



Industrial Hemp

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Introduction

Hemp has been grown for many centuries for its fibrous stem and the vegetable oil found in the seeds.¹ U.S. hemp production was strong until U.S. cotton production and imports of other less expensive fiber materials displaced hemp in the marketplace in the mid-1850s. The 1937 Marijuana Act defined hemp as a narcotic drug, requiring producers to hold a federal registration and special tax stamp.² Due to the demand for rope during WWII, U.S. industrial hemp production peaked in 1943 at a record high of 145 million pounds (141 million pounds of fiber and 14 million pounds of seed). After WWII (circa 1948) hemp production fell due to a lack of demand.³

Global Production

There are approximately 30 countries that currently permit farmers to grow industrial hemp. These include much of the European Union, Chile, Korea, Canada, and China. China is one of the world's largest hemp producers and exporters.³

Globally, hemp production declined considerably between 1966 and 1994, nevertheless, production has stabilized to some extent post 1994. Global seed and fiber production has ranged from over 500,000 tons in 1965 to less than 100,000 in 1994, see Figure 1. Over the last 10 years, fiber production has declined and seed production has increased. This is largely due to a weak demand for hemp fiber since there are many synthetic and natural substitutes and processing is difficult.

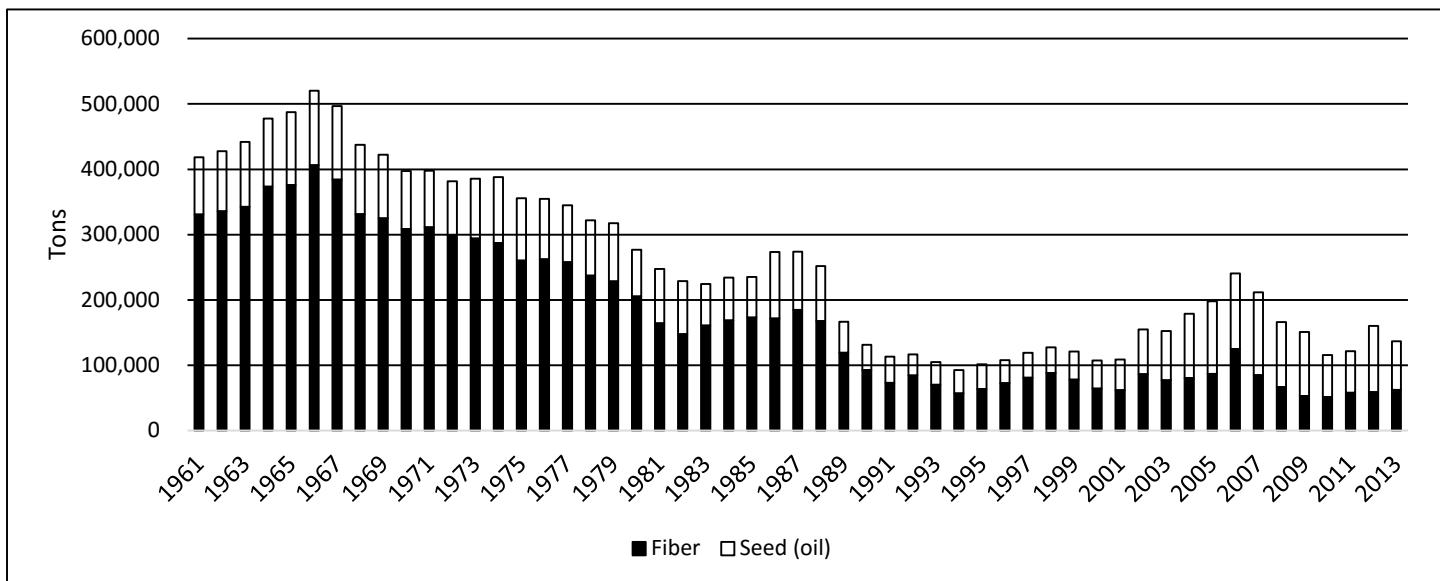


Figure 1. Global Hemp Production⁴

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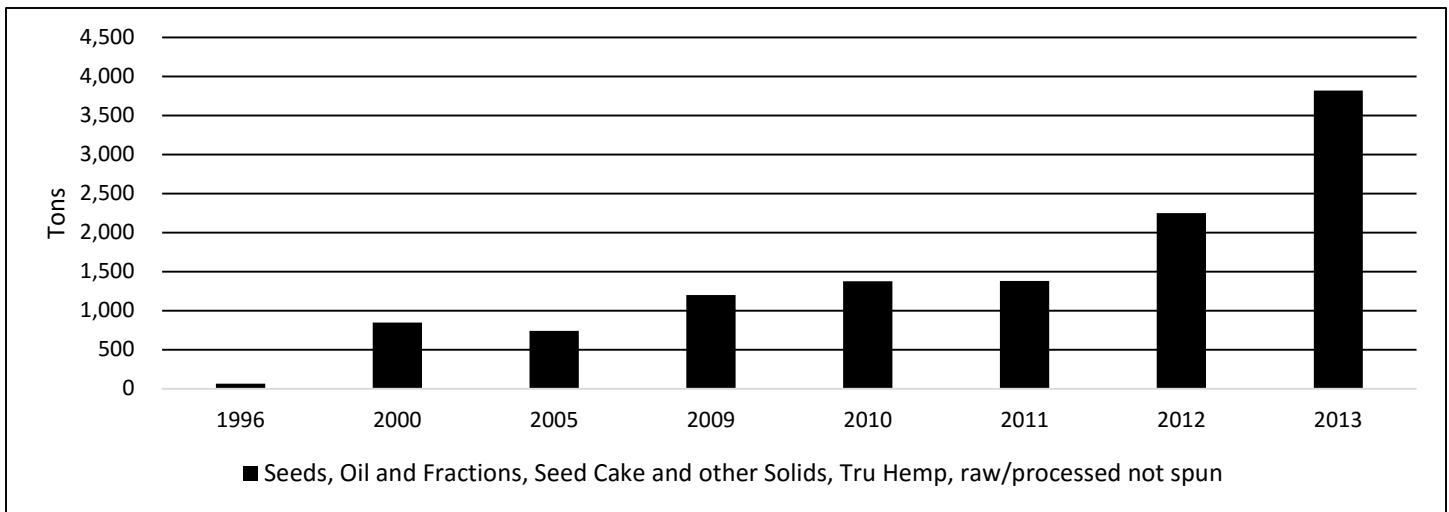


Figure 2. U.S. Hemp Imports of Selected Hemp Products²

However, hemp oil, extracted from the seed, has a stronger demand due to the quality of the oil and its many uses, including; food, protein powder, cosmetics, paint, varnishes, bioplastics, binders, biodiesel, snack foods, coffee, beer, livestock feeds and more.

Hemp Processing/Value Chain

Hemp processing is carried out in two separate courses; first, the seeds undergo primary and secondary processing into oil and other products; second, the fiber goes through the primary processing of removing the core/curds from the fiber. Once the fiber and the core are separated, each goes through various secondary processing systems to convert fiber and core/curds into higher values products.

The process for extracting the oil from hemp seed is relatively well developed and not very different from other oil seeds. Yet, the methods for processing the fiber, specifically separating the core/curds from the fiber is considerably more difficult. A considerable level of development will need to be done in Colorado’s hemp value chain to support any sizable production of industrial hemp. Reportedly, one processing plant is planning to process up to 25 tons of hemp fiber per day⁵ which would likely support less than 1,800 acres of fiber production. As of August 2015 there were 2,458 acres in industrial hemp production. The current status of industrial hemp production in Colorado this is shown in Table 1.

U.S. Market Potential for Industrial Hemp

In the last twenty years there have been many feasibility studies conducted in the U.S. and Canada regarding the market potential of industrial hemp in the U.S. Many of these studies have a very positive outlook on the U.S. market potential, where many others provide a less favorable view. However, since 1996 the U.S. demand for hemp products has grown significantly. As illustrated in Figure 2 the amount of industrial hemp products imported has increased from 65 tons in 1996 to over 3,800 tons in 2013.

The Regulatory Environment for Industrial Hemp

Even though production of industrial hemp is legal in the state of Colorado, there are rules and regulations that a growers must abide by that can be both time-consuming

Table 1. Colorado Industrial Hemp Production⁶

	Research & Development	Commercial	Total
Registrations ^a	26	270	296 ^c
Acres	24.24	2,434	2,458
Sq. Ft.	7,229	361,867	369,096
Regstrants ^b	14	144	158 ^c

^agrowing locations

^bentities authorized

^cA registrant may have more than one registration, hence the different number of registrations and registrants.

Notes: Registrations as of 8/19/2015, These numbers are always in flux as the Colorado Department of Agriculture continues to get new registration applications while others expire.



and expensive. The Colorado Department of Agriculture (CDA) requires registration of any person wishing to grow industrial hemp. Furthermore, growers are required to report all growth and sales activities as well as verifying plant variety, verification that the delta-9 tetrahydrocannabinol (THC) concentrations are at or below three tenths of one percent, along with documentation of a purchase agreement and proof of in-state processing.⁶ Since industrial hemp is also federally regulated the Drug Enforcement Agency (DEA) also requires a federal permit in addition to field monitoring, product testing and other requirements. Failure to get permission from the DEA may result in federal charges or property confiscation, regardless of whether the grower has a state-issued permit.²

Cost of Production

Growing hemp to the point of harvest is not a tremendously expensive enterprise. Field preparation is typical of that of other traditional crops (corn, wheat, etc.). Planting can also be accomplished with a traditional grain/seed drill. Acquiring the seed may prove difficult because of state and federal regulations (Colorado hemp producers may only purchase seed within the state). Also, seed costs for Colorado producers will be significantly high until there is a large enough supply of certified seed developed in-state. Seed that

currently exists in Colorado may be variable and may produce plants that have unknown THC levels. Importation of viable industrial hemp seed across State lines and Country boundaries is illegal under the Federal Controlled Substances Act.⁶ Seeding rates for industrial hemp the Colorado are variable and the accompanying seed costs are very high and variable. Seeding rates have been reported to be between 20 to 50 pounds per acre while seed costs ranged from \$35.00 to \$70.00 per pound.⁶

Fertilizer rates are similar to that of irrigated wheat. Also, there are not any pesticides (herbicides, insecticides, fungicides, etc.) currently registered for use on Industrial Hemp or any Cannabis species due to the predominant federal nature of pesticide regulation.⁶ Additionally, the planting of industrial hemp may jeopardize Federal farm programs managed by the USDA such as crop insurance, farm loans, and conservation reserve programs.⁶ Likewise, acquiring banking assistance such as operating loans may be difficult since banks may be hesitant to provide services to industrial hemp growers for fear of being prosecuted for federal laws and regulation violations.⁶

Harvesting costs for hemp grown for seed production is similar to that of other small grains. Harvesting hemp seed requires minor modifications to a traditional combine to accommodate the height of the plant. In contrast, harvesting hemp for fiber production is somewhat more expensive since there can be more wear and tear on equipment due to the coarseness of the fiber and the more intensive management required to get the fiber to market.

Even though growing and harvesting expenses are not high, the regulatory environment seems to be the greatest barrier to entry at this time, as well as the greatest source of confusing information for growers. The costs of permitting are relatively high -- commercial registration fees are \$500 plus \$5 per acre or \$0.33 per 1000 square feet, also noncontiguous fields require separate registration fees. Additionally, the CDA will select at least one third of registrants each year for field sampling and verification of 0.3% or less THC content. Any test results that come back above the allowable THC threshold will subject the crop to seizure and destruction. Furthermore, the costs of field sampling and lab testing incurred by the CDA will be passed on to the

Table 2. Expected Hemp Yields (Fiber and Seed) Based on Various Corn Yields (hemp yields at normal moisture content)³

	Low Productivity (100 bu corn)		Medium-Low Productivity (125 bu corn)		Medium-High Productivity (150 bu corn)		High Productivity (175 bu corn)	
	Fiber Yield Tons/Acre	Seed Yield lbs./Acre	Fiber Yield Tons/Acre	Seed Yield lbs./Acre	Fiber Yield Tons/Acre	Seed Yield lbs./Acre	Fiber Yield Tons/Acre	Seed Yield lbs./Acre
Fiber Only	4.6		5.8		6.9		8.1	
Dual System	2.2	520	2.8	650	3.3	780	3.9	910
Seed Only		600		750		900		1,050

Table 3. Net Hemp Returns/Acre (does not include land costs)³

Production System	\$75/to Fiber and \$0.70/lb. Seed			
	Low Productivity	Medium-Low Productivity	Medium-High Productivity	High Productivity
Fiber Only	(\$167)	(\$149)	(\$130)	(\$112)
Dual System	\$42	\$125	\$208	\$290
Seed Only	\$119	\$217	\$315	\$412

Notes: Costs include labor and depreciation/overhead but not land costs. \$3.50/gal fuel; N, P, and K at \$50/unit; 50 miles one-way trucking to market.

registrant. Fees for field sampling are currently \$35 per hour and will include drive time, sampling time and any per diem or room charges incurred by the CDA's representative(s).⁶

Industrial hemp yields vary depending on soil fertility, water availability, and plant variety. Research by the University of Kentucky indicates the expected yields for fiber ranges from 4.6 tons per acre to 8.1 tons per acre, see Table 2. It is important to note that when harvesting hemp in a dual system or a seed only system, the male plant has largely disappeared, thus the fiber in a dual system will likely be much lower quality and the yield half that of a fiber only system.

Net returns from hemp production can be expected to be variable while the Colorado Hemp Value Chain is developing. Estimated enterprise budgets for both hemp seed and hemp fiber can be found in appendices A and B, respectively. These budgets are based on costs of production benchmarks for Alberta, Canada.⁷ Yields are based on medium-low productivity yields. Also, the budgets do not account for land costs and transportation costs to processing facilities. The budgets offer a breakeven analysis and a seeding rate and seed cost comparison. Prices received were estimated, however analysis suggests alternative prices needed to cover all

costs (breakeven). Furthermore, Table 3 shows the estimated net returns for Kentucky growers.

Conclusions

As producers contemplate entering industrial hemp production, it would be wise to carefully plan and develop a business and marketing plan. They should also conduct a sensitivity analysis of possible ranges of input and processing costs and a yearly breakeven analysis based on those anticipated costs. It may also be sensible to consider starting small and focusing on seed production at least until one believes they have found a strong market for the fiber. There is considerable opportunity to develop one's own unique products and market them on a local scale.

It is important to note there are fewer barriers to entry into hemp production for someone who is currently a row crop producer, since in most cases they will already have appropriate equipment.

There is definitely market potential for hemp, but there is also considerable risks associated with industrial hemp production when considering price, yield volatility and the regulatory environment.

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Appendix A.

Industrial Hemp Seed

Estimated Production Costs & Returns

GROSS RECEIPTS FROM PRODUCTION

GROSS RECEIPTS	Unit	Price	Yield/Acre	Per Acre	Per LB.
HEMP SEED	LB.	\$3.70	825	\$3,052.50	\$3.70
NET GOV'T PAYMENTS	ACRE			\$0.00	\$0.00
Total Receipts				\$3,052.50	\$3.70

DIRECT COSTS

	Unit	Cost/ Unit	Quantity	Cost Per Acre	Cost Per LB.
<i>OPERATING PRE-HARVEST</i>					
SEED	DOLS	1,789.77	1.00	1,789.77	2.17
FERTILIZER	DOLS	80.00	1.00	80.00	0.10
Application	DOLS	7.00	1.00	7.00	0.01
IRRIGATION	DOLS	30.00	1.00	30.00	0.04
FIELD PREP	DOLS	85.00	1.00	85.00	0.10
LABOR	DOLS	6.25	1.00	6.25	0.01
REGISTRATION FEES	DOLS	505.00	1.00	505.00	0.61
SAMPLING FEES	DOLS	50.00	1.00	50.00	0.06
INTEREST EXPENSE (6 mths @ 7.5%)	DOLS	74.93	1.00	74.93	0.09
Total Pre-Harvest Expenses				2,627.95	3.19
<i>HARVEST COSTS</i>					
CUSTOM HARVEST (Combine)	DOLS	45.00	1.00	45.00	0.05
HAULING	DOLS	30.00	1.00	30.00	0.04
Total Harvest Costs				75.00	0.09
Total Operating Costs				2,702.95	3.28
<i>PROPERTY & OWNERSHIP COSTS</i>					
GENERAL FARM OVERHEAD	DOLS	48.00	1.00	48.00	0.06
OWNERSHIP COSTS	DOLS	50.00	1.00	50.00	0.06
REAL ESTATE TAXES	DOLS	16.00	1.00	16.00	0.02
Total Property & Ownership Costs				114.00	0.14
Total Direct Costs				2,816.95	3.41
RETURN TO MANAGEMENT & RISK				235.55	0.29

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS (\$/ACRE)

		ALTERNATIVE PRICES				
		\$/LB.				
ALTERNATIVE YIELDS		-35%	-15%	\$3.70	+15%	35%
		\$2.41	\$3.15	\$3.70	\$4.26	\$5.00
-35%	536.25	(\$1,527.27)	(\$1,130.44)	(\$832.82)	(\$535.20)	(\$138.38)
-15%	701.25	(\$1,130.44)	(\$611.52)	(\$222.32)	\$166.87	\$685.80
LBS	825.00	(\$832.82)	(\$222.32)	\$235.55	\$693.43	\$1,303.93
+15%	948.75	(\$535.20)	\$166.87	\$693.43	\$1,219.98	\$1,922.06
+35%	1,113.75	(\$138.38)	\$685.80	\$1,303.93	\$1,922.06	\$2,746.23

Currently seeding rates are variable and seed costs are high and variable.

		Per Acre Seed Costs				
		Seed Cost (\$/lb.)				
		\$34.09	\$42.61	\$51.14	\$59.66	\$68.18
20.00		\$681.82	\$852.27	\$1,022.73	\$1,193.18	\$1,363.64
Seeding Rate	27.50	\$937.50	\$1,171.88	\$1,406.25	\$1,640.63	\$1,875.00
(lbs/acre)	35.00	\$1,193.18	\$1,491.48	\$1,789.77	\$2,088.07	\$2,386.36
	42.50	\$1,448.86	\$1,811.08	\$2,173.30	\$2,535.51	\$2,897.73
	50.00	\$1,704.55	\$2,130.68	\$2,556.82	\$2,982.95	\$3,409.09

Appendix B.

Industrial Hemp Fiber

Estimated Production Costs & Returns

GROSS RECEIPTS FROM PRODUCTION

GROSS RECEIPTS	Unit	Price	Yield	Per Acre	Per TON
HEMP FIBER	TON	\$441.00	6.35	\$2,800.35	\$441.00
NET GOV'T PAYMENTS	ACRE			\$0.00	\$0.00
Total Receipts				\$2,800.35	\$441.00

DIRECT COSTS

	Unit	Cost/ Unit	Quantity	Cost Per Acre	Cost Per TON
<i>OPERATING PRE-HARVEST</i>					
SEED	DOLS	1,789.77	1.00	1,789.77	281.85
FERTILIZER	DOLS	80.00	1.00	80.00	12.60
Application	DOLS	6.50	1.00	6.50	1.02
IRRIGATION	DOLS	30.00	1.00	30.00	4.72
FIELD PREP	DOLS	80.00	1.00	80.00	12.60
LABOR	DOLS	6.25	1.00	6.25	0.98
REGISTRATION FEES	DOLS	505.00	1.00	505.00	79.53
SAMPLING FEES	DOLS	50.00	1.00	50.00	7.87
INTEREST EXPENSE (6 mths @ 7.5%)	DOLS	74.72	1.00	74.72	11.77
Total Pre-Harvest Expenses				2,622.24	412.95
<i>HARVEST COSTS</i>					
MOWING	DOLS	15.00	1.00	15.00	2.36
RAKE	DOLS	10.00	1.00	10.00	1.57
BALE (\$10/bale)	DOLS	90.00	1.00	90.00	14.17
HAULING	DOLS	90.00	1.00	90.00	14.17
Total Harvest Costs				205.00	32.28
Total Operating Costs				2,827.24	445.24
<i>PROPERTY & OWNERSHIP COSTS</i>					
GENERAL FARM OVERHEAD	DOLS	48.00	1.00	48.00	7.56
OWNERSHIP COSTS	DOLS	50.00	1.00	50.00	7.87
REAL ESTATE TAXES	DOLS	16.00	1.00	16.00	2.52
Total Property & Ownership Costs				114.00	17.95
Total Direct Costs				2,941.24	463.19
RETURN TO MANAGEMENT & RISK				(140.89)	(22.19)

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS (\$/ACRE)

		ALTERNATIVE PRICES				
		\$/TON				
ALTERNATIVE YIELDS		-35%	-15%	\$441.00	+15%	+35%
		\$286.65	\$374.85	\$441.00	\$507.15	\$595.35
-35%	4.13	(\$1,758.09)	(\$1,394.05)	(\$1,121.01)	(\$847.98)	(\$483.94)
-15%	5.40	(\$1,394.05)	(\$917.99)	(\$560.94)	(\$203.90)	\$272.16
TONS	6.35	(\$1,121.01)	(\$560.94)	(\$140.89)	\$279.16	\$839.23
+15%	7.30	(\$847.98)	(\$203.90)	\$279.16	\$762.22	\$1,406.30
+35%	8.57	(\$483.94)	\$272.16	\$839.23	\$1,406.30	\$2,162.40

Currently seeding rates are variable and seed costs are high and variable.

		Per Acre Seed Costs				
		Seed Cost (\$/lb.)				
		\$34.09	\$42.61	\$51.14	\$59.66	\$68.18
Seeding Rate	20.00	\$681.82	\$852.27	\$1,022.73	\$1,193.18	\$1,363.64
(lbs/acre)	27.50	\$937.50	\$1,171.88	\$1,406.25	\$1,640.63	\$1,875.00
	35.00	\$1,193.18	\$1,491.48	\$1,789.77	\$2,088.07	\$2,386.36
	42.50	\$1,448.86	\$1,811.08	\$2,173.30	\$2,535.51	\$2,897.73
	50.00	\$1,704.55	\$2,130.68	\$2,556.82	\$2,982.95	\$3,409.09