

Hemp: An Agricultural Super-Crop Held Hostage

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When Americans hear the word *hemp*, most of them think of dirty, unshaven, immoral, long-haired, drug-addled, petty-criminal, anti-establishment, heathen, communist “Hippies”! This is the image industrial hemp needs to free itself from. What people should think when they hear the word *hemp* is cheap, renewable, highly profitable, multi-purpose super-crop. It does not go unnoticed that the negative image of hemp has ten bad words associated with it, and the positive image only has five good words to defend itself with. Because of this, the positive words need to have more than twice as much weight behind them. Fortunately, they do, and by the end of this paper, hemp will be disassociated from the negative image it has labored under for so long in this country.

Industrial hemp is an easily grown crop that is beneficial to the farmer and the land on which it is grown. Every part of the hemp plant can be used for industrial and consumer consumption. The hemp plant produces fibers, seeds, oils, and biomass, which can be used for a variety of purposes in a variety of products. It is estimated that 25,000 industrial products can be made from the various parts of the hemp plant. Hemp is also considered “eco-friendly” due to its versatility and renewability (Duppong, 2009). The benefits of hemp include its versatility, ease of growth, cost effectiveness, health benefits, environmental benefits, superiority over other cultivated product sources, and room for industry growth as new technology develops. Opponents of industrial hemp claim that it sends the wrong message to our America’s youth, that hemp can be used as cover for marijuana growers, and growing hemp will lead to an increase in illegal recreational drug use. Hemp opponents also claim that it is not cost effective, and that while hemp is versatile, most of its uses are already filled by other resources. Some people worry that using hemp products will get them high or cause them to fail a drug test and

lose their job. Some of the claims on both sides of this argument have merit, but they are also both wrong on some points as well.

Hemp is a versatile and useful industrial product that can be of great benefit to the United States (U.S.) and the rest of the world. The federal ban placed on hemp in 1937 has put the U.S. at a disadvantage when it comes to hemp research, growth, processing, and industrial development. It will take time, money, and some legal changes for the United States of America to climb to the top of the hemp industry, but the promise of hemp is worth all the hard work.

Throughout this paper, industrial hemp will simply be referred to as *hemp* for the sake of brevity. It is important when talking about industrial hemp that it is differentiated from marijuana and recreational drug use. Though both plants are of the same species, marijuana and hemp are chemically different. The chemical in marijuana that gets users high is 9 tetrahydrocannabinol or THC. The THC levels in marijuana range from 5 to 30 percent, but in hemp the THC level is 0.03 percent (Cowan, 2002). The various hemp plants cultivated over the centuries were not valued for their THC content, which led to this dramatic difference between the two. Dr. William M. Pierce, professor of pharmacology at the University of Louisville claims that in excess of ten cigarettes of hemp with a THC content of one percent would have to be smoked in order for someone to get high smoking it. Anyone trying to do this would have to smoke the ten cigarettes so fast that he/she would likely be overwhelmed by the high-temperature smoke, vapor, and gas. If someone tried to ingest enough hemp to get high, that person would have also taken in enough fiber, which is a laxative, to cause severe gastrointestinal unrest (Cowan, 2002). Hemp oil also has a very high cannabidiol (CBD)-to-THC ratio.

The chemical CBD works to counter-act the euphoric high produced by THC; because of this, hemp oil has none of marijuana's narcotic effects (Duppong, 2009). It is possible to convert CBD into THC with acid catalyzed cyclization, but the drug trade has easier ways to obtain THC through synthesizing methods (Small, 2002). The belief that hemp is marijuana is unjustified and uneducated. The dedicated chemist could turn hemp into a source of intoxication, but the same can be done illegally with corn as well. Hemp oil does contain trace amounts of THC, which can only be detected by the most sensitive tests, but it can be detected. The same false positive results can be reached for opioids after eating poppy seed bagels. The federal government doesn't regulate bagels, and the same should go for hemp (Cowan, 2002). Another concern with allowing the growth of hemp is that it will afford camouflage for actual marijuana, because the two are visually indistinguishable. The two are distinguishable in appearance, and the way they are grown is visually different. Hemp plants, especially types used for fiber, are planted much more closely together than marijuana plants are. This is because hemp used for fiber is discouraged from branching. The strains of hemp grown for the seed do more closely resemble marijuana-purposed plants. This would be troubling, if not for the fact that cross-pollination of hemp and marijuana plants dramatically reduces the THC content of the offspring. This leads to poor quality marijuana and angry drug dealers. In fact planting hemp everywhere would cripple the marijuana producer's ability to supply quality marijuana to consumers (Cowan, 2002).

The history of hemp cultivation and use is so far into mankind's past that it predates written language. Hemp is believed to have been indigenous to regions with a temperate climate in Asia. Hemp is one of the oldest known resources that humans have cultivated. The

earliest records of hemp's use are from the 28th century B.C.E. when Emperor Shen Nung introduced hemp to China (Cowan, 2002). Hemp fibers have been found in 10,000-year-old Taiwanese pottery, and hemp textiles can be traced back to 8000 B.C.E. (Zheng, 2010).

The history of hemp in America has illustrious roots. The sails of Christopher Columbus's ships were made of hemp, so was the first American flag sewn by Betsy Ross, and the Declaration of Independence was written on hemp paper by Thomas Jefferson (Cowan, 2002). The Crown required colonial farmers to grow hemp, and after the revolution, farmers were allowed to pay their taxes with it. The first pair of Levi Strauss' jeans was made from hemp fibers, and it looked like the American future of hemp was on the rise (Zheng, 2010). Early in the 1900's, hemp was grown on hundreds of thousands of acres in Kentucky, Tennessee, Iowa, Nebraska, South Dakota, Wisconsin, Minnesota, and Michigan. When Harry Anslinger became America's first drug czar in 1931, a position appointed to him by his future uncle-in-law Andrew Mellon, a financial backer for DuPont, the future of hemp began to disappear in the U.S. In 1937, Harry Anslinger introduced the Marijuana Prohibitive Tax Act dooming hemp production and innovation in the U.S. (Kane, 1999). Coincidentally, 1937 is the same year *Mechanical Engineering* called hemp "the most profitable and desirable crop that can be grown" and in 1938, *Popular Mechanics* declared hemp the "new billion dollar crop" (Cowan, 2002). After Anslinger's bill was passed through Congress, hemp production, research, and industry ended in America. There was a brief revival during World War II when the government subsidized hemp to make rope for the navy with the "Hemp for Victory" campaign, but the last legal hemp crop was harvested in Wisconsin in 1958 (Cowan, 2002). Since the last legal crop of hemp in 1958, there has been a heated debate about hemp in the U.S.

America's stance on hemp is a legal oddity in the industrialized world. Thirty major industrialized countries grow hemp for industrial use. Further increasing the legal oddity of hemp, seven states have authorized the study of hemp; five states urge relaxed hemp laws from the federal government; Montana and North Dakota have legalized hemp; and Hawaii is growing hemp with the Drug Enforcement Agency (DEA). Although these states have passed these laws, growing hemp is against federal law, and federal law trumps state law. Despite the fact that hemp and marijuana are chemically different, the DEA fails to recognize the difference between the two crops, so both remain illegal. The legal status of imported hemp products is a bit different from growing hemp. The DEA interprets the drug laws regulating THC in products. The interpretation of the law by the DEA states that as long as the THC in hemp products does not enter the body, then it is not regulated by them and therefore legal. This means that textiles and fibers made from hemp or feed products for animals are legal. Conversely, those products for human consumption with THC are illegal, even if the THC content is insufficient to get someone high. It should be noted that people wanting to legalize hemp consider hemp legalization a separate issue from marijuana legalization (Cowan, 2002).

The return of hemp to the American farmer could be a huge boost to the American economy and environment. There is an estimated one- to-two-hundred-million-dollar demand for hemp products in the world economy currently being filled by other countries (Small, 2002). The market for U.S. hemp products is currently unlimited. Over 99 percent of the hemp used in the U.S. is grown in China, Eastern Europe, and Canada (Kane, 1999). The hemp industry in the U.S. created 10,000 jobs and did an estimated \$50 million in worldwide business in 1995 (Wilke, 1996). A University of Kentucky study states that the U.S. could support 82,000 acres of hemp.

The same study found that hemp could be more profitable than any other crop except for two varieties of tobacco per acre (Cowan, 2002). The University of Kentucky study concluded that hemp could generate a return of \$319.51 per acre compared to white corn with a return of \$135.84 per acre (Kane, 1999). Because the U.S. currently does not allow farmers to grow hemp, our farmers are losing money to other countries that are filling the world's demand for hemp products.

Hemp is relatively easy and cheap to grow almost anywhere in the U.S. and can be grown in all 50 states. Most farmers grow hemp for either the seed or the fibers. This is because dual-purpose strains are not as high in quality (Cowan, 2002). Hemp produces four times more fiber per acre than most forests are capable of. A single acre of hemp can generate three to eight tons of fiber per year. The amount of fiber a forest can produce in thirty years can be grown in just four months with hemp and on half the land (Green, 2004). The cost of transportation for hemp products varies, depending on the purpose of the hemp that is being grown. Hemp for fiber is bulky and is ideally processed close to the farms where it is grown. Seeds, on the other hand, are easily transported long distances and cost less to transport (Cowan, 2002). This difference in transportation cost allows the farmer to choose what to grow, depending on where he or she lives and what processing facilities are located nearby.

Hemp has a branched taproot that allows it to receive water and nutrients buried deep in the soil (Small, 2002). Hemp is naturally insect and weed resistant, lowering its cost to grow. Hemp plants are typically planted close together and choke out most weeds, due to their broad leaves. This eliminates the need for herbicides during the following year's growth cycle, saving money for the farmer yet again. Hemp can raise the yield of plants grown in the same soil after

it is rotated out of that field. The leaf mold of hemp is 50 percent nitrogen, adding natural fertilizer to the soil, and the root aerates the soil, adding nutrients and increasing water balance. All of these benefits add up to save the farmer money year after year. Farmers in the Netherlands found that after a hemp rotation winter wheat yield increased ten percent (Kane, 1999). Research providing evidence of negative impacts from growing hemp was unable to be found.

One of the most amazing abilities of hemp is its effectiveness at bioremediation. Hemp planted in soil contaminated with heavy metals, copper, salts of copper, chromium, and zinc grows just fine. The fibers from these plants are free of the contaminants and suitable for industrial use. The seeds and oil, however, do become contaminated with these pollutants and should not be used. The ability of hemp to purify the soil of contaminants should receive further study to determine its effectiveness (Small, 2002).

The most diverse array of products and uses comes from the seed of the hemp plant. Hemp plants that are specialized for seed growth tend to be about a meter in height, have a Christmas tree type shape due to branching, and produce many seed-bearing flowers on the branches. After maturity is reached, the seeds are separated from the stalks and transported for processing. The hemp seed contains almost zero THC but becomes contaminated through contact with the flowers. Another contamination source of THC in seed products is the bract, which contains has the highest THC content. The bracts are often not properly separated from the seeds, which leads to the contamination during processing. De-hulling the hemp seed has only recently become practical and was pioneered in Europe. This process produces a seed meal that requires no further processing for human consumption. Oil from the hemp seed can

be processed using existing equipment and is the most profitable part of the plant. Cold pressing is used for oil intended for human consumption. High quality oil has had the green seeds removed and is derived from the first pressing of the seeds only. The solid remains left over after pressing the hemp seeds for oil is an excellent feed called seed cake (Small, 2002). Seed cake contains 30 percent proteins, mineral nutrients, and carbohydrates that are very beneficial to livestock (Zheng, 2010). Whole seed applications have been used for poultry on farms and as a wild bird feed (Small, 2002). The seed of the hemp plant is currently the most diverse part of the plant, and with its ease of transportation, could be very profitable for rural farmers.

Oil produced from the hemp seed is rich in omega-3, -6, and -9 fatty acids. These fatty acids contained in the hemp oil nourish the skin, so hemp oil is often used in moisturizers, shaving creams, cosmetics, soaps, and shampoos. Hemp oil is a renewable and eco-friendly replacement for mineral oil derived from petroleum in these products (Zheng, 2010). Oil produced from the hemp seed is a drying oil used in varnishes, paints, and soap but is not competitive with linseed oil for these uses (Small, 2002). Hemp oil can be used for creating a cleaner and higher cetane value bio-diesel than soy or canola oil currently can provide, but it is currently cost ineffective (Duppong, 2009). Hemp oil, while currently not viable for bio-diesel, has great potential for industrial, health, and food purposes.

The application of hemp with the most potential to change America is human consumption of the seed meal and oil. It should be noted that sunflower and canola oil are cheaper to produce, but hemp oil is vastly superior for health. Hemp oil is about 75 percent

unsaturated fatty acids and is high in omega acids as well (Small, 2002). Hemp oil is not only the richest source of essential polyunsaturated fatty acids but also contains gamma linoleic acid (GLA). GLA is a rare essential amino acid found in human breast milk (Okerstrom, 2003). Hemp oil has many therapeutic effects, including control of inflammation and vascular tone. Positive effects on psoriasis, atopic eczema, and mastalgia have come from hemp oil use. Use of hemp oil may also benefit cardiovascular, psychiatric, and immunological health. Hemp seed oil is loaded with essential fat-soluble vitamins and antioxidants. Hemp oil oxidizes easily, has a short shelf life, and needs to be kept in a dark bottle and refrigerated. Hemp oil is not suitable for cooking applications and should be consumed in its raw form. Hemp oil has a nutty taste with an occasional hint of bitterness; because of this, it is great for salad dressings. Hemp seed oil, if legalized, could have a huge impact on American health, and it tastes good.

Seed meal is white, smooth, gritless, and has a nutty flavor much like the oil. Hemp seeds are about 25 percent protein and contain all eight essential amino acids. This protein content is lower than what is in soy beans but is much higher than what is in grains. This means that flour made from the seed cake after the seed is pressed for oil is high in protein. Seed meal is used in snack bars, spreads, baked goods, pasta, burgers, pizza, salad dressings, beverages, and vegan cheeses (Small, 2002).

The largest cost-saving and efficiency increases from hemp come from the fibers hemp plants produce. The federal ban on hemp has set America back when it comes to fiber harvesting techniques and machinery. This set-back means that initial fiber production costs are going to be high, but as technology and techniques are developed, the cost will drop. The benefits of hemp fibers are their length, tensile strength, wet strength, and durability. The

need for these characteristics influence the way fiber hemp is grown and bred. Hemp grown for fiber production tends to be tall with very few branches, seeds, and flowers. The hemp plants are planted very close together to discourage branching, increasing fiber length. After harvest, the stalks must be allowed to ret so that the soft parts of the stalk rot away. Retting is labor intensive and can contribute to water pollution, but with further development and research, new methods could be found to replace retting for fiber harvesting. For hemp fiber, while very valuable as a product, harvesting techniques need to be researched and improved in order to help make hemp fiber cheaper and cleaner to produce (Small, 2002)..

Long before wood, hemp was used for paper, but with the advent of new bleaching technology, wood became cheaper to produce. The production of paper from wood creates a large amount of water pollution, and wood-based paper is not suitable for specialty paper used in things like bank notes. Hemp can be added to traditional wood-based paper to increase its recyclability. The longer fibers help the recycled paper to bind together better. Hemp is superior to wood when it comes to specialty papers used in things like currency, technical filters, cigarette papers, teabags, and hygiene products (Small, 2002).

The biggest innovations in hemp fiber are coming from new composites. Hemp is being molded into plastics and used as reinforcement in cement and plaster. The benefits of hemp in automotive and other industries are that it is cost effective, has high tensile strength and stiffness, is light weight, replaces glass fibers, is easy to process and recycle, reduces molding time, and is highly customizable for different uses and manufacturing processes (“Hemp,” 2007). Synthetic fibers made from glass, carbon, and kevlar are used more often than natural

fibers, but hemp is more cost effective and comparable in strength to these materials. These applications are great for the transportation industry where strength and weight reduction are important (Small, 2002).

The newest area of hemp fiber use is in construction materials. Rising energy and production prices are causing builders and consumers to look for new materials to save money. Non-wood fiberboard is in its infancy in the U.S., and hemp fiberboard has proven to be an extremely strong material that could replace wood products. Hemp can be added to concrete to reduce weight and shrinkage, and increase strength. Gypsum and binders can be mixed with hemp fibers to create a light drywall like panel. Hemp fibers can be mineralized with lime and be blown or poured into walls and attics as an insulation (Small, 2002). The applications that hemp fibers can be used for is limited only by the imagination of the next inventors working with hemp.

Hemp is an agricultural product much maligned and misunderstood in the U.S. today. Hemp has been grown in this country since its beginning and has only recently become a taboo-crop. Hemp detractors believe that hemp is a drug, has no redeeming qualities, is cost ineffective, and has no use that is not better filled by another product. The truth is they are partially right about some things but totally wrong about others. Hemp is a great renewable and eco-friendly agricultural product. Hemp oil and seeds have superior nutritional benefits over other agricultural products. Yes, some things can be produced cheaper and in larger quantity, but hemp seed products are incredibly concentrated and potent. Other fibers are stronger or cheaper, but they are less versatile and of lower quality than hemp. The beauty and promise of hemp is that it is very diverse and excels over many other products in several ways.

Hemp is a super-crop that America needs to invest in. With time and funding, hemp could revolutionize American agriculture and industry. Laws have to change, and advocates must work long and hard to return America to its former hemp glory. Hemp is a sound American investment.

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