

**DEVELOPING REDCEDAR
ESSENTIAL OIL MARKET IN
MINNESOTA:
Economic Opportunity for Rural
Development?**

Report submitted to:

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I. Background

Eastern redcedar (*Juniperus virginiana*) is often considered a "weed or nuisance" tree. In some states, this species has been declared invasive and management strategies have been adopted to destroy it. However, in recent studies of the redcedar market in some southern states of USA, redcedar has been found to be a profitable expanding market generating \$60 million dollars in annual sales.

The focus of this study was to explore the possibility of developing market for redcedar essential oils and other by products for this species given its moderate presence in the Prairie Country RC&D area in west central Minnesota.

Using Forest Inventory Data Analysis (FIA) we have estimated the volume and acreage of redcedar resources for the state across all ownerships to serve as a bench mark for seeking opportunities to producing and finding market for redcedar oil as a possible income source for landowners and small business owners/developers.

II. Eastern Redcedar

Eastern redcedar (*Juniperus virginiana* L) is a member of the cypress family (*Cupressaceae*) and one of the most widely distributed conifers in the eastern and central United States (Figure 1). Because of its ability to grow under extreme and highly variable climatic conditions, as well as a range of soil, topographic and altitude variables, the natural range has extended well into the Great Plains. It grows on areas ranging from dry rock outcrops to swampland. Like most any species it grows best on deep, moist, well-drained sites where its height may reach as much as 60 feet in 50 years.

The species has proliferated over the past 50 years due to land conversion set aside programs (e.g., Conservation Reserve Program [CRP]), overgrazing, withdrawal of marginal land from crop or animal production and fire suppression. Because of this proliferation, habitat encroachment, and a perception of low value, many landowners view eastern redcedar as an invasive weed species.

Eastern redcedar is a dioecious species, meaning it has male and female plants, and the trees reach sexual maturity at about 10 years of age. The seed is borne in a green to greenish-white to whitish-blue cone appearing like berries on the tree and are usually found in heavy amounts, but only on the female trees. Each fruit will contain between 1 and 4 small brownish seeds. Mature trees produce some seeds nearly every year but good crops occur only every two to three years. Eastern redcedar will not reproduce naturally by sprouting or suckering, and if it is cut off near the ground level it will not reappear from that single plant. Fire is also very deadly to the small plants as the oil-soaked leaves are a natural combustible material and the bark is thin enough that it does not protect the cambial layer from ground fires. Few insects cause serious damage to the tree, although the roots are susceptible to nematode attack.

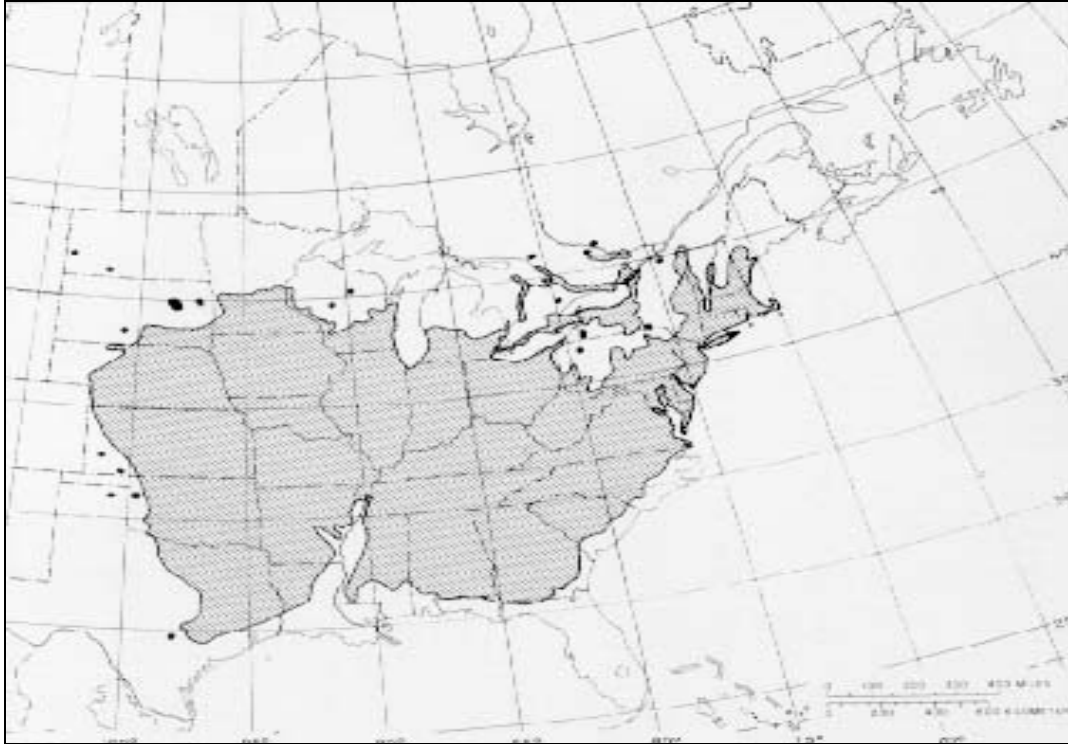


Figure1. Native range of Redcedar in the USA.

Eastern redcedar displays a great diversity in phenotypic characteristics such as tree form, color and crown shape. This is important in that this high variability in genetic material makes it an excellent candidate for the production of different varieties used in the landscape business and potentially important for development of varieties for commercial applications and uses.

III. Eastern Redcedar Resources

According to USDA Forest Service forest inventory analysis (FIA) data, the four states with the highest stocking of Eastern Redcedar are Arkansas, Tennessee, Kentucky, and Missouri (Table 1). Current raw inventory data show that these four states account for 53 percent of the nation's eastern redcedar and that the usable resource will slowly increase in quantity for the next three decades (Sullivan 2003). On the contrary, Minnesota share of Eastern Redcedar volume nationally is approximately 1% (**324,400 Cords**).

Minnesota has approximately 15 million acres of forest land that is classified as “timberland” (Fig 2). Timberland is forest land that is productive enough to produce a commercial crop of trees and is not reserved from harvesting by policy or law.

Of the total timberland in Minnesota, redcedar is by far a minor component with only about **35, 000 acres** (Fig 2). Of this about 5000 acres is found in the Prairie Country RC&D area. Acreage mentioned here reflects only redcedar stands that have redcedar as the dominant canopy for all ownerships types.

Table 1. Distribution of Redcedar on Timberland by State (US FIA Data)

State	Volume (Cords)	Percent Nationally
Arkansas	5,255,000	11
Kentucky	5,625,400	12
Missouri	7,819,300	16
Tennessee	6,873,600	14
Minnesota	324,400	1
Total Volume Nationally	48,250,000	

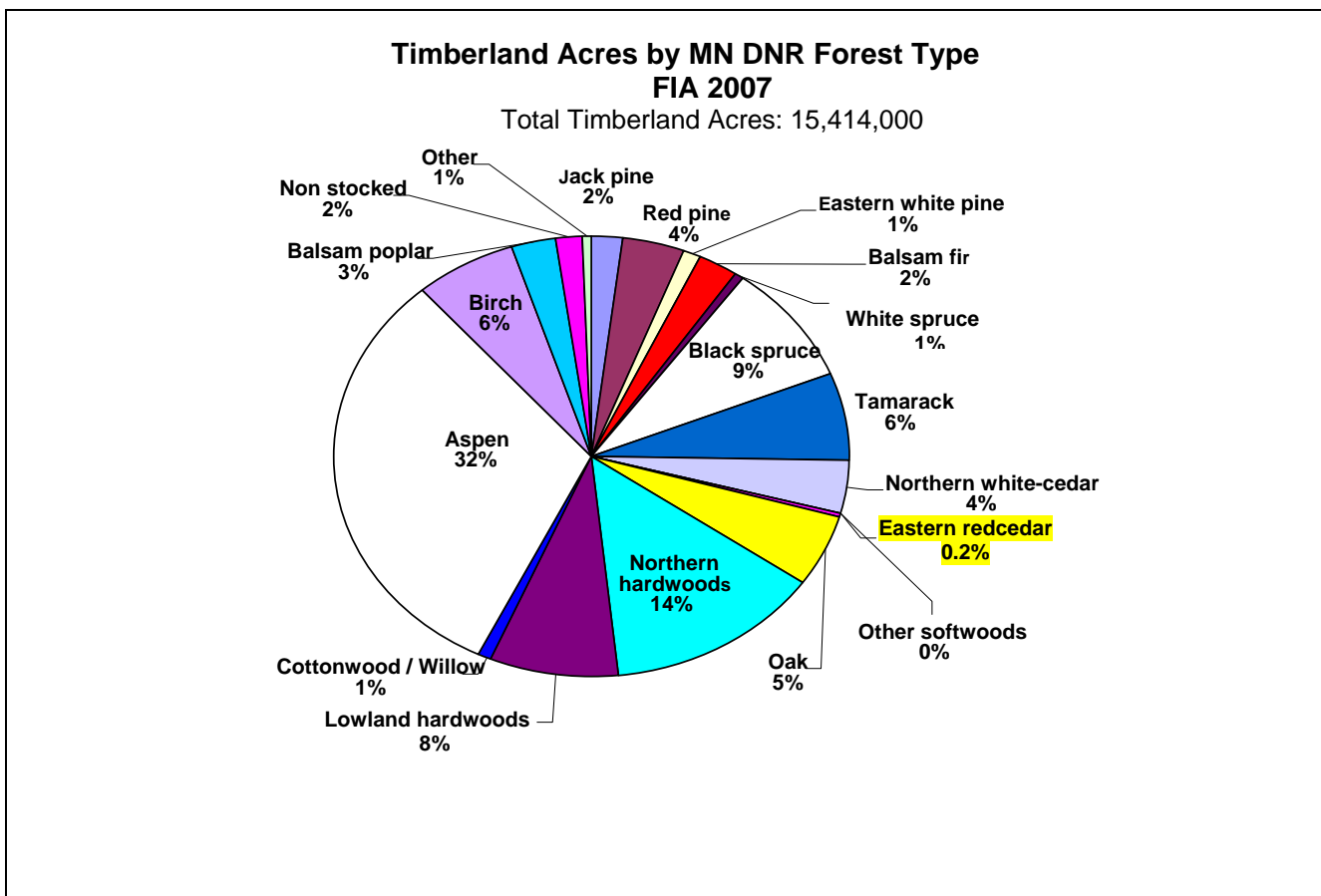


Fig 2. Distribution of timberlands in Minnesota by major species

Source: 2007 FIA Database Provided by USFS North Central Forest Experiment Station.

IV. Eastern Redcedar Possible Products

Eastern redcedar has characteristics that are unique and increasingly desirable to consumers such as durability, beauty (a purplish red color), fragrance, ease of maintenance, and insect (ant and termite) and natural decay resistance. Eastern redcedar wood is used in construction and for furniture, especially for cedar chests and closet wardrobes. As wood utilization by-products, shavings are widely used for large and small animal pet bedding, and mulch distinguishes itself by its appealing color, aroma, durability, and insect deterring properties. The heartwood of eastern redcedar logs contains secondary metabolites "oils" that resist and/or repel insects and decay (Suszkiw 2000).

From an ecological point of view, eastern redcedar is often used for wildlife habitat and in agroforestry practices for shelterbelt and windbreak plantings. Eastern redcedar is relatively fast growing, generating a marketable return in the 6- to 8-inch diameter class at age 35 to 45 years instead of 60 to 70 years required of many other timber species (Lawson 1985). With eastern redcedar, every part of the tree can be marketed (Paul Todd *personal conversation*). In addition to primary manufacturing products including cants, fence and mail box posts, dimensional lumber, and tongue and groove closet paneling, odd-sized slabs and by-products are used as craft blanks, cedar balls, clothing hangers, shoe trees, shavings or mulch. Further, sawdust and planer shavings from sawmills are processed for extracting cedarwood oil for the fragrance industry. Residue can be used as boiler fuel for generating steam for the oil process extraction and as space heating in the winter. As a result, nationwide, eastern redcedar is an estimated \$60 million per year industry (Gold et al. 2005).

Another potential opportunity for use of the whole tree or at least for the woody component is in the biomass industry. Here again a considerable amount of research is needed to determine whether the characteristics of redcedar is conducive to commercial use in this developing field.

Table 2. Eastern Redcedar Products

Logs	Clothes hangers or hooks
Cants	Cedar necktie and belt hanger
Closet lining /Paneling	Shoe rack, shoe "trees"
Fence Posts	Cedar Moth Balls
Dimensional lumber	Bird feeders
Cedarwood oil	Bird houses
Gazebo, cabana	Mailboxes
Furniture (chests, beds, drawers, tables, chairs, shelves, wardrobes and closets)	Mailbox posts
Outdoor furniture (benches, tables, chaise lounge)	Boxes, novelties
Animal bedding	Pencils
Mulch	Carvings
Wood turnings	Wreaths
Canes	Wood chips

V. Cedar Oil

Volatile or essential oils are the concentrated aromatic compounds produced from leaves, seeds, barks, roots and the peels of the fruits of wide range of plant species. They vaporize upon contact with air. Volatile oils are recovered from plants by different methods, such as steam distillation and solvent extraction, depending on the present oil quality and the stability of the aromatic components. They can be redistilled and purified for the desired properties of end products. The volatile/essential oils and their derivatives are used for their aromatic property as flavorings in food, beverage products, as fragrances in perfumery and cosmetic products (Baucard and Serth, 1991).

Oil obtained from wood of eastern redcedar (Virginian Cedarwood oil -“Red Cedarwood oil”) has been known for a long time and used in a very broad range of products due to its unique properties, such as its odor, repellency or toxicity to many pests. Also cedarwood oil derivatives have been used in numerous industrial products in the form of fragrances and flavors.

Virginia Cedarwood oil is obtained from steam-distilling sawdust, waste shavings, old stumps, and chipped logs of eastern redcedar. This oil is widely used in the fragrance industry in products such as soaps, air fresheners, floor polishes, and sanitation supplies (Table 3). It is also used in deodorants, insecticides, mothproof bags, floor polishes, and janitorial supplies

Therefore, today eastern redcedar is regarded as a potentially valuable and renewable resource for most of eastern and southern eastern USA in view of the huge volumes of standing redcedar resources.

VI. Recovery Methods and Oil Yield

According to Semen and Hiziroglu (2005), Redcedar oil is recovered by several methods, such as steam distillation, continuous partial pressure, solvent extraction and super critical fluid extraction, for laboratory or commercial uses. Oil yield depends on the type of the recovery method used. It is also correlated to the oil content of the wood, which is affected by the other factors, such as, age of tree, time of harvesting, growth/soil and harvesting conditions, tree segment from which sample is taken from and size of the wood sample. The influence of these major factors on the oil content/oil yield should be taken into the consideration while reviewing major recovery methods used in the laboratory or industry. Steam distillation is the most commonly used and the simplest method of oil recovery due to its suitability to field conditions (Mater Engineering, 1992). The principal feature of the steam distillation is that steam vaporizes the volatile oil/substances, which are insoluble or slightly soluble in water. Once the steam is cooled down and condensed, the oil separates. Klein reported the oil yield from eastern redcedar wood ranges from 1 to 3.5%, depending on the ratio of the heartwood to sapwood. Eller et al. (2000) found that wood produced the same yield of oil (3.5%) whether it is from virgin or secondary growth trees. Adams et al. (1987) calculated oil yields from heartwood of eastern redcedar species based on both dry material weight and fresh material weight using a laboratory scale steam distillation unit.

Distillation was carried out for 20h. The yields from heartwood of eastern redcedar were 3.18 and 2.56% on dry and wet bases, respectively. A six hours solvent extraction (hexane followed by

methanol) was also carried out on the same material and 4.01% yield on dry base was attained. Payne et al. (1999) conducted a study to determine the quantity of Cedar oil isolated by various methods including laboratory and commercial steam distillation. In this study, sawdust wood material was pretreated with several different procedures, such as blending, soaking in water for overnight. The samples, which were blended and then soaked overnight, resulted in the highest yield. A modified Abderhalden drying apparatus (ADA) method was developed to determine the oil yield and moisture content accurately (Baucard and Serth, 1991). It was found that the oil yield from ADA was greater than the one obtained through laboratory steam distillation (SDA). The results indicated that the oil yield from heartwood chips (4.86%) and that from sawdust (5.65%) were not significantly different while using ADA method (Baucard and Serth, 1991).

VII. Redcedar Market and Competition Considerations

Essential oils are at the core of the \$10 billion U.S. food flavorings and cosmetic industry. Despite their being a very small volume commodity, the oils and their chemical derivatives have a strategic importance because of their irreplaceability in certain formulas that have been well established and on the retail market for years. Most of the users of essential oils are located in highly developed and industrial countries such as the United States, Europe, and Japan.

There are nonetheless severe drawbacks to entering the essential oils and aromatics business. Small producers in the United States also must contend with a virtual price control by a few large companies on the East Coast.

More recently, since the beginning of the current economic depression, the prices for essential oils have fallen at the same time that consumption has decreased. For example, cedarwood oil Texas has dropped from a total production of 600 drums per month to 350 drums per month, and this oil is one of the highest volume oils. The price for cedarwood oil Texas is now at 1975 levels (\$2.75 per pound). The same is happening for a number of other essential oils. For instance, current price for Virginia Cedar Oil (Eastern redcedar oil) is about \$20 for 16 oz (~ \$20/lb see Table 3). This price is down by \$7 or 15% compared to 2 years ago. It is worth noting that, despite the reduction in price, manufacturers are still getting good price for the oil in view of the fact that prices for wood including redcedar wood are in sharp decline due to the current economic downturn.

Table 3. Current redcedar oil retail price

Virginia Cedar Oil	Retail Price
1 oz	\$2.89
2 oz	\$5.56
16 oz	\$20.39
32 oz	\$39.27
25 lb. pail	\$388.24

Source: Texarome Inc. Leakey, Texas.

According to Paul Todd (President, Aromatic Cedar Association), there are two options available to the entrepreneur desiring to enter the essential oils market. The first is to enter the market in a fairly major way, for example, with an investment in an essential oil distillation plant of between \$1 million and \$2 million. Such a plant would need to be set up to process 50 tons of raw materials a day. This option even when capital is available will not be conducive for Minnesota due to low volume of redcedar resources.

The second option will be to process redcedar for a niche market, thus converting redcedar resources for other uses along side producing other by- products from this process. This raises the second alternative for essential oils production that is probably more consistent with rural small business development. This alternative is to develop a very small-scale “back yard” distillation process in conjunction with entering into the biomass energy market or small saw mill business where excess low quality and excess material could be channeled into oil production. This will be ideal for the redcedar resources in the Prairie Country RC&D area and in Minnesota in general where redcedar resources are available in modest quantities.

The biggest problem for the very small entrepreneur trying to sell manufactured oil is the reliability of his or her production. It is difficult to get enough production to convince a buyer—for example, a cosmetic company - to buy the product. A consumer-based product line cannot be introduced only to find that the oil for that commercial product is not in dependable supply. If a reliable supply and sufficient quantities of the raw material cannot be identified, the project will be dropped and not deemed feasible.

VIII. Factors to Consider for Entering The Redcedar Oil Production Business

Equipment Needs, Costs, and Suppliers

A distillation unit that could achieve a very small-scale level of production would cost in the range of \$5,000 to \$10,000 and could be lease-purchased or bought. If purity and efficiency were not major concerns, it would also be possible to build a very small “home-made” distilling apparatus, since the overall concept is not complex. In fact, many of those in the cedar oil business design their own distilling equipment. The key is having a source of steam: the steam volatilizes the oil in the nodules of the boughs, and the steam-oil mix is put through a condenser. The oil and water separate and the oil is dipped off. Someone with a steam boiler can build a still with drums and chicken wire to hold the plant material. Some kind of chopper is necessary to pulverize the plant material too.

Capital Needs

The most critical need for a new or startup business is usually capital. Manufacturing businesses, such as cedar oil production, are not typically successful with the shoestring approach where the business starts with personal capital in one’s garage and grows as profits are reintroduced to the business. Land, buildings and equipment purchases for even a modest venture such as a small sawmill can run over \$100,000 and particleboard plants begin in the multi-million dollar range.

To apply for any business loan or assistance, one of the first requirements is to be able to reassure people that are far removed from forestry that the raw resource is available. Knowledgeable estimates of size and availability of redcedar and other junipers within a given radius of a proposed plant is of paramount importance. Whether the goal is making particleboard or lumber, or instituting a burning and clearing program, it is important to be able to point with some confidence to areas of raw material concentration. An excellent vehicle for such a survey may lie with the Forest Inventory and Analysis (FIA) as analyzed above.

Distribution and Packaging

Essential oils must be stored so that they remain unexposed to air, light, heat, and heavy metals. If allowed to deteriorate, they become less fragrant, more viscous, and darker. Because they have no fatty acids, rancidity is not a problem. Properly stored and sealed, most oils last for years and some reputedly improve with age.

Environmental Considerations

Society is becoming more careful about the toxicity or other adverse effects of materials. Many small companies are virtually uninsurable by insurance companies, and product liability for a small line of retail cosmetic products is very expensive. One lawsuit can bankrupt a small company at any given time. Processing plants can require up to 2 years of preparation because of permit requirements and environmental constraints, chiefly related to air quality and water quality concerns. There are a lot of shysters in the aromatics business. For example, “stretching” an oil with synthetic compounds. There is a labeling law in the United States related to the use of products in the food industry. All products that use the term “natural flavor” in the label must use compounds that are naturally derived. This requirement can create market opportunities in some instances.

Rural Development Strategy

Essential oils, like many other specialty manufactured products, are almost certainly a product about which few bankers anywhere, much less bankers in rural areas, are likely to be knowledgeable. Similarly, rural bankers would have no easy way of obtaining statistics on such products. Therefore, securing financial assistance for these enterprises would almost certainly require that these products be introduced (along with several other natural resource-based enterprises) through a concerted education program throughout a rural region. Such a program might involve bankers, small business development centers, State departments of economic development and agriculture, a university center capable of the appropriate technology transfer, and community leaders.

Marketing is one of the most important facets of successful businesses. Assistance to small and startup businesses, especially ones with a new product line, is of paramount importance. These needs should be recognized and appropriate agencies tasked with assistance to the business owner.

IX. Conclusion

Eastern Redcedar is one of the most important sources of essential oils. As a natural chemical, the range of values of Redcedar essential oil is extremely broad. Use of it extends as an essential ingredient in the perfumery industry due to its woody smell, to all areas of life from repelling pests to curing illness. It is important to note that, not all of cedarwood for oil production comes directly from felled trees, but sawdust and wood shavings that are produced during sawing of logs, manufacturing of secondary forest products such as lumber etc is also used in the oil distillation process. These uses of Redcedar wood residues increase the economic viability of distillation plant for oil production, and minimizes the wastage of Redcedar wood. Despite these known facts and diverse uses, a profitable commercial business based on distillation and sale of Redcedar essential oil alone in Minnesota will be challenging. Based on the modest volume of Redcedar resources in Minnesota, a good market strategy to be successful in the market place will be to concentrate in developing small market niches for Redcedar oil in combination with other products, and building strong relationship with suppliers and consumers at the same time.

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