments were sold to buyers located using the *Herbal Green Pages* (Rogers, 1995) and the *Natural Food Merchandiser* (New Hope Communications, 1996). Small quantities were sold to local herb-alists in Las Cruces, while larger quantities were sold to a tincture manufacturer in northern New Mexico and distributors in California and Oregon. Of the herbs sold from the New Mexico State University (NMSU) project (there were 9 total), distributors in California and Oregon were particularly interested in echinacea and yerba mansa.

Results and discussion

Results of this study suggest that in Las Cruces, 12-inch (30-cm) spacing of echinacea and yerba mansa produces the greatest yields (Table 3). In Alcalde, a statistically significant linear trend in yields due to plant spacing was found for echinacea, but not for valerian (Table 4). At both sites, however, the trend was increased mean yields with greater planting density. Return to land and risk for both crops at both sites were positive, using the 12-inch spacing and estimated market prices (Table 5). In Las Cruces, the returns estimated are based on a planting density of 14,520 plants/acre (35,864 plants/ha) and in Alcalde, 13,068 plants/acre (32,278 plants/ha).

In the case of echinacea and valerian roots, income in this analysis was considered available after two years. However, echinacea tops and seeds can be harvested during the first year of production. Echinacea had good results

Table 3. Echinacea (*Echinacea purpurea*) and yerba mansa (*Anemopsis californica*) yields in plant-spacing experiment, Las Cruces, N.M., 1996.

Herb spacing	Mean yield dry wt (lb/acre) ^z	SE	Linear effect
Echinacea roots, 12-inch ^y	1,980	151.64	***
Echinacea roots, 18-inch	1,560		
Echinacea roots, 24-inch	914		
Yerba mansa roots, 12-inch	3,890	133.80	***
Yerba mansa roots, 18-inch	2,550		
Yerba mansa roots, 24-inch	2,110		

^zSource: Kleitz, 1998.^y1 lb/acre = 1.12 kg·ha⁻¹.^x1 inch = 2.54 cm.***Linear effect significant at $p \leq 0.001$.**Table 4. Echinacea (*Echinacea purpurea*) and valerian (*Valeriana officinalis*) yields in plant-spacing experiment, Alcalde, N.M., 1996.**

Herb spacing	Mean yield dry wt (lb/acre) ^z	SE	Linear contrast
Echinacea roots, 12-inch ^y	1,860	143	*
Echinacea roots, 18-inch	1,440		
Echinacea roots, 24-inch	1,300		
Valerian roots, 12-inch	2,330	330	NS
Valerian roots, 18-inch	1,870		
Valerian roots, 24-inch	1,880		

^z1 lb/acre = 1.12 kg·ha⁻¹.^y1 inch = 2.54 cm.*Linear effect significant at $p \leq 0.05$.

at both sites even though income from tops and seeds was not included. Commercial growers of echinacea can sell tops for between \$1 to \$2/lb (\$2.21 to \$4.42/kg) and seeds for \$5/lb

(\$11.03/kg) (\$15/lb or \$33.08/kg for certified organic) (R. T. Johnson, personal communication). Echinacea tops can be harvested up to three times annually in Las Cruces. A seed or flow-

ers-only harvest could substitute for a tops harvest. Commercial farms typically produce 2,000 to 8,000 lb/acre (2,240 to 8,960 kg·ha⁻¹) of *E. purpurea* top material and 400 lb/acre (448 kg·ha⁻¹) of seed (R.T. Johnson, personal communication).

The sensitivity analysis performed for echinacea in Las Cruces showed that positive 2-year return to land and risk is obtained when root yields are 1,200 lb/acre (1,344 kg·ha⁻¹) and the price drops to \$5/lb (\$11.03/kg) (Table 6). At 800 lb/acre (896 kg·ha⁻¹) yield, less than half of the average for 12-inch spacing, and \$5/lb (\$11.03/kg), echinacea root returns fall just short of breaking even. Yerba mansa also had positive results. Yerba mansa sold for \$4 to \$10/lb (\$8.82 to \$22.05/kg) for dried root in 1996. The sensitivity analysis for this crop showed that a positive 1-year return to land and risk is made when yerba mansa is sold at \$2/lb (\$4.41/kg) and when yields fall to 3,200 lb/acre (3,584 kg·ha⁻¹) (Table 6).

In Alcalde, the sensitivity analysis showed at \$10/lb (\$22.05/kg) and 500 lb/acre (560 kg·ha⁻¹), echinacea still generates a positive 2-year return to land and risk. At \$4/lb (\$8.82/kg), valerian yields need to be 2,000 lb/acre (2,240 kg·ha⁻¹) in Alcalde to return \$1,748 over 2 years (Table 7).

Quality affects the per-unit price that growers obtain for medicinal herbs. Local herbalists will purchase from small

Table 5. Economic results for echinacea (*Echinacea purpurea*), valerian (*Valeriana officinalis*), and yerba mansa (*Anemopsis californica*) in Las Cruces and Alcalde, N.M., 1996.

Description	Las Cruces	Alcalde
Echinacea roots, 12-inch spacing ^z		
Average yield (lb/acre) ^y	1,978	1,857
Price (\$/lb) ^x	12.00	12.00
Gross income (\$/acre) ^w	23,736	22,284
Expenses (\$/acre)	7,643	7,672
Return to land and risk after two seasons (\$/acre)	16,093	14,612
Yerba mansa roots, 12-inch spacing		
Average yield (lb/acre)	3,885	N/A
Price (\$/lb)	4.00	N/A
Gross income (\$/acre)	15,540	N/A
Expenses (\$/acre)	7,438	N/A
Return to land and risk from 1-year-old roots (\$/acre)	8,102	N/A
Valerian roots, 12-inch spacing		
Average yield (lb/acre)	N/A	2,328
Price (\$/lb)	N/A	4.00
Gross income (\$/acre)	N/A	9,312
Expenses (\$/acre)	N/A	6,782
Return to land and risk after two seasons (\$/acre)	N/A	2,530

^z1 inch = 2.54 cm.^y1 lb/acre = 1.12 kg·ha⁻¹.^x\$1/lb = \$2.205/kg.^w\$1/acre = \$2.47/ha.

Table 6. Estimated return to land and risk under varying price and yield combinations for echinacea (*Echinacea purpurea*) and yerba mansa (*Anemopsis californica*), Las Cruces, N.M.

Yield (lb/acre ²)	Price (\$/ lb ³)			
Echinacea roots	\$5.00	\$10.00	\$12.00	\$20.00
2-year return to land and risk (\$/acre) ^x				
800	(687) ^w	2,894	4,327	10,056
1,200	806	6,177	8,326	16,920
1,400	1,546	7,813	10,319	20,345
Yerba mansa roots	\$2.00	\$4.00	\$8.00	\$10.00
1-year return to land and risk (\$/acre)				
2,800	(118)	4,896	14,922	19,935
3,200	344	6,074	17,538	23,261
3,400	586	6,674	18,848	24,936

²1 lb/acre = 1.12 kg·ha⁻¹.

³\$1/lb = \$2.205/kg.

^x\$1/acre = \$2.47/ha.

^wNegative.

Table 7. Estimated return to land and risk under varying price and yield combinations for echinacea (*Echinacea purpurea*) and valerian (*Valeriana officinalis*), Alcalde, N.M.

Yield (lb/acre ²)	Price (\$/ lb ³)			
Echinacea roots	\$5.00	\$10.00	\$12.00	\$20.00
2-year return to land and risk (\$/acre) ^x				
500	(1,265) ^w	973	1,869	5,449
1,400	1,548	7,815	10,321	20,347
1,800	2,798	10,855	14,078	26,969
Valerian roots	\$3.00	\$4.00	\$5.00	\$6.00
2-year return to land and risk, \$/acre				
1,000	(1,518)	(623)	272	1,168
2,000	(42)	1,748	3,538	5,329
3,000	1,433	4,119	6,804	9,490

²1 lb/acre = 1.12 kg·ha⁻¹.

³\$1/lb = \$2.205/kg.

^x\$1/acre = \$2.47/ha.

^wNegative.

local growers, and often pay a higher price per pound for small quantities of freshly harvested material, rather than buying from distant distributors whose product freshness is less certain. Factors such as color, aroma, flavor, percentage extraneous matter, size, moisture content, presence of mold, and chemical analysis can affect price (Baker, 1997). The level of distribution channel—farm gate, first handler, wholesale distributor, processor—also affects prices.

Where in the marketing system a farmer can sell depends on farm size, and marketing functions and processing operations performed. Value increases as additional processing is performed. In the botanical medicine pyramid, fresh herb is at the base of the pyramid, followed by dried herb, tincture, extract, standardized extract, and phyto-

medicine at the peak (Brevoort, 1998). A tincture process involves infusing fresh or dried herbs in alcohol, while an extract requires heating and greater concentration. Standardized extracts are standardized to one or more known marker compounds, which may not be the active ingredients, and phyto-medicines (gingko (*Ginkgo biloba* L.) is an example) are standardized to marker compounds in a process which often eliminates other compounds (Brevoort, 1998).

A farmer may receive \$3 to \$4/lb (\$6.62 to \$8.82/kg) for certified organic dried and cut valerian root from a wholesaler such as Frontier Cooperative Herbs (Baker, 1997), while a wholesale distributor such as Starwest Botanicals, Inc. can sell certified organic dried and cut root from the U.S. for

\$12.70/lb (\$28/kg) in 25-lb (11.35-kg) lots (Ernst, 1996). The NMSU research project received \$8/lb (\$17.64/kg) for fresh, cleaned valerian root delivered within a few days of harvest to a tincture manufacturer in Santa Fe, N.M. Shipping fresh roots entails higher shipping charges than dried root to distant markets as some means (dried ice, ice packs) must be included to prevent mold. Whether prices are f.o.b. or cost, insurance and freight (c.i.f.) should be clarified. Prices for echinacea roots, tops, and seed also vary widely (Table 8).

Often the per-unit price depends on whether a grower must move a large quantity quickly to one or a few buyers versus whether a grower has the staff to pursue selling much smaller quantities to many different buyers. In addition, the services of an experienced herb broker can also help in obtaining the best possible price in the market. Experienced brokers will know most of the production regions and what acreage has been planted, whether unforeseen weather anomalies are expected to affect yields, import patterns, and the potential for bargaining for higher prices with manufacturers and other distributors. In this analysis, only a charge for management and supervision was included, although additional marketing costs may also be incurred if a broker is used or sales staff hired.

The importance of keeping tabs on market prices and acreage expansion cannot be over emphasized. Compared to conventional field crops, medicinal herbs appear to be in the introductory phase of the product life cycle, with annually increasing demand. However, large medicinal herb acreage is in production around the globe, domestic and international conferences and trade shows draw thousands of participants and exhibitors, and market gluts can occur. For example, in Fall 1998 echinacea inventories increased to the point that prices for nonorganic echinacea fell below \$12/lb (\$26.46/kg) (R. T. Johnson, personal communication).

Although this research analyzes the potential financial outcomes of growing selected medicinal herbs in New Mexico, more research is needed. Yield response to water and fertilizer applications is unknown. In addition, the effect on herb quality from irrigation, soil fertility, harvest timing, seed source, and plant age needs to be assessed. For example, application of high levels of

Table 8. Selling prices of selected vendors of echinacea (*Echinacea purpurea*) and valerian (*Valeriana officinalis*) herbs and seeds, 1997.

Company	Cost {\$/lb [lot size (lb)]} ^y			
	Starwest ^z	Good Hope ^y	Richters ^x	Johnny's ^w
Echinacea				
Certified organic seeds				115
Certified organic cut/dried tops	11.05 [25]			
Certified organic cut/dried roots	34.00 [25]			
Noncertified organic seeds			68.55	35
Noncertified organic cut/dried tops	8.50 [25]	24.97		
Noncertified organic cut/dried roots	22.35 [25]	32.00 [25]	96.70	
Valerian				
Certified organic cut/dried roots	12.70 [25]			
Noncertified organic seeds			680.27	182
Noncertified organic cut/dried roots	3.20 [25]	3.02 [25]	34.47	

^zErnst, 1996.^yGood Hope Botanicals, 1997.^xRichters, 1997.^wJohnny's Selected Seeds, 1997.^v\$1/lb = \$2.205/kg. 1 lb = 0.454 kg.

nitrogen and medium levels of potassium has been linked to higher levels of alkylamides in *E. purpurea* (El-Gengaihi, et al., 1998). Alkylamides are responsible for the numbing and tingling sensations produced by echinacea and are desired compounds (Foster, 1999). The medicinal herb market is moving toward payments of bonuses to growers who can increase the content of marker compounds in selected herbs, such as echinacea, where standardization of herbal preparations is common. In such cases, growers are being asked to provide laboratory analyses along with product samples, and such tests can cost \$200 to \$500 depending on the number of tests run.

An additional caveat is in order. This study projected the financial return to a small-scale operation in which minor investments in a converted barn batch drying facility are assumed. Larger scale farming will require medicinal herb growers to either lease or build facilities capable of handling the washing, chopping, drying, and cleaning requirements for larger quantities of root, top, and seed material. In a region such as northern New Mexico, such facilities cooperatively managed might be an appropriate strategy for a relatively small farm producing medicinal herbs.

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