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From the Ground Up: A Look at Kansas' First Year of Industrial Hemp Production

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Abstract
Over the last five years, industrial hemp began to re-enter mainstream agriculture through the 2014 Farm Bill pilot program legalizing the study of growth, cultivation, and marketing of industrial hemp by state departments of agriculture and higher education institutions for research purposes. The 2018 Farm Bill expanded opportunities for industrial hemp production beyond research creating a national commercial industrial hemp production program that allows states, Indian Tribes, and Territories to submit plans for regulating and monitoring their own industrial hemp production programs. This paper looks at Kansas' experience during its first growing season under the pilot research program.

Keywords: Hemp, industrial hemp, grower, processor, distributor, *Cannabis sativa* L, cannabidiol, CBD.

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Short Description
In April 2018, former Governor Jeff Colyer signed the Kansas Senate Bill 263. This event embarked Kansas on a journey to legalize production of industrial hemp for research purposes. This paper provides a snapshot of the first industrial hemp growing season for Kansas farmers.

Background -- 2014 and 2018 Farm Bills
Once a commodity valued for its fiber and food byproducts, industrial hemp disappeared from the agricultural landscape by the mid-1950s. Over the last five years, industrial hemp began a re-entry into mainstream agriculture with the passage of the Agricultural Act of 2014 (2014 Farm Bill). This act created a pilot program legalizing the study of growth, cultivation, and marketing of industrial hemp by state departments of agriculture and institutions of higher education for research purposes. In addition, the 2014 Farm Bill defined industrial hemp as "*Cannabis sativa*

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L. and any part of such plant, whether growing or not, with a delta-9 tetrahydrocannabinol (THC) concentration of not more than 0.3 percent (%) on a dry weight basis" (USDA, 2020).

The Agriculture Improvement Act of 2018 (2018 Farm Bill) expanded opportunities for industrial hemp production beyond state pilot programs by directing the U.S. Department of Agriculture (USDA) Agriculture Marketing Service (AMS) to implement regulations and guidance for a national industrial hemp production program that allows states, Indian Tribes, and Territories of the U.S. to submit plans for regulating and monitoring their own industrial hemp production programs. Furthermore, the 2018 Farm Bill provided USDA AMS the authority to directly regulate industrial hemp producers within the states, Indian Tribes, and Territories of the U.S. not seeking regulatory responsibility for industrial hemp production within their respective borders.

Touted as a versatile crop because of its multiple purposes, each variety of industrial hemp and its ultimate end use determine how the crop is best planted, grown, managed, harvested, and handled. When grown for fiber, grain, or seed production, industrial hemp is typically planted in large agricultural fields much like traditional commodity crops such as corn or soybeans, using field-scale farm equipment for field preparation and harvest.

By contrast, when grown for cannabidiol (CBD) oil, minor cannabinoids or floral material, industrial hemp production more closely resembles techniques generally applied when producing a horticultural crop; in open field conditions, in-ground in high tunnels, or in pots in a controlled, indoor environment such as a greenhouse or high tunnel. To achieve maximum quality, the goal is to harvest unpollinated floral material exclusively from female plants. Growing for CBD is labor-intensive as it requires hand tools for weed suppression and harvest.

State of Kansas Pilot Research Program

A total of 21 states, including Kansas, passed legislation to establish research programs under guidelines provided by the 2014 Farm Bill. Some established programs in 2017, others in 2018. Kansas was one of six states that created a research program in 2018 (Mark et al. 2020). This paper looks at Kansas' progress from the passage of Senate Bill (SB) 263 during the 2018 legislative session to the research results from the 2019 Kansas industrial hemp growing season.

Kansas SB 263, the Alternative Crop Research (Act), authorized the development of an industrial hemp pilot research program. The bill specifically allowed for a pilot program in any county. SB 263 was signed by then Governor Jeff Colyer and became law on April 20, 2018. Industrial hemp is defined by Kansas statute as "all parts and varieties of the plant *Cannabis sativa* L., whether growing or not, that contain a THC concentration of not more than 0.3% on a dry weight basis." (K.S.A. 2-3901, *et seq.*)

K.S.A. 2-3901 grants responsibility for the Kansas industrial hemp program to the Kansas Department of Agriculture (KDA) alone or in coordination with a state educational institution. It required the KDA to establish rules and regulations for the industrial hemp research program; after which it could begin accepting applications for licenses to grow, distribute, and/or process industrial hemp. The Act further required the formation of an advisory board to assist the Secretary of Agriculture in reviewing and approving all applications for licenses to grow, distribute, and/or process industrial hemp in Kansas and to develop a fee schedule as the statute did not allocate state funds to administer the program.

Rules and Regulations
The statute established a deadline of December 31, 2018 for full program rules and regulations requiring the process to be fast-tracked by the KDA, with final rules published in the Kansas Register on January 24, 2019. Kansas Administrative Regulations (K.A.R.) 4-34-1 *et seq.*, Industrial Hemp Rules and Regulations, provided the framework by which the KDA conducted the industrial hemp pilot research program. For growers, distributers, and processors these were the rules governing their activities with industrial hemp. Oversight was assigned to KDA Plant Protection and Weed Control Division which created a Kansas Industrial Hemp Program to manage the pilot research program.

Year 1 Kansas Research Pilot Program Production
NOTE: Production data is for one year only and limited to self-reporting by holders of research licenses.

Grower Licenses
A total of 213 research grower licenses, approximately 71% of all grower applications, were approved and granted licenses from 72 of Kansas' 105 counties (69%). Licensed research growers planted 2,782 acres. Ninety percent (2,400 acres) were planted for CBD production; 75% reported floral as the exclusive intended end use, and 15% reported a combination of floral and fiber/seed production. The remaining 10% were planted exclusively for fiber and/or seed production. CBD is generally offered as a natural health and wellness product extracted from floral and other plant materials of industrial hemp. Although CBD is considered an active ingredient in a U.S. Food and Drug Administration (FDA)-approved drug [Epidiolex® (cannabinol)], it is often marketed and sold as a nutritional supplement regardless of current FDA regulation and oversight (Hilborn 2019).

In 2019, field sizes ranged from 0.003 acres to 80 acres. Eighty acres was the maximum allowed per research license. Approximately 71% of all fields planted were harvested. By land size 1,831 acres were harvested from 2,782 acres planted (66%). Reported growing locations included warehouses, fields, greenhouses, and high tunnels. From submitted production reports, harvested plots exclusively grown for floral material had an average dry weight yield of 470 pounds per acre. How this compares to a national average for floral production is difficult to determine without a coordinated national reporting system. Estimated yields for floral production on a per acre basis in Kansas may achieve 3,300 pounds (Kansas Legislative Division of Post Audit 2020).

Matching outdoor industrial hemp fields in 2019 to CropScape, USDA's satellite Cropland Data Layer (2019), reveals that most licensed areas were not cultivated in 2018 (Table 1). Among fields planted to industrial hemp in 2019 (columns 2 and 5) 60% were categorized as either pasture or non-cultivated undeveloped land in 2018. Approximately 23% of planted hemp acreage in 2019 was previously used for corn or soybeans. On net, it appears industrial hemp cultivation in 2019 represented extensive growth in cultivated agriculture, rather than substitute crop production. However, the precision of the estimates may be affected by the accuracy of reported hemp field GPS coordinates and the potential undercounting of cropland in CropScape (Lark et al. 2017).

Multiple obstacles were reported by licensed growers during the 2019 crop season, beginning with access to seed or clones grown from certified seed which means a source that is certified to Association of Official Seed Certifying Agencies (AOSCA) standards. The certified

seed requirement was part of state statute, not within rules and regulations, making it difficult for growers to access varieties of seed and transplants generally used for CBD production. In late spring 2019, the certified seed requirement was changed by the Kansas legislature to "authorized seed or clone plants" meaning the seed or plant material required a certificate of analysis from a testing laboratory and certification in writing by the grower or distributor that the seeds or clone plants possessed the qualities of industrial hemp. This makes it easier for growers to access plant material generally used in CBD production operations. An additional obstacle reported by some growers was that the cost of industrial hemp for planting was too expensive to purchase.

Based on a survey filed with the KDA by licensed growers, more than 50% (33 of 61 respondents) found acquiring seed, seedlings, or clones difficult. Additional reported obstacles to growing included:

- Lack of availability of specific varieties of seed, seedlings, or clones – 90%
- Desired variety did not meet the statutory or regulatory requirements – 42%
- Disreputable vendors – 27%
- Lack of information (from credible, objective public sources) on varieties and/or travel distance to acquire – 21%

Other reported obstacles to acquisition included: lack of general supply, delays from custom planting service provider, state took too long to approve program, and suppliers out of stock when grower application was approved.

When seed, seedlings, or clones were secured, growers encountered additional production barriers which are generally observed with intensive agriculture production. Grower reports and surveys indicate complications from chronic wet field conditions that prevented planting and harvest. Excess rain during planting season hindered and completely prohibited some planned outdoor operations. However, roughly 99% of industrial hemp plantings occurred in outdoor locations. Additional planting and harvest complications included regulatory compliance details that slowed timely planting or harvest, pressure from weeds and insects that were unmanageable or left uncontrolled, pollination caused by male plants in the growing area or from Ditch weed (naturalized *C. Savita L.*), high manual labor planting and management requirements, and lack of market outlets. Considering all the reported complications encountered by growers, only 53.67 acres (< 2%) of plantings had to be destroyed for testing at a THC concentration exceeding 0.3% prior to harvest.

Distributor Licenses

Other than a licensed grower having the authority to distribute or transport industrial hemp, any other person wishing to distribute or transport industrial hemp in Kansas was required to hold a research distributor license. A total of 20 distributor licenses from 12 counties were approved for the 2019 pilot research growing season. Based on survey results from 10 distributors, five (50%) did not actually distribute industrial hemp in 2019. Of the five who did not distribute, three reported an inability to acquire hemp for distribution. Those who distributed reported they transported germplasm, grain, floral material, or biomass from three states – Kansas, Colorado, and Kentucky. Seven of the ten indicated they planned to distribute industrial hemp again in 2020.

In surveys filed with the KDA, research distributors' top concerns included: acquiring proper documentation for hemp intended for propagation, non-compliant (> 0.3% THC) harvested plant material, lack of proper documentation for harvested hemp, and pesticides in

harvested hemp. Four distributors reported using a third-party laboratory for cannabinoid quantification before receiving hemp for transport. Two distributors reported rejecting hemp (did not take possession) because of THC concentration in the plants exceeding the legal threshold. Five distributors reported receiving outside business funding from private investors, business partners, or a bank loan.

Processor Licenses

Licenses were awarded for 35 processors from 23 counties. Reports submitted to the KDA indicated 13 licensed research processors (37%) conducted activities in eight counties: Dickinson, Harvey, Haskell, Johnson, Leavenworth, Montgomery, Reno, and Sedgwick. In 2019, each active licensed research processor specifically processed for CBD. Only three licensees processed more than 35,000 pounds of plant material. Six processed less than 500 pounds and two reported only completing small trial runs. The median driving distance from a hemp grower's field to a processor was 48 miles (Figure 1; Panel A); that same distance to one of the three large processors was 93 miles (Figure 1; Panel B). Of the eight licensed research processors who submitting data, four processed from plant material only, two from plant and floral material, and two from floral material only.

Three processors reported receiving hemp from out-of-state for processing. Although they did not report amounts received, imports were accepted from Colorado and Kentucky, both states with established industrial hemp programs. Two processors reported rejecting hemp with both citing non-compliant plant material (> 0.3% THC) and one also citing poor quality (too low CBD percentage) for rejection. Both reported rejecting product based on lab analysis reports and they did not take possession of the non-compliant plant material. Methods of acquiring hemp for processing were either direct from a licensed grower, from a Kansas licensed distributor, or through a mail carrier (USPS, UPS, FedEx, etc.).

Processors reported their biggest concerns when acquiring hemp were 1) non-compliant plant material (> 0.3% THC); 2) poor yield quality (low CBD percentage); and 3) the presence of contaminants such as pesticides and heavy metals. Processors who responded to the survey (n=13) reported obstacles related to available funding, permitting (both local zoning and state licensing), facilities not meeting fire code, acquiring adequate amounts of industrial hemp because of low production yields, and service availability from equipment manufacturers.

Grower-Identified Improvements

The research program as approved in Kansas allows growers, distributors, and processors to report their experiences, and identify how their outcomes could be improved. Among the suggestions offered by growers, a few were mentioned multiple times. Suggestions included 1) the need for earlier planning to facilitate purchase of seed or plants; 2) ability to identify buyers and markets before planting; 3) need for pollination prevention, such as using auto-flowering or sterile varieties and timing a planting to escape naturalized *C. sativa* L. pollen flow; and 4) the need for more pest and weed control options for better yields (Griffin et al., 2020a).

Year 2 Kansas Pilot Research Program and Beyond

Licensees conducting, cultivating, growing, transporting, distributing, handling, storing, and processing activities with industrial hemp will continue under the pilot research program authority until the KDA establishes a new program pursuant to K.S.A. 2-3906 *et seq.* and the 2018 Farm Bill. Using the same rules and regulations as 2019, research licenses to grow,

distribute, or process hemp were accepted by the KDA in late 2019. These research licenses were promptly reviewed and approved (December 2019 through January 2020) to allow for more timely purchase of seed, seedlings, and clones for planting. A total of 218 grower licenses were awarded, an increase of 5 licenses from 2019. Research distributor licenses awarded increased by one, from 20 to 21 licenses, for 2020 and research processor licenses awarded decreased from 35 to 24 licenses. As of late May 2020, states (n = 41) reported roughly 390,000 acres licensed to plant industrial hemp with Kansas having approximately 10,000 acres.

Kansas submitted its commercial program plan to the USDA AMS in January 2020 and received approval in April 2020. The commercial plan removes the research requirement for individuals seeking to grow industrial hemp. However, Kansas like many other states, did not participate under the 2018 Farm Bill provisions for the 2020 growing season for reasons relating to the Interim Final Rule for Establishment of a Domestic Hemp Production Program (7 CFR 990), lack of state statute due to a short 2020 legislative session, or a lack of state regulations.

Conclusions

Even as an unproven crop, industrial hemp grown for extraction of CBD appears, after a single growing season, to be a popular alternative crop for some Kansans. Despite continuing statutory, regulatory, environmental, and crop and product market hurdles in 2019, optimism remains high. Industrial hemp's value as an alternative seed stock and fiber source in Kansas, however, is less clear considering the lack of producer attention to these end uses. Growing conditions, traditional Kansas row crop agriculture, and Kansas State University's research efforts suggest seed and fiber production should be successful (Griffin et al., 2020b).

It remains to be seen if enough producers are willing to incorporate industrial hemp for fiber/seed into cropping rotations and whether such a system will be profitable. Clearly, more work is needed to determine the best-suited varieties for the region. Economically speaking, the need for full market system development is critical to a successful future for industrial hemp. Currently markets are opaque; producers perceive a lack of processing availability; and reliable, replicated cultivation guidance is not available. The learning curve is steep and market clarity will come as knowledge about the crop increases once the national commercial program becomes a reality. Until then, Kansas producers who choose to grow industrial hemp continue in the entrepreneurial tradition of their pioneer forefathers by helping establish an agronomic crop.

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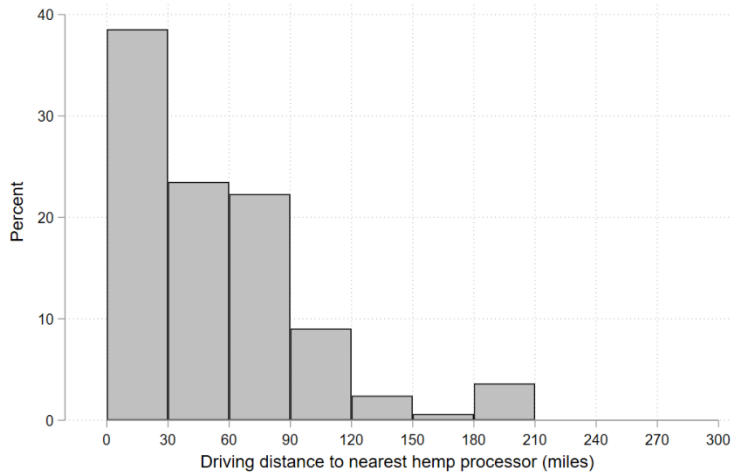
Table 1: Land Use Classification in 2018 for Outdoor Fields Growing Hemp in 2019

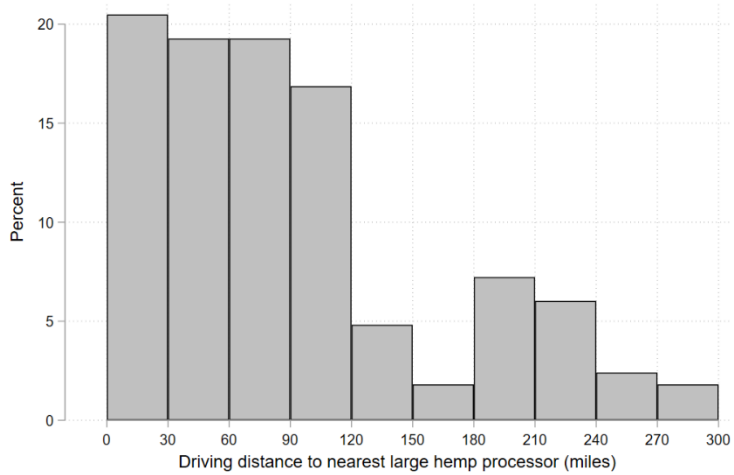
Crop Grown in 2018	By Hemp Field (%)				By Hemp Acres (%)		
	(1)	*(2)*	*(3)*		*(4)*	*(5)*	*(6)*
	All Applicants	**Planted Fields**	**Harvested Fields**		**All Applicants**	**Planted Fields**	**Harvested Fields**
Corn	7.4	10.1	11.8		8.1	12.2	12.9
Soybean	10.5	12.8	12.4		8.3	10.3	11.4
Wheat, sorghum, or other small grains	13.8	11.9	11.2		20.4	17.1	16.6
Hay/Pasture	43.8	45.9	46.5		28.6	20.8	25.5
Undeveloped/Open Space	21.5	16.1	15.3		33.1	38.2	33.0
Developed	2.9	3.2	2.9		1.6	1.3	0.6
Fields (N)	*484*	*218*	*170*	*Acres (N)*	*9,094*	*2,702*	*1,787*

Columns (1) to (3) indicate the percentage of Kansas fields growing hemp in 2019 by the primary crop grown in 2018. Columns (4) to (6) indicate the percentage of Kansas acres growing hemp in 2019 by the primary crop grown in 2018. Columns do not sum to 100 due to rounding. Above figures exclude plots where hemp was reported to have grown in mixed light or indoor facilities (warehouses, greenhouses, hoophouses). The 'All Applicants' category includes fields proposed for production on all hemp license applications submitted for 2019. The 'Planted Fields' and 'Harvested Fields' include only those fields for which licensees submitted planting and harvesting reports, respectively. Crop histories obtained from USDA's CropScape (2019) geospatial Cropland Data Layer (CDL) using GPS coordinates of field entrances reported by growers. Other small grains include barley, millet, oats, rye, and triticale. Fields coded as double cropped in the CDL are assigned the crop grown during the hemp season. Undeveloped/Open Space includes non-cultivated plots classified as barren, forested, shrubland, and herbaceous as well as plots categorized as Developed/Open Space. Developed areas include fields with constructed materials, impervious surfaces, or vegetation planted in developed settings for recreation, erosion control or aesthetics. Data and definitions available at https://www.nass.usda.gov/Research_and_Science/Cropland/Release/. See Lark et al. (2017) for discussion of potential classification errors in the CDL.

Panel A: All Processors



Panel B: Largest Three Processors



Panel A: *N=166*. Distance calculated from hemp growing licensee's nearest planted field to a processor. Driving distance calculated using the geomapping API from HERE Technologies via the 'georoute' command in Stata. Panel B. Largest three processors processed ≥ 35,000 pounds.

Figure 1: Histogram of Distance From the Planted Hemp Field to Nearest Processor