

# Hemp: Many possibilities as an alternative crop

By Jim Bauder and Linzy Carlson  
MSU Land Resources and Environmental Sciences

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BOZEMAN -- Most people know that industrial hemp has been a source of rope, cloth and paper since ancient times, but few recognize its incredible potential today. It represents an ecologically stable, renewable source of raw materials to make such diverse products as automobile fuel, plastics, building materials and food for animals and people.

The agronomics of hemp are pretty standard. Start with a light textured soil with a pH of 6.0-7.5 worked into a firm, level seedbed at 45 to 50 degrees Fahrenheit. Using a regular grain drill, seed 35-60 pounds per acre (depending on seed weight and germination rate). Because hemp plant density chokes out weeds, it grows well without herbicides. It naturally resists attack from bugs and fungi, reducing the need for pesticides and fungicides. In contrast, almost half of all agricultural chemicals used in the U.S. are applied to cotton. Hemp requires 12-16 inches of water over the course of its 120-150 day growing season. Harvesting hemp involves either swathing and baling it for fiber use or combining it for seed. Hemp can be grown for both fiber and seed, but this often sacrifices the quality of both. Yields range from 3-4 tons/acre for fiber and 300-600 pounds/acre for seed, depending on soil quality.

Once harvested, hemp seed can be processed into oil, which can then be made into oil for human consumption, lotions, soaps, salves and plastics. Hemp seed can also be made into flour, wine, beer and even candy. The seed is highly nutritious, containing more essential fatty acids than any other source. It is high in B-vitamins and contains 35 percent dietary fiber. It is second only to soybeans in complete protein and is actually more digestible by humans.

Hemp can be manufactured into biodegradable plastic products, such as plant-based cellophane and resins, and materials previously made entirely from synthetic fibers. For example, the automobile industry has been using natural fibers, similar to those from hemp, in composite materials used to make door panels and moldings and for insulation, carpets and fabrics. The aviation industry has also been taking a closer look at natural fiber, because in plane crashes people often die not only from the impact but also from inhalation of toxic fumes from burning synthetic materials. Aside from being more ecologically friendly than synthetics, natural fibers lead to stronger, lighter products while causing less wear and tear on manufacturing equipment.

Important early documents, such as the Declaration of Independence, were written on hemp paper, so making paper from hemp and other natural fibers is certainly not new technology. In today's age of recycling, hemp can be added to recycled pulp to add strength, since each time paper is recycled the original wood fibers get short and weaker. Hemp paper can be recycled seven times, while wood paper only lasts three recyclings. Hemp fiber has less lignin than wood pulp, thus reducing the quantity of environmentally hazardous chemicals needed for processing. Plus, the finished hemp paper has no acid, so it does not become brittle and yellow with age.

One of the downsides of hemp is that it is potentially a noxious weed. It has the potential to escape, and it is very competitive and a very efficient in its water use.

Perhaps the most exciting use of hemp is in the production of biofuels, the diesel and gasoline-like fuels made from hemp oil, vegetable oil or animal fats. Once again, this is not new technology. In 1895 Dr. Rudolf Diesel invented the first peanut oil powered diesel engine and Henry Ford strongly supported using ethanol made from American grown oilseed crops, such as hemp. Wood paper and petroleum based fuels and plastics came to dominate the markets, but relatively recent concerns of smog, acid rain, health problems and dependence on foreign oil have revived thoughts of hemp's many benefits. And there are numerous advantages to hemp-derived biofuels for both gasoline and diesel engines. The following list deals with a specific biofuel called biodiesel.

Biodiesel is the only alternative fuel that runs in any conventional, unmodified diesel engine. Its use can extend the life of diesel engines, because it is more lubricating than petroleum diesel fuel. Fuel consumption, auto ignition, power output and engine torque are relatively unaffected by biodiesel and it is a proven fuel with over 30 million successful US road miles and over 20 years of use in Europe.

It can be stored anywhere that petroleum diesel fuel is stored. Biodiesel is as biodegradable as sugar, 10 times less toxic than table salt and has a high flashpoint of about 300 degrees Fahrenheit compared to petroleum diesel fuel, which has a flash point of 125 degrees F.

When burned in a diesel engine, biodiesel replaces the exhaust odor of petroleum diesel with a smell something akin to french fries. Biodiesel is 11 percent oxygen by weight and contains no sulfur, so instead of creating sulfur-based smog and acid rain as by-products, it produces oxygen instead. Biodiesel can be made from domestically produced, renewable oilseed crops such as hemp.

Biodiesel is the only alternative fuel in the US to complete EPA Tier I Health Effects Testing under section 211(b) of the Clean Air Act, which provide the most thorough inventory of environmental and human health effects attributes that current technology will allow. The Congressional Budget Office, Department of Defense, US Department of Agriculture and others have determined that biodiesel is the low cost alternative fuel option for fleets to meet requirements of the Energy Policy Act.

Ask any American what environmental problems they are most concerned with and undoubtedly the response will contain mention of rapidly filling landfills, air and water pollution and the adverse affects of these factors on earth's plant, animal and human population. Ask any American farmer what needs to be done to help the flailing agricultural economy and part of the solution will probably entail integration of alternative crops into conventional farming operations. With this in mind, hemp may help provide both economic and ecological stability.

## **Basic Uses of Industrial Hemp: Food, Fuel, Fiber**

by Mari Kane

Cannabis Hemp really can provide all the basic necessities of life: food, shelter, clothing and medicine. It has been said that "anything made from a hydrocarbon can be made from a carbohydrate." Hemp is the cousin of marijuana. They are from the same plant -- Cannabis sativa L. There are over 1,000 strains of Cannabis Hemp bred for various uses. The term "Hemp" refers to the industrial use of the stalk and seed of certain varieties; Cannabis or "marijuana" refers to the smoking or ingesting of the flowers and leaves of certain other varieties.

Psychoactivity requires high levels of THC -- Tetrahydrocannabinol. Cannabis contains 5%-10% THC. Industrial hemp contains only .3%-1.5% THC, yet has a higher concentration of Cannabidiol, or CBD, which maintains an inverse relationship with THC and tends to moderate its effects.

The plant itself is easy to grow in temperate as well as tropical climates, and requires the usual amount of fertilizer and water, but no pesticides nor herbicides. A hemp crop is usually harvested in 100-120 days after reaching a height of 4-15 feet, depending on the variety. At that point one can make it into whatever suits their needs.

### **FOOD**

The hemp seed is the only source of food from the hemp plant. It is not really a seed, but an achene -- a nut covered with a hard shell. Hemp seed is used for people and animal food, and industrial use. Whole hemp seeds imported to the United States or Canada must be sterilized to prevent sprouting. This is not the case in Europe where fresh seeds are used. Shelled hemp seeds are the latest technological advance.

#### **Whole Seed**

The whole seed contains roughly 25% protein, 30% carbohydrates, 15% insoluble fiber, Carotene, phosphorous, potassium, magnesium, sulfur, calcium, iron and zinc, as well as vitamins E, C, B1, B2, B3 and B6. Hemp seed is one of the best sources of Essential Fatty Acids (EFAs) with a perfect 3:1 ratio of Omega-6 Linoleic Acid and Omega-3 Linolenic Acid, good for strengthening the immune system. It is also a source of Gamma Linoleic Acid (GLA) which is otherwise available only from specialty oils like evening primrose oil or borage oils. Whole seeds are made into snack bars, cookies and porridge, or they may be roasted and consumed alone or in a trail mix, or brewed with coffee or beer. Wild and domestic birds love hemp seeds, too.

#### **Shelled Seed**

Removing the outer coating of the hemp seed produces a wonderful nut that is being used in many different food applications, including snack bars, cookies, nutbutter, chips, pasta, tortillas and hummus. The flavor is nutty and can be used as a topping on just about anything. It can be roasted with spices or just eaten raw.

#### **Seed Oil**

Hemp seed is 30% oil and is low in saturated fats. Hemp seed oil is good for lowering cholesterol levels and strengthening cardiovascular systems. The oil has a pleasantly nutty flavor. Among the foods hemp seed oil is made into are sauces, butter, salad dressings, condiments and pesto. Processing of hemp seed oil starts with drying the seeds to prevent sprouting. The seeds are then pressed and bottled immediately under oxygen-free conditions. Hemp seed oil is fragile and should be kept refrigerated in dark, air tight containers.

#### **Seed Meal and Presscake**

The meat of the seed is also highly nutritious and versatile as a seed "meal" and may be made into hemp milk and cheese, non-dairy ice cream, burgers, and anything else one might conceive of. Left over from pressing the oil is the "presscake" -- high in amino acids, which can be crushed for animal feed or pulverized for flour to make breads, pastas or pancakes.

Throughout history, hemp has provided a nourishing food supply to many cultures around the world. In Asia, roasted hemp seed is eaten as a snack, like popcorn. In Russia, hemp butter was used as a condiment by the peasant folk. In Poland, seeds are used for holiday sweets. Hemp seed was eaten by Australians during two famines in the nineteenth century. The most famous hemp seed consumer is Buddha himself, who ate them during his fast of enlightenment.

## **Body Care**

One of the fastest growing market sectors for hemp seed oil is body care products. The phenomenal essential fatty acid content of hemp oil makes it ideal as a topical ingredient in both leave-on and rinse-off bodycare products. The EFAs help soothe and restore skin in lotions and creams, and give excellent emolliency and smooth after-feel to lotions, lipbalms, conditioners, shampoos, soaps and shaving products.

## **Non-Food Oil Uses**

Other non-food uses for hemp seed oil are lamp lighting, printing, lubrication, household detergents, stain removers, varnishes, resins and paints. In this area, hemp seed oil is similar to linseed oil.

## **FIBER**

One of the most valuable parts of the hemp plant is the fiber, commonly referred to as "bast," meaning that it grows as a stalk from the ground. Other fibers such as sisal, manila hemp and jute are mistakenly referred to as hemp, yet only *Cannabis sativa* is considered "true hemp." Among the characteristics of hemp fiber are its superior strength and durability, and its resistance to rot, attributes that made hemp integral to the shipping industry. The strong, woody bast fiber is extracted from the stalk by a process known as decortication. Hemp fiber contains a low amount of lignin, the organic glue that binds plant cells, which allows for environmentally friendly bleaching without the use of chlorine. In composite form, hemp is twice as strong as wood. All products made with hemp fiber are biodegradable.

### **Long Fiber**

Extracted from the bark of the stalk, this type of fiber is called "long" because it stretches the entire length of the plant. The length of the fiber enhances the strength and durability of the finished goods. Hemp can grow to 15 feet or more, making it excellent for textile production. Hemp is most similar to flax, the fiber of linen products. By contrast, cotton fibers are approximately 1-2 cm in length and are prone to faster wear. Hemp fiber also has insulative qualities that allow clothing wearers to stay cool in summer and warm in the winter. It also provides UV protection. Long hemp fiber is used in twine, cordage, textiles, paper, webbing and household goods.

### **Short Fiber**

The short fibers, or "tow," are the secondary hemp fibers. While not as strong as the long fibers, the tow is still superior to many other fibers. Tow is extracted from the long fibers during a process called "hackling," a method of combing and separating the fiber from hurd. Short fibers are used to make textiles, non-woven matting, paper, caulking, auto parts, building materials and household goods.

As long ago as 450 BC, the Scythians and Thracians made hemp linens. The Chinese first used hemp for paper making in 100 AD. Hempen sails, caulking and rigging launched a thousand ships during the Age of Discovery in the 15th century. The American Declaration of Independence was drafted, but not signed, on hemp paper.

### **Core**

Also known as hurds or shives, the core is the woody material found in the center of the hemp stalk. It is rich in cellulose, a carbohydrate that can be made into paper, packaging and building materials, as well as plastic composites for making skate boards, auto bodies and interior auto parts such as door panels and luggage racks.

## **FUEL**

Hemp biomass as a source of fuel is the most under-exploited use of hemp, due to the fact that it is economically unfeasible at this time. Hemp stalks can be used in the generation of energy through a process called "chemurgy" which is a cross between chemicals and energy. The hemp stalk can be converted into a charcoal-like substance through a process called pyrolysis, and used for power generation and to produce industrial feed stocks. Auto giant Henry Ford was a pioneer in the pyrolysis process, and operated a biomass pyrolytic plant at Iron Mountain in northern Michigan.

Hemp as an auto fuel is another potential use. Almost any biomass material can be converted into methanol or ethanol, and these fuels burn cleanly with less carbon monoxide and higher octane. In

fact, the diesel engine was invented to burn fuel from agricultural waste, yet ended up burning unrefined petroleum. Hemp seed oil can also be refined to produce a type of biofuel. Woody Harrelson recently toured the west coast with a diesel bus run on hemp biofuel, and a hemp-powered car toured North America a few summers ago, demonstrating the environmental benefits of biofuels.

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## **HEMP.**

### **SOILS SUITED TO HEMP.**

Pubdate: 1914 Source: 1913 Yearbook of the United States Department of Agriculture  
Author: Lyster H. Dewey, Botanist in Charge of Fiber-Plant Investigations, Bureau of Plant  
Industry Pages: 308-309, 335-337

Hemp requires for the best development of the plant, and also for the production of a large quantity and good quality of fiber, a rich, moist soil having good natural drainage, yet not subject to severe drought at any time during the growing season. A clay loam of rather loose texture and containing a plentiful supply of decaying vegetable matter or an alluvial deposit alkaline and not acid in reaction should be chosen for this crop.

### **SOILS TO BE AVOIDED.**

Hemp will not grow well on stiff, impervious, clay soils, or on light sandy or gravelly soils. It will not grow well on soils that in their wild state are overgrown with either sedges or huckleberry bushes. These plants usually indicate acid soils. It will make only a poor growth on soils with a hardpan near the surface or in fields worn out by long cultivation. Clay loams or heavier soils give heavier yields of strong but coarser fiber than are obtained on sandy loams and lighter soils.

### **HEMP DESTROYS WEEDS.**

Very few of the common weeds troublesome on the farm can survive the dense shade of a good crop of hemp. If the hemp makes a short, weak growth, owing to unsuitable soil, drought, or other causes, it will have little effect in checking the growth of weeds, but a good, dense crop, 6 feet or more in height, will leave the ground practically free from weeds at harvest time. In Wisconsin, Canada thistle has been completely killed and quack-grass severely checked by one crop of hemp. In one 4-acre field in Vernon County, Wis., where Canada thistles were very thick, fully 95 per cent of the thistles were killed where the hemp attained a height of 5 feet or more, but on a dry, gravelly hillside in this same field where it grew only 2 to 3 feet high, the thistles were checked no more than they would have been in a grain crop. Some vines, like the wild morning-glory and bindweed climb up the hemp stalks and secure light enough for growth, but low-growing weeds can not live in a hemp field.

### **YIELD.**

The yield of hemp fiber ranges from 400 to 2,500 pounds per acre. The average yield under good conditions is about 1,000 pounds per acre, of which about three-fourths are line fiber and one-fourth is tow. The yield per acre at different stages of preparation may be stated as follows:

Stalks: Green, freshly cut; 15,000 pounds Stalks: Dry, as cured in shock; 10,000 pounds  
Stalks: Dry, after dew retting; 6,000 pounds Long fiber, rough hemp; 750 pounds Tow; 250  
pounds

If the 750 pounds of long fiber is hackled it will yield about 340 pounds of single-dressed hemp, 180 pounds shorts, 140 pounds fine tow, and 90 pounds hurds and waste.

The average yields in the principal hemp-producing countries of Europe, based on statements of annual average yields for 5 to 10 years, are as follows:

Russia; 358 pounds Hungary; 504 pounds Italy; 622 pounds France; 662 pounds

The yield is generally higher in both Europe and the United States in regions where machine brakes are used, but this is due, in part at least, to the better crops, for machine brakes usually accompany better farming.

#### COST OF HEMP-FIBER PRODUCTION.

The operations for raising a crop of hemp are essentially the same for raising a crop of wheat or oats up to the time of harvest, and the implements or tools required are merely a plow, disk, drill or seeder, a harrow, and a roller, such as may be found on any well-equipped farm. Estimates of the cost of these operations may therefore be based upon the cost of similar work for other crops with which all farmers are familiar. But the operations of harvesting, retting, breaking, and baling are very different from those for other farm crops in this country. The actual cost will, of course, vary with the varying conditions of different farms.

Hemp can not be economically grown in areas of less than 50 acres in any one locality so as to warrant the use of machinery for harvesting and breaking. The following general estimate is therefore given for what may be considered the smallest practical area:

Estimated cost and returns for 50 acres of hemp.

Cost: Plowing (in fall) 50 acres, \$2 per acre; \$100 Disking (in spring), 50 cents per acre; \$25 Harrowing, 30 cents per acre; \$15 Seed, 40 bushels, delivered, \$4.50 per bushel; \$180 Seeding, 40 cents per acre; \$20 Rolling, 30 cents per acre; \$15 Self-rake reaper for harvesting; \$75 Cutting with reaper, \$1 per acre; \$50 Picking up from gavels and shocking, \$1 per acre; \$50 Spreading for retting, \$1.50 per acre; \$75 Picking up from retting swath and setting in shocks, \$1.40 per acre; \$70 Breaking 50,000 pounds fiber, including use of machine brake, 1.5 cents per pound; \$750 Baling 125 bales (400 pounds each), including use of baling press, \$1.40 per bale; \$175 Marketing and miscellaneous expenses; \$150 Total cost; \$1,750

Returns: Long fiber, 37,500 pounds, 6 cents per pound; \$2,250 Tow, 12,500 pounds, 4 cents per pound; \$500 Total returns; \$2,750

It is not expected that a net profit of \$20 per acre, as indicated in the foregoing estimate, may be realized in all cases, but the figures given are regarded as conservative where all conditions are favorable.