

INDUSTRIAL HEMP: RULES, REGULATIONS AND AGRONOMICS

BY

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HEMP FARMING ACT 2018

- “HEMP.—THE TERM ‘HEMP’ MEANS THE PLANT *CANNABIS SATIVA* L. AND ANY PART OF THAT PLANT, INCLUDING THE SEEDS THEREOF AND ALL DERIVATIVES, EXTRACTS, CANNABINOIDS, ISOMERS, ACIDS, SALTS, AND SALTS OF ISOMERS, WHETHER GROWING OR NOT, WITH A DELTA-9 TETRAHYDROCANNABINOL CONCENTRATION OF NOT MORE THAN 0.3 PERCENT ON A DRY WEIGHT BASIS.”

HEMP FARMING ACT 2018

- HEMP IS REMOVED FROM THE CONTROLLED SUBSTANCES ACT
- USDA MAINTAINS AUTHORITY OVER FEDERAL REGULATIONS AND GUIDELINES
- FDA MAINTAINS AUTHORITY OVER HEMP PRODUCTS
- ALLOWS FOR FEDERAL FUNDING FOR HEMP RESEARCH
- ALLOWS FOR FEDERAL CROP INSURANCE
- ALLOWS INTERSTATE COMMERCE (OF PRODUCTS <0.3% THC)

HEMP PROGRAM – GETTING STARTED

- NEED TO ACQUIRE A LICENSE
 - GROWER LICENSE
 - PROCESSOR LICENSE
- NEED TO PASS A CRIMINAL BACKGROUND CHECK AND FINGER PRINTING
- PROVIDE MAPS AND GPS COORDINATES OF THE GROWING/PROCESSING LOCATION(S)
- PAY FEES
 - LICENSE FEE
 - APPLICATION FEE
 - TESTING FEE

MORPHOLOGY

- DICOTYLEDONOUS PLANT
- PRIMARILY DIOECIOUS
 - SEPARATE MALE/FEMALE PLANTS
- SOMETIME MONECIOUS
 - MALE/FEMALE FLOWERS ON SAME PLANT
- GENDER CAN BE DETERMINED 4-6 WEEKS AFTER PLANTING
- REPRODUCTION OCCURS THROUGH POLLINATION
 - POLLEN SHED TYPICALLY LASTS 2-4 WEEKS
 - MALE PLANTS WILL DIE AFTER POLLINATION



Male Plant



Female Plant

CLIMATE AND SOIL REQUIREMENTS

- **SOIL TYPE:** WELL-DRAINED SOILS ARE BEST (SANDY TO LOAMY)
 - HEAVY CLAY SOILS CAN REMAIN SATURATED AND COOLER
- **SOIL TEMPERATURES:** >45-50°F
- **OPTIMUM AIR TEMPERATURE:** 65-75°F
- **MOISTURE REQUIREMENT:** MINIMUM OF 10-15 INCHES
 - DOESN'T LIKE WET CONDITIONS BUT TENDS TO BE THIRSTY
- **SOIL FERTILITY:** AVOID MARGINAL SOILS WITH LOW FERTILITY
- **PHOTOPERIOD:** REQUIRES >10 HOURS DARKNESS TO INITIATE FLOWERING

FIELD SELECTION

GENERAL

- FIELDS THAT ARE MOST PRODUCTIVE
- FIELDS WITH LOWEST WEED PRESSURE
- FIELDS THAT ARE WELL-DRAINED
- AVOID FIELDS WITH COMPACTION
- AVOID FIELDS PRONE TO DISEASE
- ROTATION AFTER SOYBEANS
 - POTENTIAL FOR WHITE MOLD
- ROTATION AFTER CORN
 - INCREASED NITROGEN DEMAND

ORGANIC

- ROTATIONS THAT PROVIDE NATURALLY LOW WEED PRESSURE
 - ROTATION AFTER LEGUME SOD CROPS (ALFALFA, CLOVER)
 - BEST WEED CONTROL
 - RESIDUAL NITROGEN
 - ROTATION AFTER WINTER RYE
 - TERMINATE 10-14 DAYS PRIOR TO PLANTING TO REDUCE POTENTIAL ALLELOPATHIC EFFECT
 - ROTATION AFTER CORN/SOYBEANS
 - HIGHER WEED POTENTIAL
- INCREASE PLANTING RATES

FERTILITY

- NUTRIENT DEMAND INCREASES WITH PLANT AGE – GREATEST DEMAND IS AT FLOWERING
- **PH RANGE:** 6.0-7.5
- **NITROGEN** (ACTUAL): 125-150 POUNDS/ACRE (GRAIN); 50-150 POUNDS/ACRE (FIBER)
 - MAJORITY IS STORED IN THE STALK
 - EXCESS NITROGEN CAN CAUSE LODGING AND/OR DELAY MATURITY
 - NEED TO DETERMINE THE EFFECT ON FIBER QUALITY
- **PHOSPHORUS** (ACTUAL): 40-70 POUNDS/ACRE (GRAIN AND FIBER)
 - MAJORITY IS STORED IN THE SEED
- **POTASSIUM** (ACTUAL): 60-100 POUNDS/ACRE (GRAIN); 200-300 POUNDS/ACRE (FIBER)
 - MAJORITY STORED IN THE STALK
- **SULFUR** (ACTUAL): 15-25 POUNDS/ACRE

NITROGEN



40 lbs/ac - Nitrogen
Yield: ~500 lbs/ac



125 lbs/ac - Nitrogen
Yield: ~1500 lbs/ac

PLANTING

- FIRM, SHALLOW SEEDBED
 - ROLLING/PACKING FOR GOOD SEED-TO-SOIL CONTACT
- **PLANTING DEPTH:** $\frac{1}{4}$ - $\frac{3}{4}$ INCHES
 - **TARGET:** $\frac{1}{2}$ INCH
- **PLANTING RATE:**
 - CBD: 1500-2000 PLANTS/ACRE (1 PLANT PER 4-6 FT)
 - FIBER: 40-60 POUNDS/ACRE (23-34 SEEDS/FT²)
 - GRAIN: 25-35 POUNDS/ACRE (14-20 SEEDS/FT²)
- **PLANTING METHOD:** GRAIN DRILL/AIR DRILL, BRILLION SEEDER, BROADCAST, CORN PLANTER (CBD, GRAIN), TRANSPLANTER (CBD)
- **PLANTING DATE:**
 - FIBER: APRIL TO MAY (>45°F SOIL TEMP) – SAME TIME AS **SMALL GRAINS**
 - GRAIN/CBD: MAY TO JUNE (>50°F SOIL TEMP) – SAME TIME AS **CORN**
- PLANT AFTER A RAIN, NOT BEFORE (EXCEPT IN ARID REGIONS)

Planting Depth
is IMPORTANT!



PESTS (WEEDS)

- ONE OF THE MOST SIGNIFICANT PESTS OF HEMP
- **FIELD SELECTION IS CRITICAL**
- AVOID WET WEATHER AFTER PLANTING
- **WEED CONTROL DURING FIRST 30-DAYS IS CRITICAL**
- FIND SITUATIONS THAT REDUCES WEED PRESSURE
 - PLANT AFTER LEGUME SOD CROPS (ALFALFA, CLOVER)
 - GOOD SOIL FERTILITY
 - PLANT AFTER A RAIN, NOT BEFORE
 - PLANT DURING A DRY PERIOD
 - WELL-DRAINED SOILS
 - USE OF SOIL AMENDMENTS (GYPSUM, LIME, COMPOST)
- POSSIBLE MECHANICAL CONTROL (ROTARY HOE, TINED-WEEDER, HARROW, CULTIVATOR)



Weeds during Slow Growth Phase

PESTS (DISEASE)

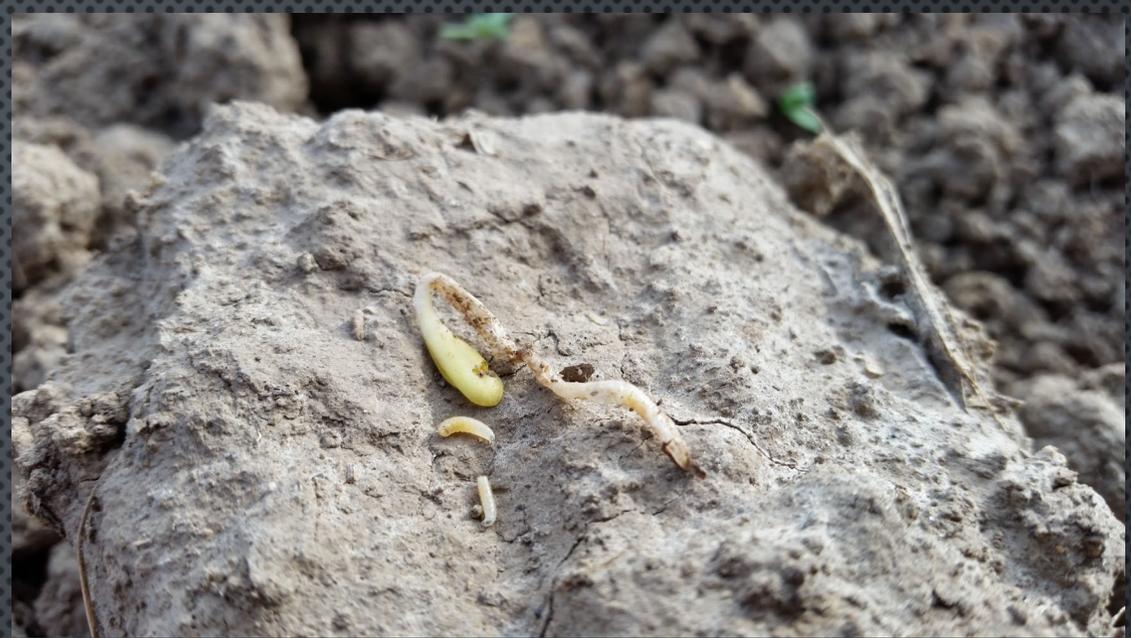
- TWO SIGNIFICANT DISEASES:
 - WHITE MOLD (*SCLEROTINIA SCLEROTIORUM*)
 - GRAY MOLD (*BOTRYTIS CINEREA*)
- CONDITIONS FOR MOLD
 - COOL – MODERATE TEMPERATURES (<85°F)
 - HIGH HUMIDITY
 - DRIZZLE/FOGGY CONDITIONS (MARITIME-LIKE)
- REDUCE DISEASE PRESSURE
 - KNOW THE DISEASE HISTORY OF YOUR FIELDS
 - AVOID FIELDS PRONE TO WHITE MOLD OR GRAY MOLD
 - CONSIDER ROTATING AFTER CORN/WHEAT RATHER THAN SOYBEANS
 - REDUCE PLANT POPULATIONS AND WIDEN ROW SPACING (INCREASES AIRFLOW)



White Mold – Left, advanced stage; Right, beginning stage

PESTS (INSECTS)

- GENERALLY, INSECT PEST ARE NOT ECONOMICALLY SIGNIFICANT IN GRAIN OR FIBER HEMP
- COMMON INSECT PESTS
 - JAPANESE BEETLES
 - CORN EARWORM
 - EUROPEAN CORN BORER
 - EURASIAN HEMP BORER
 - APHIDS
 - SEEDCORN MAGGOT
 - SPIDER MITES
 - STINKBUGS
 - GRASSHOPPERS



Seedcorn Maggot



Japanese Beetle

TYPES OF HEMP

- CANNABIDIOL (CBD)
 - FIBER
 - GRAIN

TYPES OF HEMP

CBD HEMP

- SIMILAR TO GROWING PRODUCE OR TOBACCO
- **PLANTING STOCK:** SEEDS OR TRANSPLANTS (CLONES)
 - FEMALE PLANTS ONLY
- **PLANTING METHOD:** TYPICALLY BY HAND OR TRANS-PLANTER. CAN BE GROWN IN GREENHOUSE
- **PLANTING RATE:** 1500-2000 PLANTS/ACRE (<1 LB SEED)
- **HARVEST METHOD:** TYPICALLY BY HAND
- **POST-HARVEST:** PLANTS ARE HUNG TO DRY IN DRYING SHEDS OR WAREHOUSES; FLOWERS ARE STRIPPED FROM BRANCHES

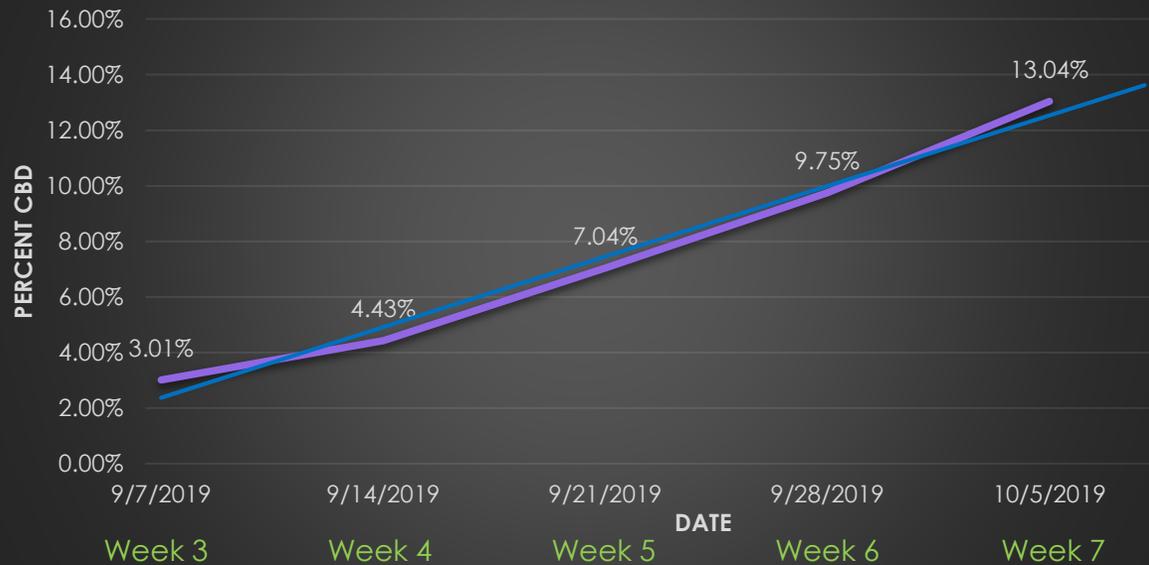


COMPARISON OF CBD AND THC OVER TIME

CBD:THC
Ratios Vary: 20:1 to 30:1

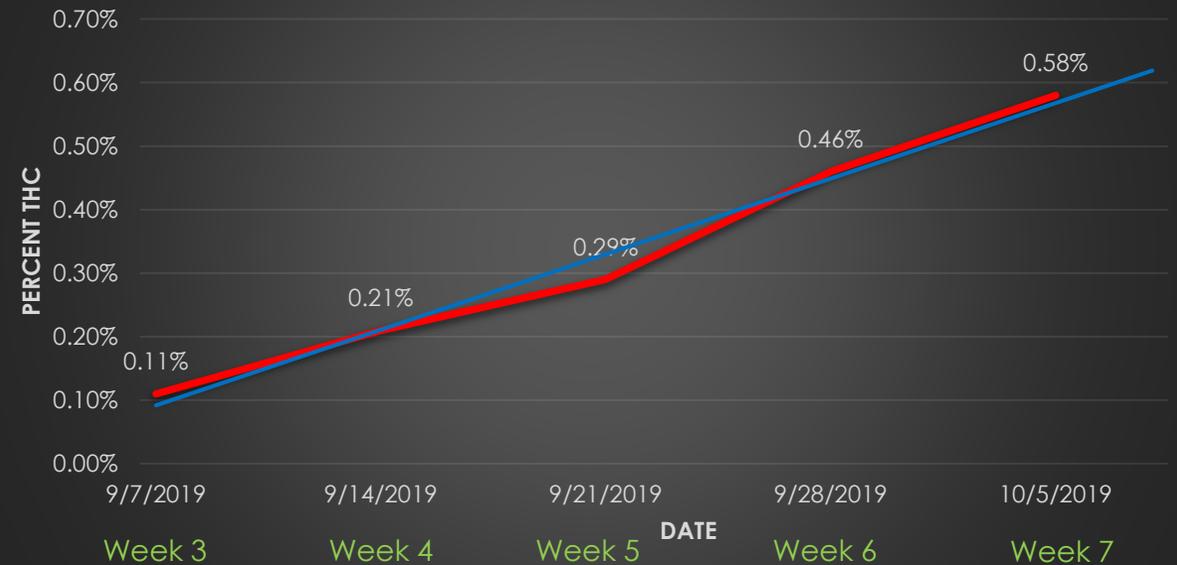
CBD

Total Potential CBD



THC

Total Potential THC



POST HARVEST (CBD)

STORAGE

- THIS IS ONE OF THE MOST OVERLOOKED AND UNDERESTIMATED PORTIONS OF GROWING CBD HEMP
- PLANT SIZE WILL DETERMINE HOW MUCH SPACE IS NEEDED TO HANG AND STORE THE CROP
 - ESTIMATES RANGE FROM 5 – 50 CUBIC FEET/PLANT
 - DEPENDS ON SIZE OF PLANTS: 6 FT (HEIGHT) X 3 FT (WIDTH) X 3 FT (DEPTH) = 54 CUBIC FEET PER PLANT
- SOME WILL HARVEST AND HANG ENTIRE PLANTS WHILE OTHERS WILL DE-BRANCH AT HARVEST



De-branched cannabis for drying



Whole plants of cannabis for drying

POST HARVEST (CBD)

DRYING

- HANGING PLANTS TO DRY IS THE MOST POPULAR AND COST EFFECTIVE WAY TO DRY
 - ABSOLUTELY ESSENTIAL TO HAVE ADEQUATE AIRFLOW
- **CLIMATE CONTROLLED BUILDINGS ARE PREFERRED**
 - DRY TIME: 7-21 DAYS TO DRY
 - TEMPERATURE: 65 – 70°F
 - HUMIDITY: 50 – 55%
 - DEHUMIDIFIERS ARE PREFERRED
- DRYING SHEDS CAN WORK BUT CANNOT CONTROL HUMIDITY
 - DRY TIME: 30-90 DAYS TO DRY – DEPENDS ON OUTSIDE HUMIDITY
 - **RELATIVELY HIGH RISK OF MOLD WITHOUT CONTROLLING HUMIDITY**
- DRYING CONTAINERS/STRUCTURES (10-30 DAYS TO DRY)
 - ALLOWS FOR BATCH DRYING AND CAN BE MOBILE
 - LOW HEAT WITH GOOD AIRFLOW IS ESSENTIAL



<https://twitter.com/hashtag/cbdcrew>

Whole plants in climate controlled building



Plants hang dry in a semi trailer

COMMERCIAL CBD PRODUCTION (HIGH CBD GRAIN CULTIVARS)



<http://business.hemptrade.ca/list/member/power-zone-agricultural-center-4346>

The GrassHopper– FormationAg
Chaff Collection



<https://www.pinterest.com/pin/57983913938792750/>

CleanCut Harvester – FormationAg



<https://formation-ag.com/products/harvesting/cleanstrip>

CleanStrip Harvester – FormationAg

MARKETING/SALES (CBD)

- CONTACT SEVERAL PROCESSORS TO DETERMINE THEIR DEMAND AND SPECIFICATIONS
 - VERY FEW PROCESSORS BUYING BIOMASS
 - MOST PROCESSORS ARE DOING OIL SPLITS OR TOLL PROCESSING
 - PROCESSOR TURNS FARMER'S BIOMASS IN TO OIL AND TAKE HALF OF THE OIL AS PAYMENT
- MANY PROCESSORS HAVE A MINIMUM %CBD REQUIREMENT (MOST ARE >8%-10% CBD)
- CONTRACTING PRIOR TO PLANTING IS CRITICAL
 - ANALYSTS ESTIMATE 90% OF CBD CROP HAS NOT BEEN PROCESSED OR SOLD
- OVERSUPPLY
 - * 2019: ~511,000 ACRES LICENSED; ~230,000 ACRES PLANTED; ~115,000 HARVESTED
 - * 2018: ~78,000 ACRES GROWN
 - * 2017: ~25,00 ACRES GROWN

INDUSTRIAL HEMP

- FIBER -



TYPES OF FIBER HEMP

FIBER HEMP

- **TWO TYPES:** TRUE FIBER TYPE vs. DUAL PURPOSE
- **PLANTING STOCK:** SEEDS
- **PLANTING METHOD:** GRAIN/AIR DRILL, BROADCAST
- **PLANTING RATE:** 40-60 LBS/AC vs 25-35 LBS/AC
- **HARVEST METHOD:** MOWING, RAKING (1-3x), BALING (ROUND OR SQUARE)
- ★ **HARVEST TIMING:** AT POLLINATION (JULY/AUG) vs AFTER COMBINING (OCTOBER/SPRING) ★



<http://www.hemptrade.ca/eguide/fibre-production/fibre-harvesting-equipment>

True Fiber Type



Dual Purpose

HARVEST (FIBER)

- HARVEST TIMING:
 - MOWING:
 - FIRST 1-2 WEEKS OF POLLINATION (JULY/AUGUST)
 - LEAVE 4-6 INCHES OF STUBBLE TO REDUCE ASH CONTENT
 - RAKING:
 - RAKE WHEN STALKS TURN FROM GREEN TO PALE YELLOW
 - 1-3 TURNS MAY BE REQUIRED
- RETTING PERIOD: 2-6 WEEKS (DEPENDS ON ENVIRONMENT)
- BALING
 - BALE MOISTURE: <15%
 - LARGE SQUARE BALES ARE PREFERRED



<http://www.hemptrade.ca/eguide/fibre-production/storing-baled-hemp-fibre>

Retted Hemp Straw



<http://www.hemptrade.ca/eguide/fibre-production/salvaging-hemp-fibre>

Baling

FIBER YIELDS

- TRUE FIBER-TYPE: 4 - 6 TONS/ACRE
- DUAL PURPOSE: 0.5 - 2.0 TONS/ACRE
- **HEIGHT OF PLANTS AND PLANT DENSITY GREATLY INFLUENCE YIELD**

INDUSTRIAL HEMP

- GRAIN -



TYPES OF HEMP

GRAIN HEMP

- SIMILAR TO GROWING SMALL GRAINS (WHEAT)
- **PLANTING STOCK:** SEEDS
- **PLANTING METHOD:** **GRAIN/AIR DRILL**, BROADCAST, CORN PLANTER
- **PLANTING RATE:** 25-35 POUNDS/ACRE
- **HARVEST METHOD:** COMBINE
- **POST-HARVEST:** GRAIN SHOULD BE CLEANED, THEN DRIED IN AERATION BINS IMMEDIATELY AFTER HARVEST





ASSESSING MATURITY

- MATURATION BEGINS AT THE BOTTOM OF THE HEAD AND CONTINUES UPWARD
- SEED BRACTS WILL TURN BROWN AND SHRINK EXPOSING SEEDS
- **HARVEST TIME:**
 - 70-80% OF SEEDS MATURE (100-120 DAYS)
 - SEPTEMBER/OCTOBER
 - **WITHIN 2-4 DAYS OF A KILLING FROST**
 - SOME SEEDS WILL BE IMMATURE AT HARVEST
- **HARVEST MOISTURE: 12-18%**
- **STORAGE MOISTURE: 9%**



HARVEST

- STRAIGHT CUT COMBINING IS RECOMMENDED
 - ROTARY WORKS BEST (SINGLE)
 - CONVENTIONAL WORKS FINE
 - DRAPER HEADERS ARE PREFERRED
- CUT GRAIN HEADS ONLY
 - REDUCES FIBER INTAKE IN THE COMBINE
 - CONSIDER LEAVING 5-15% OF THE LOWER HEADS IN UNEVEN STANDS
- REDUCE GROUND SPEED (2-3 MPH)
- SWATHING IS NOT RECOMMENDED
 - ALLOWS LARGE VOLUMES OF FIBER THROUGH THE COMBINE



Straight Cutting



<http://www.hemptrade.ca/eguide/fibre-production/fibre-harvesting-equipment>

Swathing

POST HARVEST

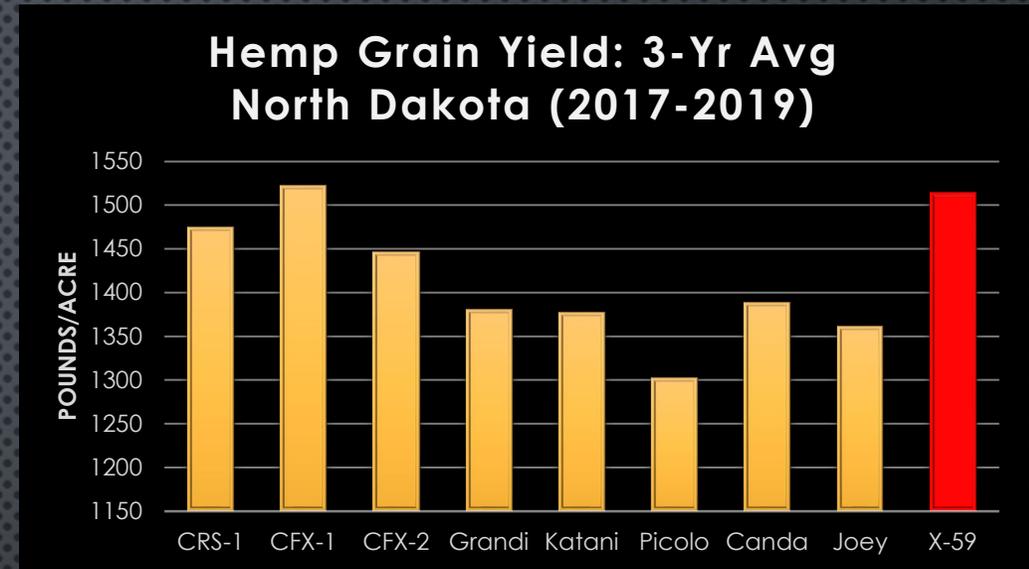
- HANDLE GRAIN WITH CARE
 - CONVEYORS ARE PREFERRED
 - RUN AUGERS FULL AND SLOW
- QUICK CLEANING IS RECOMMENDED PRIOR TO STORAGE
 - FINAL CLEANING CAN BE PERFORMED AFTER GRAIN IS DRY
- **GRAIN SHOULD BE DRIED IN AERATION BINS IMMEDIATELY AFTER HARVEST**
 - SPOILAGE CAN BEGIN WITHIN **4-6 HOURS** AFTER COMBINING
 - DO **NOT** LEAVE GRAIN SIT OVERNIGHT WITHOUT AIR
 - GRAIN MAY NEED TO BE ROTATED IN BINS TO REDUCE “HOT SPOTS”
 - MONITOR GRAIN REGULARLY
- **DRY MOISTURE: 9%**



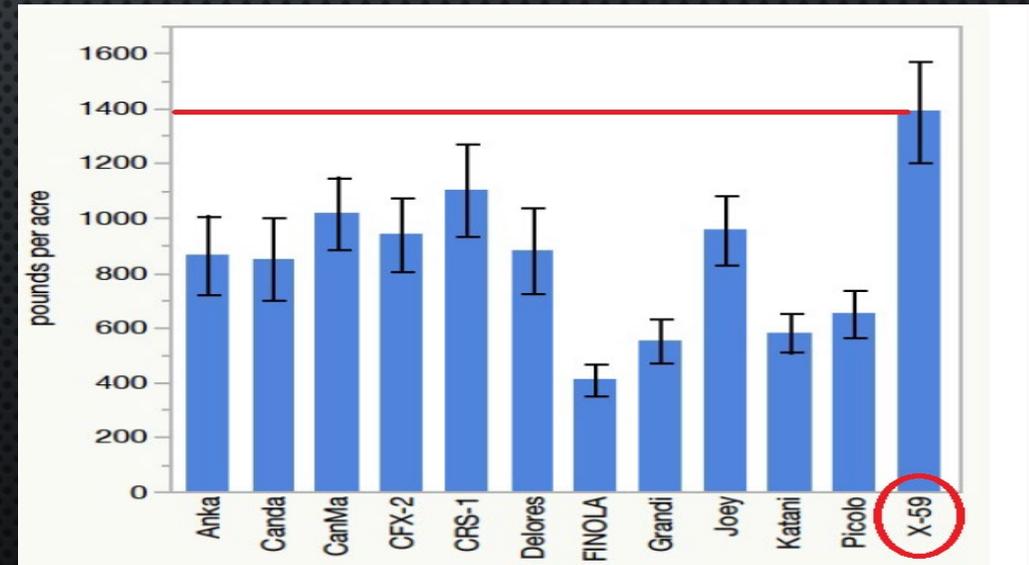
Cleaning grain before storage

GRAIN YIELD

- **YIELD**
 - **RANGE:** 600-2000 POUNDS/ACRE
 - **AVERAGE:**
 - CONVENTIONAL: 1200-1400 POUNDS/ACRE
 - ORGANIC: 600-800 POUNDS/ACRE
- KNOW WHICH FOOD-GRADE CULTIVARS BUYERS WANT



Industrial Hemp Variety Performance in North Dakota – NDSU



University of Minnesota Industrial Hemp Variety Trial - 2017

FIBER HARVEST (DUAL PURPOSE)

- **AVERAGE YIELD:** 0.5-2.0 TONS/ACRE
- **HARVEST TIME:**
 - MOWING: 1-3 DAYS AFTER COMBINING
 - BALE: 14-30 DAYS AFTER MOWING (WHEN DRY)
 - **MOW AND BALE IN SPRING (PREFERRED)**
- **MOISTURE:** <15%
- **EQUIPMENT**
 - **MOWER:** DISK MOWER (WATCH FOR WRAPPING), SICKLE MOWER (PREFERRED), SWATHER
 - **BALER:** LARGE SQUARE BALER (PREFERRED), ROUND BALER



<https://www.nuntisunya.com/en/hemp-stem-faq-uses-benefits/>

SUMMARY

- KNOW WHICH TYPE OF HEMP YOU WANT TO GROW (CBD, FIBER, GRAIN)
- BEST TO FIND A BUYER BEFORE GROWING A HEMP CROP
- KNOW WHAT QUALITY SPECIFICATIONS THE BUYER/PROCESSOR REQUIRES
 - CBD: MINIMUM CBD CONCENTRATION, HEAVY METALS
 - FIBER: TRUE FIBER TYPE VS. DUAL PURPOSE
 - GRAIN: FOOD-GRADE CULTIVARS, MICROBIAL CONCENTRATION
- FIELD SELECTION IS IMPORTANT FOR WEED CONTROL
- APPLY ADEQUATE NITROGEN
- UNDERSTAND HARVEST AND DRYING REQUIREMENTS TO AVOID SPOILAGE



RESOURCES

- [CANADIAN HEMP TRADE ALLIANCE](#) (ONLINE)
- [WISCONSIN HEMP – UW-EXTENSION](#) (ONLINE)
- [ALBERTA AGRICULTURE AND FORESTRY – INDUSTRIAL HEMP](#) (ONLINE)
- [GROWING INDUSTRIAL HEMP IN ONTARIO](#) (ONLINE)
- [INDUSTRIAL HEMP PRODUCTION AND MANAGEMENT – MANITOBA](#) (ONLINE)
- [HEMP PRODUCTION IN SASKATCHEWAN](#) (ONLINE)
- [HEMP DISEASES AND PESTS: MANAGEMENT AND BIOLOGICAL CONTROL](#) (BOOK)
- [THE CULTIVATION OF HEMP: BOTANY, VARIETIES, CULTIVATIONS AND HARVESTING](#) (BOOK)
- [MARIJUANA BOTANY: THE PROPAGATION AND BREEDING OF DISTINCTIVE CANNABIS](#) (BOOK)

QUESTIONS?

AGRONOMIST – LEGACY HEMP, LLC

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