

# Department of Agricultural and Resource Economics

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## 2019 INDUSTRIAL HEMP EXTRACT (CBD) PRODUCTION BUDGET (1 Acre)

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This spreadsheet contains the 2019 University of Tennessee Industrial Hemp Extract (CBD) Production budget for growers that are adopting the plasticulture production system for 1-acre production of industrial hemp for extract. There are no protected cells in the spreadsheet, so the user should make sure that any changes made do not affect formulas. Any changes made on the "Industrial Hemp Extract Budget" will be reflected in the "Profit Matrix," where the total cost is utilized to determine the potential profit for several yield and price scenarios. This spreadsheet should not be considered representative of all circumstances and is provided as a template or guide that can be used to estimate production costs for planning purposes. Inputs, production practices and prices for inputs vary tremendously from farm to farm; as such, producers are encouraged to use their own inputs, input prices and cost structures for planning purposes.

Disclaimer: This budget does NOT imply any production recommendations. Significant variability in plant spacing, fertilization rate, irrigation, labor hours, drying and storage methods, and other input costs exist in the production of industrial hemp for extract. The information contained in this spreadsheet relies on assumptions and observations in Tennessee. The price of industrial hemp for extract is not well established, so extreme caution is recommended when evaluating price potential. The profit matrix estimates the profitability of industrial hemp extract production based on different yield and price projections. These budgets should not be construed as a reflection of all circumstances across the state, as significant variability will occur. To improve accuracy, users are encouraged to use inputs, prices and processes that are utilized on their specific farms. Note that there is a large amount of uncertainty and unknown factors associated with hemp extract production, costs and markets; therefore, growers should do their own research and manage their risk.

**2019 Industrial Hemp Extract Production Budget (1 Acre)**

| <b>REVENUE <sup>1</sup></b>                        |  |                   |                    |                    |  |
|--|--|-------------------|--------------------|--------------------|--|
| Description  | Quantity   | Unit              | Total (\$/acre)    |                    |  |
| Projected Cannabidiol (CBD) % of Dry Matter        | 10%  | % of dry matter   |                    |                    |  |
| Price Per % CBD Oil                                | \$1.50   | \$ per %          |                    |                    |  |
| Total Plant Population (# of Transplants Per Acre) | 1,500  | transplants/acre  |                    |                    |  |
| Percent of Transplants Harvested/Marketed          | 95%  | %                 |                    |                    |  |
| Average Dried Floral Material Per Plant (lbs)      | 1.00   | lbs/plant         |                    |                    |  |
| Total Harvested Dried Floral Material              | 1,425  | lbs/acre          |                    |                    |  |
| <b>Estimated Gross Revenue</b>                     |  |                   | <b>\$21,375.00</b> |                    |  |
| <b>EXPENSES</b>                                    |  |                   |                    |                    |  |
|  | Unit   | Quantity (#/acre) | Price (\$/unit)    | Total (\$/acre)    |  |
| <b>Variable Expenses</b>                           |  |                   |                    |                    |  |
| Transplants <sup>2</sup>                           | Purchased Transplants                                | 1,500             | \$4.00             | \$6,000.00         |  |
| Soil Test <sup>3</sup>                             | Soil Fertility Test                                  | 1                 | \$20.00            | \$20.00            |  |
|  | Heavy Metal  | 1                 | \$50.00            | \$50.00            |  |
|  | Pesticide Residue                                    | 1                 | \$350.00           | \$350.00           |  |
| Fertilization <sup>4</sup>                         | Dolomite Lime - Spread                               | 1                 | \$30.00            | \$30.00            |  |
|  | Nitrogen - N   | 100               | \$0.46             | \$46.00            |  |
|  | Phosphorus - P                                       | 150               | \$0.60             | \$90.00            |  |
|  | Potassium - K  | 180               | \$0.34             | \$61.20            |  |
|  | Other  | 0                 | \$0.00             | \$0.00             |  |
| Fertigation  | Nitrogen - N   | 100               | \$0.48             | \$48.00            |  |
|  | Other  | 0                 | \$0.00             | \$0.00             |  |
| Plastic Mulch <sup>5</sup>                         | Plastic Mulch  | 1                 | \$285.00           | \$285.00           |  |
| Irrigation <sup>6</sup>                            | Drip Tape  | 1                 | \$156.00           | \$156.00           |  |
|  | Pumping Cost   | 96                | \$2.14             | \$205.44           |  |
|  | Water Cost   | 0                 | \$3.00             | \$0.00             |  |
| Machinery Costs <sup>7</sup>                       | Fuel, Operator Labor, Repair and Maintenance         | 1                 | \$305.18           | \$305.18           |  |
| Other Processing Costs                             | Drying/Grinding/On-Farm Processing                   | 1                 | \$0.00             | \$0.00             |  |
| Other Expenses <sup>8</sup>                        |  | 1                 | \$0.00             | \$0.00             |  |
| <b>Non-operator Labor Expense <sup>9</sup></b>     |  |                   |                    |                    |  |
|  | Pre-plant and Planting Labor                         | 50                | \$11.63            | \$581.50           |  |
|  | In-season Labor                                      | 50                | \$11.63            | \$581.50           |  |
|  | Harvest Labor  | 100               | \$11.63            | \$1,163.00         |  |
|  | Post-harvest Labor                                   | 175               | \$11.63            | \$2,035.25         |  |
|  | Management Labor                                     | 25                | \$15.00            | \$375.00           |  |
|  | Other Labor  | 0                 | \$11.63            | \$0.00             |  |
| <b>Total Labor Expense</b>                         |  | 400               |                    | <b>\$4,736.25</b>  |  |
| <b>Marketing and TDA Charges</b>                   |  |                   |                    |                    |  |
| Pallet Boxes                                       | Boxes and Plastic Cover                              | 10                | \$22.50            | \$225.00           |  |
| Transportation to Processor <sup>10</sup>          | 50 miles One-Way to Market                           | 1                 | \$63.58            | \$63.58            |  |
| License Fee <sup>11</sup>                          | Up to 5 acres  | 1                 | \$250.00           | \$250.00           |  |
| Sampling Fee <sup>12</sup>                         | 1 Variety  | 1                 | \$150.00           | \$150.00           |  |
| Inspection Fee <sup>13</sup>                       |  | 2                 | \$35.00            | \$70.00            |  |
| Cannabinoid Test <sup>14</sup>                     |  | 1                 | \$40.00            | \$40.00            |  |
| <b>Total Marketing and TDA Charges</b>             |  |                   |                    | <b>\$798.58</b>    |  |
| Interest <sup>15</sup>                             | Half of Specified Variable Expenses                  |                   | 6.50%              | \$428.40           |  |
| <b>Total Variable Expenses</b>                     |  |                   |                    | <b>\$13,610.05</b> |  |
| <b>Fixed Expenses</b>                              |  |                   |                    |                    |  |
| Machinery <sup>16</sup>                            | Depreciation, Interest, Taxes, Insurance and Housing | 1                 | \$78.03            | \$78.03            |  |
| Irrigation System <sup>17</sup>                    | Capital Recovery                                     | 1                 | \$424.46           | \$424.46           |  |
| Drying Barn <sup>18</sup>                          | Annual Lease   | 1                 | \$555.00           | \$555.00           |  |
| Drying Materials <sup>19</sup>                     | Depreciation   | 1                 | \$50.00            | \$50.00            |  |
| Land Rent <sup>20</sup>                            |  | 1                 | \$95.00            | \$95.00            |  |
| <b>Total Fixed Expenses</b>                        |  |                   |                    | <b>\$1,202.49</b>  |  |
| <b>Total Expenses</b>                              |  |                   |                    | <b>\$14,812.54</b> |  |
| <b>RETURNS OVER SPECIFIED EXPENSES</b>             |  |                   |                    | <b>\$6,562.46</b>  |  |

**\*Disclaimer:** This budget does NOT imply any production recommendations. Significant variability in plant spacing, fertilization rate, irrigation, labor hours, drying and storage methods, and other input costs exist in the production of industrial hemp for extract. This spreadsheet should not be considered representative of all circumstances and is provided as a template or guide that can be used to estimate production costs for planning purposes.

## FOOTNOTES

1) Prices and yields are estimates. Markets and prices have not been well established, so variability in prices is likely. Prices may change dramatically between planting and harvest. The percent of CBD oil is a key determinant in price and is variety and environment dependent. Significant variability in CBD oil content may occur. Processors may have minimum CBD oil thresholds to purchase the crop. Discussions regarding processor requirements (minimum CBD percentage, production methods, and delivery and payment terms) are strongly advised prior to planting the crop. A floral dry matter yield of 1 lb per plant is assumed; however, plant weights can vary. To modify revenue: number of transplants per acre, plant survival rate, pounds of floral material per plant, percentage of CBD oil in dry matter, and price can be modified to more accurately reflect individual circumstances. Payment timing and delivery should be discussed with the processor to ensure sufficient cash reserves or operating credit is available.

2) Spacing: There are no recommendations on plant populations for industrial hemp. *2016 Kentucky Department of Agriculture Industrial Hemp Research Pilot Program Production Report Summary* indicates that transplanting rates ranged from a low of less than 500 plants/acre to a high of + 5,000 plants/acre, with the three most common planting rates for transplants being: 500-999 plants/ac; 1,000-1,499 plants/ac; and +5,000 plants/ac. Similar transplanting rates have been observed in Tennessee. Row spacing and number of plants per acre may affect disease, weed, and insect infestation and per-acre expenses.

3) Soil testing is highly recommended for production of hemp for CBD extracts. A heavy metal test (arsenic, cadmium, lead, methylmercury) should be performed on all production sites. Pesticide residue tests should be performed on the fields that may have contamination issues. Costs are surveyed from two labs that are commonly used by Tennessee hemp producers. Note that producers should consult with the buyer or processor on which lab to use and what tests need to be conducted. Additional fertilizers may be needed based on soil tests (substantial variation exists).

4) Fields should be tested for fertility prior to planting. Currently, UT Extension does not have fertility recommendations for hemp. Estimates are based on industry/expert opinions; however, substantial variation in fertilizer application rates and application methods exists. This budget assumes a pre-plant broadcast application and incorporation of N-P-K. Producers with the appropriate equipment may band the fertilizer (with application rates adjusted) as an alternative to broadcasting. In-season application of nitrogen by fertigation is assumed. In-season application of nitrogen should be distributed over multiple applications. It is strongly recommended to consult a qualified agronomist to determine application timing and quantity of nitrogen applied per application during the growing season.

5) Plastic mulch will help control weeds and maintain soil moisture. Not all industrial hemp producers use plastic mulch; however, additional manual and mechanical weed control may be required in non-mulch systems. Currently, no chemicals are approved for industrial hemp production in Tennessee.

6) Irrigation costs will vary based on water source, irrigation system, energy source, irrigation quantities and irrigation frequency. Irrigation costs are calculated based on irrigating one inch of water per week for eight weeks. A total of 96 hours will be needed to cover an acre. Cost of fuel per hour is surveyed from one Tennessee hemp grower. Water cost is not included; however, if county or municipal water is used for irrigation, prevailing water rates from the utility company should be included. The cost of establishing a water source (pond or well) is not included. User should include these costs if it applies to them.

7) Variable machinery costs include estimates for fuel, operator labor, and repair and maintenance from Mississippi State University's budget generator. Machinery costs will vary based on existing farm resources and the equipment used. It is important to note that some labor requirements may be offset by mechanization. Additional machinery may be required based on site-specific characteristics. For example, depending on the condition of the planting site, plowing of the soil may be necessary. Disking alone to prepare the planting area, even with a tiller, may not be sufficient, especially since there is no chemical weed control available.

8) Other expenses may include security cost, insurance cost, etc. Growers should consider all the risk involved with industrial hemp production. Currently there is no federal crop insurance for producers to mitigate some of the risks. Producers should be aware of the huge amount of risks involved, from sourcing seed, production, to marketing. Several private insurance companies are offering programs for protecting growers from liability or natural disaster; however, the cost can be substantial. Consult with professionals before choosing any policy.

9) Labor: Production of industrial hemp extract can be very labor intensive. As such, securing sufficient labor for your operation's production methods and size is strongly advised. Pre-plant and planting labor will be contingent on plant populations, level of mechanization and the planting/irrigation system utilized. In-season labor to control weeds and operate/maintain irrigation systems will depend on weed infestation and irrigation use. Harvest labor includes harvesting, transporting and hanging the crop. Post-harvest labor includes on-farm processing (removal from the drying barn, removing leaves and floral material, bagging and preparation for transportation to the processor). Management labor should be included. Labor is assumed to be the 2019 H2A rate in Tennessee: \$11.63/hr.

10) Transportation costs will vary based on distance, gas mileage, cost of fuel, rate of speed and cost of labor. Transportation cost of \$63.58 is calculated: 50 mile distance one way, 13 miles per gallon, \$3/gallon fuel, 3 hours of labor, \$13.50/hour.

11) License fee: See 2019 Tennessee Department of Agriculture Industrial Hemp Application guidelines. Fee for a grower license is based on planning acreage for production: \$250 for less than 5 acres, \$300 for 5 to 20 acres, and \$350 for more than 20 acres. One-acre production is assumed in this budget. Growers should modify the license fee per acre if more than 1 acre is planted.

12) Sampling fee: TDA charges \$150 per variety for the THC test pre-harvest, and the harvest material should contain less than 0.3% THC; if tested "hot" (over 0.3%), the materials will be destroyed. If more than one variety is planted, growers should adjust the cost per acre.

13) Inspection fee: There are several inspectors working in different areas that are in charge of the compliant sampling process. They charge \$35 per hour for the time spent traveling to the farm and collecting samples.

14) Cannabinoid Test: A cannabinoid test is needed when selling/delivering the dry floral material to the buyer, often a processor. Most growers get paid per CBD percentage per pound. Costs are surveyed from one lab that is commonly used by Tennessee hemp producers. Note that processors often require a minimum level of CBD content in the delivered product. If the tested result is lower than the minimum requirement, processors will not accept the product. Growers also reported that some processors require a yeast, mold and terpenes test, which will add \$50 to the cost.

15) Operating interest is assumed to be charged on half of specified variable expenses at an interest rate of 6.5%.

16) Fixed machinery cost estimates include depreciation, interest, taxes, insurance and housing for specified pieces of equipment. Each operation will have different machinery lines available; as such, capital costs will vary tremendously. For producers entering hemp production with limited or no current machinery, alternatives such as leasing, custom hiring and barter should be fully explored to limit up-front capital requirements.

17) Fixed irrigation expenses include depreciation and interest for the irrigation system.

18) Industrial hemp production requires access to drying facilities. Costs for lease expense or capital recovery for ownership should be considered. This budget assumes industrial hemp requires three to four times the space needed to dry one acre of tobacco (this will vary tremendously based on number of hemp plants per acre). Drying structures other than tobacco barns can be considered.

19) Drying material expenses include the capital recovery cost of tobacco sticks for hanging the harvested materials.

20) 2018 Tennessee State Average Cropland Cash Rents as reported by USDA NASS are used. However, rental rates are subject to local market conditions.

## Hemp Extract Net Return Table (\$/acre)

Price (\$/lb) is determined by CBD percentage and price per percent in dried floral material (leaves and flower). The mid-point price and yield will update with changes on the budget tab.

|                  |          | Yield (lbs/acre) |          |          |         |         |         |         |         |        |        |        |
|------------------|----------|------------------|----------|----------|---------|---------|---------|---------|---------|--------|--------|--------|
|                  |          | 175              | 425      | 675      | 925     | 1,175   | 1,425   | 1,675   | 1,925   | 2,175  | 2,425  | 2,675  |
| Price<br>(\$/lb) | 7.00     | (13,588)         | (11,838) | (10,088) | (8,338) | (6,588) | (4,838) | (3,088) | (1,338) | 412    | 2,162  | 3,912  |
|                  | 8.00     | (13,413)         | (11,413) | (9,413)  | (7,413) | (5,413) | (3,413) | (1,413) | 587     | 2,587  | 4,587  | 6,587  |
|                  | 9.00     | (13,238)         | (10,988) | (8,738)  | (6,488) | (4,238) | (1,988) | 262     | 2,512   | 4,762  | 7,012  | 9,262  |
|                  | 10.00    | (13,063)         | (10,563) | (8,063)  | (5,563) | (3,063) | (563)   | 1,937   | 4,437   | 6,937  | 9,437  | 11,937 |
|                  | 11.00    | (12,888)         | (10,138) | (7,388)  | (4,638) | (1,888) | 862     | 3,612   | 6,362   | 9,112  | 11,862 | 14,612 |
|                  | 12.00    | (12,713)         | (9,713)  | (6,713)  | (3,713) | (713)   | 2,287   | 5,287   | 8,287   | 11,287 | 14,287 | 17,287 |
|                  | 13.00    | (12,538)         | (9,288)  | (6,038)  | (2,788) | 462     | 3,712   | 6,962   | 10,212  | 13,462 | 16,712 | 19,962 |
|                  | 14.00    | (12,363)         | (8,863)  | (5,363)  | (1,863) | 1,637   | 5,137   | 8,637   | 12,137  | 15,637 | 19,137 | 22,637 |
|                  | 15.00    | (12,188)         | (8,438)  | (4,688)  | (938)   | 2,812   | 6,562   | 10,312  | 14,062  | 17,812 | 21,562 | 25,312 |
|                  | 16.00    | (12,013)         | (8,013)  | (4,013)  | (13)    | 3,987   | 7,987   | 11,987  | 15,987  | 19,987 | 23,987 | 27,987 |
|                  | 17.00    | (11,838)         | (7,588)  | (3,338)  | 912     | 5,162   | 9,412   | 13,662  | 17,912  | 22,162 | 26,412 | 30,662 |
|                  | 18.00    | (11,663)         | (7,163)  | (2,663)  | 1,837   | 6,337   | 10,837  | 15,337  | 19,837  | 24,337 | 28,837 | 33,337 |
|                  | 19.00    | (11,488)         | (6,738)  | (1,988)  | 2,762   | 7,512   | 12,262  | 17,012  | 21,762  | 26,512 | 31,262 | 36,012 |
|                  | 20.00    | (11,313)         | (6,313)  | (1,313)  | 3,687   | 8,687   | 13,687  | 18,687  | 23,687  | 28,687 | 33,687 | 38,687 |
| 21.00            | (11,138) | (5,888)          | (638)    | 4,612    | 9,862   | 15,112  | 20,362  | 25,612  | 30,862  | 36,112 | 41,362 |        |
| 22.00            | (10,963) | (5,463)          | 37       | 5,537    | 11,037  | 16,537  | 22,037  | 27,537  | 33,037  | 38,537 | 44,037 |        |

**\*Disclaimer:** The total cost is utilized to determine the potential profit for several yield and price scenarios. The price of industrial hemp for extract is not well established, so extreme caution is recommended when evaluating price potential. This budget should not be construed as a reflection of all circumstances across the state, as significant variability will occur.

**Machinery Operations and Irrigation Cost Estimates for Hemp Extract Production (\$/Acre)**

| Machinery                      | Size            | Purchase Price  | Fixed    | Repair & Maintenance | Fuel     | Labor     | Number of Passes | Variable  | Fixed    | Total     |
|--------------------------------|-----------------|-----------------|----------|----------------------|----------|-----------|------------------|-----------|----------|-----------|
| Disk/Tractor                   | 5/75 hp         | \$ 2,070/49,300 | \$ 3.06  | \$ 0.65              | \$ 2.86  | \$ 5.57   | 1                | \$ 9.08   | \$ 3.06  | \$ 12.14  |
| Bed Shaper/Tractor             | 8/75 hp         | \$ 4,280/49,300 | \$ 12.39 | \$ 3.42              | \$ 5.62  | \$ 19.32  | 1                | \$ 28.36  | \$ 12.39 | \$ 40.75  |
| Planter - Transplanter/Tractor | 1-R/75 hp       | \$ 2,820/49,300 | \$ 21.00 | \$ 1.79              | \$ 11.02 | \$ 70.83  | 1                | \$ 83.64  | \$ 21.00 | \$ 104.64 |
| Utility Trailer/Tractor        | 10 ft/75 hp     | \$ 2,820/49,300 | \$ 2.69  | \$ 0.48              | \$ 2.77  | \$ 8.10   | 1                | \$ 11.35  | \$ 2.69  | \$ 14.04  |
| BS Lay Tape/Tractor            | 8' center/75 hp | \$ 4,590/49,300 | \$ 12.92 | \$ 3.61              | \$ 5.62  | \$ 10.92  | 1                | \$ 20.15  | \$ 12.92 | \$ 33.07  |
| Plastic Layer/Tractor          | 8/75 hp         | \$ 2,580/49,300 | \$ 9.46  | \$ 2.39              | \$ 5.62  | \$ 10.92  | 1                | \$ 18.93  | \$ 9.46  | \$ 28.39  |
| Fertilizer Spreader/Tractor    | 6/75 hp         | \$ 1,280/49,300 | \$ 0.81  | \$ 0.16              | \$ 0.58  | \$ 1.13   | 1                | \$ 1.87   | \$ 0.81  | \$ 2.68   |
| Rotary Tiller/Tractor          | 5/75 hp         | \$ 2,130/49,300 | \$ 9.37  | \$ 3.95              | \$ 6.74  | \$ 13.11  | 5                | \$ 119.00 | \$ 9.37  | \$ 128.37 |
| Mulch Lifter/Tractor           | 1-R/75 hp       | \$ 2,230/49,300 | \$ 6.33  | \$ 0.75              | \$ 4.09  | \$ 7.96   | 1                | \$ 12.80  | \$ 6.33  | \$ 19.13  |
| Total                          |                 |                 | \$ 78.03 | \$ 6.34              | \$ 44.92 | \$ 147.86 | -                | \$ 305.18 | \$ 78.03 | \$ 383.21 |

\*Tractor and implement size will be dependent on the existing resources of the farm. Farms will have different machinery compliments and cost structures. The table above is an estimation based on the assumptions provided.

| Irrigation System     | Unit   | Price     | Quantity | \$/acre   |
|-----------------------|--------|-----------|----------|-----------|
| Fertigation System    | each   | \$ 47.37  | 1        | \$ 47.37  |
| Barb Lock Sleeve      | 1/4"   | \$ 0.54   | 30       | \$ 16.20  |
| Transfer Barb         | 1/4"   | \$ 0.23   | 30       | \$ 6.90   |
| Feeder Tube           | ft     | \$ 0.11   | 50       | \$ 5.50   |
| Header Line 1 1/2"    | ft     | \$ 0.39   | 300      | \$ 117.00 |
| Adapter (Reg to Head) | 1 1/2" | \$ 5.64   | 1        | \$ 5.64   |
| End Plug for Header   | 1 1/2" | \$ 3.77   | 1        | \$ 3.77   |
| Hose Clamp            | 1 1/2" | \$ 1.05   | 2        | \$ 2.10   |
| Pressure Regulator    | 12 PSI | \$ 41.60  | 1        | \$ 41.60  |
| PVC Female Adaptor    | 1 1/2" | \$ 5.64   | 1        | \$ 5.64   |
| Y Filter              | 1"     | \$ 23.16  | 1        | \$ 23.16  |
| PVC Fitting (bush)    | 1 1/2" | \$ 3.37   | 1        | \$ 3.37   |
| PVC Fitting (adpt)    | 1 1/2" | \$ 2.08   | 1        | \$ 2.08   |
| Hole Punch            | 1/4"   | \$ 4.68   | 1        | \$ 4.68   |
| Coupler               | 5/8"   | \$ 0.58   | 4        | \$ 2.32   |
| Pump (annual fixed)   |        | \$ 115.00 | 1        | \$ 115.00 |
| Interest              | 5.50%  | -         | -        | \$ 22.13  |
| Total                 |        | -         | -        | \$ 424.46 |

Drip tape irrigation system, 8-ft row spacing.

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