2020 Cornell Hemp Trials for New York State

Grain, Dual Purpose, and Fiber Production

In 2020, hemp grain and fiber cultivar trials were seeded at two locations in Central New York (Table 1). These locations are part of Cornell University Agricultural Experiment Station (https://cuaes.cals.cornell.edu/) or Cornell AgriTech (https://agritech.cals.cornell.edu/). Due to lack of rain after planting, establishment was poor at the Geneva location and only the fiber trial was harvested. Also, the planter malfunctioned at Ithaca. The load bar for the cone seeder was slowly twisting during the planting. The first trials planted (fiber and early grain) were able to be used, but the dual-purpose trial was unsalvageable. After repairing the seeder, the grain trials were reseeded. Data presented in this report consist of grain and fiber yield, cannabinoid content, and grain quality components.

Table 1. Trial locations, planting dates, and site characteristics.

Location	Latitude	Planting date	Soil type	Natural Drainage Class*
Ithaca, NY (SN)	42.45 N	June 6, 24	Niagara silt loam	Somewhat poorly drained
Geneva, NY (RN)	42.88 N	June 4	Lima loam	Moderately well drained

*Tile drainage in most fields.

Information in this report was collected due to the efforts and collaborations of many faculty, staff, and students at Cornell University:

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Methods

Replicated hemp grain, dual purpose (grain and fiber), and fiber cultivar trials were planted using a small plot cone seeder. Plots were six rows wide, with 7.5 inches (19.05 cm) between rows, resulting in plots that were 45 in (114.3 cm) wide and 20 ft (6.1 m) long. Trials were planted in a randomized complete block design with four replicates and were analyzed using standard ANOVA (analysis of variance).

Seeding rates were 20 pure live seeds (PLS)/ft^2 for grain and dual-purpose cultivars and 40 PLS/ft^2 for fiber cultivars with the intention of having 15 seedlings/ft^2 in the grain and dual-purpose trials and 30 seedling/ft^2 in the fiber trials. Trials were fertilized prior to planting with 75 lbs. of nitrogen/acre as 22-9-9 and then, at three weeks, top dressed with 75 lbs./acre of nitrogen as ammonium sulfate (21-0-0).

The cultivars included in the trials, as well as seed purity, germination rate, and gram weight per one thousand seeds are found in Table 2.

Two to three weeks after planting, seedling counts were conducted. Within 2 days of harvest, the top 5 cm (2 inches) from 10 female plants per plot were sampled for cannabinoids. The inflorescences were dried at 35°C for 10-12 days and then ground and analyzed with UV-HPLC. Harvest dates for all locations are found in Table 3.

Fiber trials were harvested between flowering and seed set with sickle bar mowers. Biomass was spread out in an even layer for field retting and monitored until fully retted. The retted plots were again weighed and sampled for percent dry matter. Yields are reported as retted stem dry weight in tons per acre.

Grain and dual-purpose trials were harvested with an Almaco SPC20 plot combine when all cultivars had at least 60% mature seed. Harvested grain was dried in forced air ovens at 35°C until a stable moisture was achieved (6-8% moisture) and then cleaned to remove immature seeds and weed seeds. Samples from the cleaned grain were analyzed for test weight, thousand kernel weight (TKW) and quality components. Using near infrared reflectance spectroscopy (NIRS), equations have been developed to predict quality components, including crude protein, fiber as neutral detergent fiber (NDF), and fatty acid profile. Selected samples were sent to Dairy One (dairyone.com) to refine and further validate the NIRS equations.

Table 2: Fiber, grain, and dual-purpose hemp cultivar information

Fiber cultivars	**Source**	**Purity**	**Germination**	**TSW (g)**
Carmagnola	Schiavi Seed	99.05%	80%	16.2
Carmagnola Selezionata	Schiavi Seed	99.63%	76%	20.5
Yuma Crossbow		99.78%	81%	15.8
Jinma			57%	15.6
Grain cultivars				
Henola	Bija Hemp	99.96%	76%	15.0
CFX-2	Hemp Genetics International	99.74%	79%	16.8
Picolo	Hemp Genetics International	99.81%	70%	15.9
CRS-1	Hemp Genetics International	99.41%	81%	18.8
X-59	Legacy Hemp	99.75%	72%	21.2
Canda	Parkland Industrial Hemp Growers	99.79%	67%	20.0
Joey	Parkland Industrial Hemp Growers	99.65%	73%	18.3
USO-31	UNISeeds Inc.	99.83%	75%	15.0
Dual Purpose cultivars				
Bialobrzeskie	Bija Hemp	99.74%	93%	12.2
Hlukhivs'ki 51	Fiacre Seeds	99.88%	76%	17.3
Hliana	Fiacre Seeds	99.86%	81%	16.8
Hlesia	Fiacre Seeds	99.78%	78%	18.4
NWG 452	New West Genetics	99.69%	87%	13.2
NWG 2730	New West Genetics	99.97%	90%	14.2
Wojko	Schiavi Seed	99.35%	47%	15.7
Altair	UNISeeds Inc.	99.83%	91%	17.9
Anka	UNISeeds Inc.	99.81%	90%	16.9
Fedora 17	UniSeeds, Inc.	99.85%	93%	16.8
Felina 32	UNISeeds Inc.	99.35%	75%	16.6
Ferimon	UNISeeds Inc.	99.90%	83%	16.6
Futura 75	UNISeeds Inc.	99.86%	78%	18.7
Rigel	UNISeeds Inc.	99.77%	69%	18.5
Vega	UNISeeds Inc.	99.92%	95%	19.1

Table 3. Trial locations, type, and harvest/data collection dates.

Location	**Grain**	**Dual-Purpose**	**Fiber – green**	**Fiber - retted**
Geneva, NY	-	-	9/9	10/6, 10/15
Ithaca, NY - original	8/21-8/31	-	8/28	10/8
Ithaca, NY - replant	9/3-9/10	9/10-9/26	-	-

Results

Fiber Trials

Seedling counts

For the fiber trials, seed germination rates for the cultivars in the fiber trials ranged from 57 to 81%. Seeding rates were corrected so that the same number of viable seeds were planted in each plot for all cultivars except 'Jinma' which was limited by seed amount. Stand counts in seedlings per square foot ranged from 10.7 – 14.5 in Geneva and 25.6- 35.4 in Ithaca.

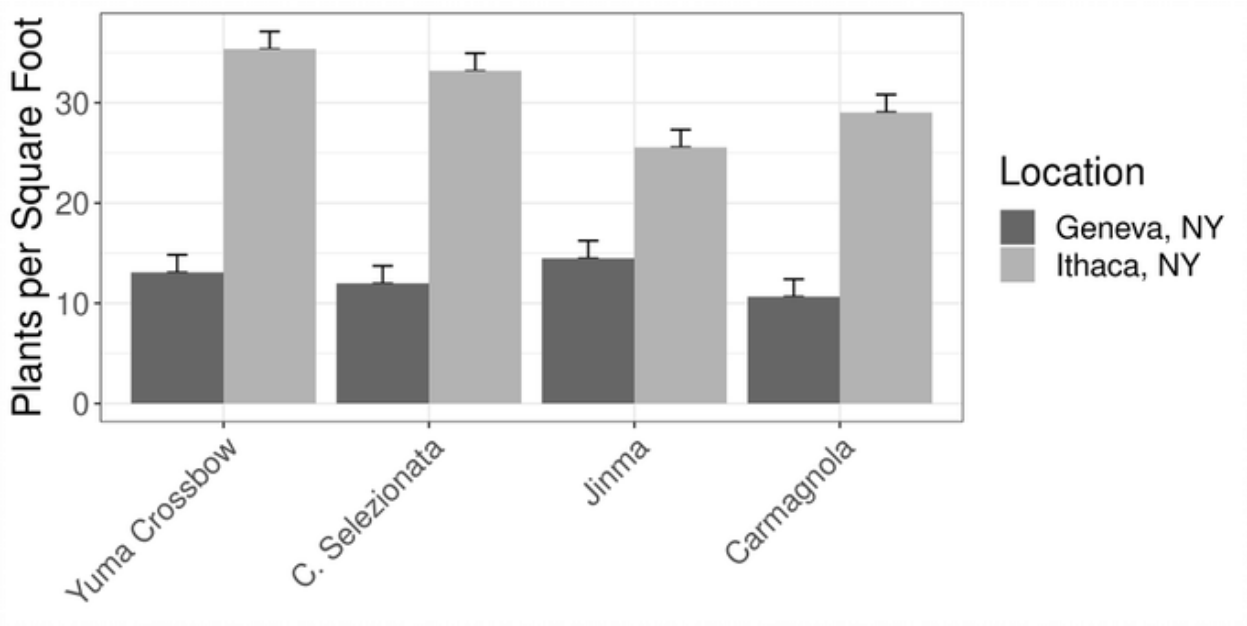

Figure 1. 2020 NY hemp seedling establishment for fiber cultivars by trial location.

Harvest yields

Plots were cut, retted, weighed, and sampled for dry matter determination. Plot weight times percent dry matter was used to estimate retted hemp straw yield (Fig. 2). Mean retted straw yields by trial location were 2.83 tons/acre in Geneva and 4.48 tons/acre in Ithaca. 'Yuma Crossbow' was much earlier maturing than the other cultivars in this trial and was harvested for grain in the Ithaca trial on August31. 'Yuma Crossbow' was harvested for fiber yield in the Geneva trial.

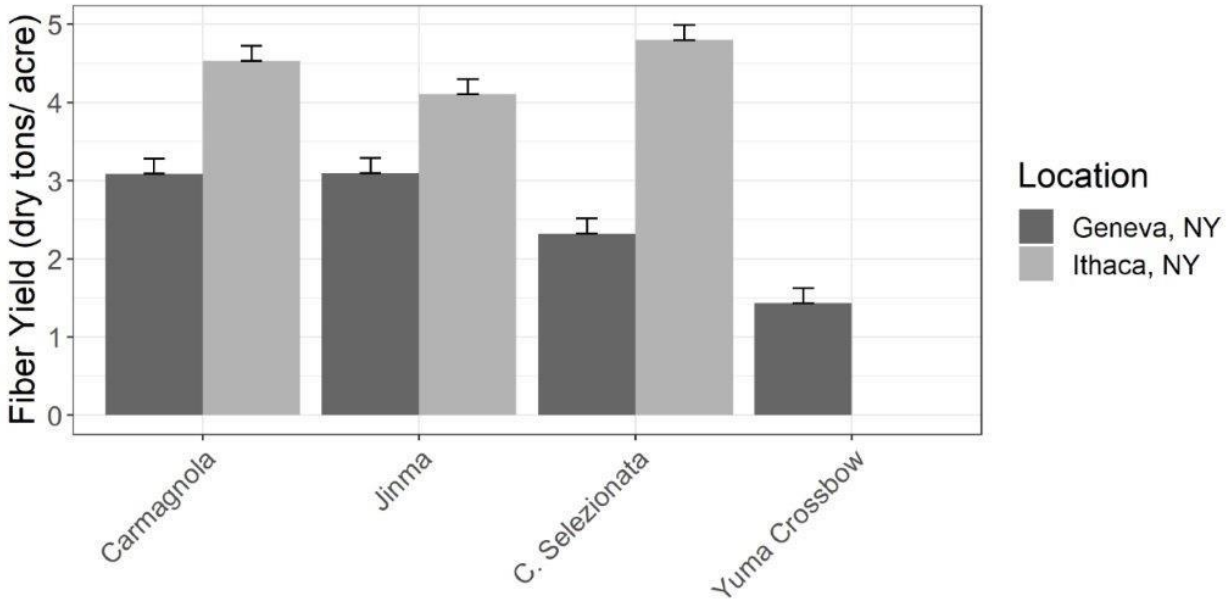

Figure 2. 2020 NY hemp retted fiber yield for cultivars by trial location.

Grain Trials

Seedling counts

The grain/dual-purpose cultivars were divided into two trials based on expected maturity dates, with 8 cultivars in the earlier maturing "grain" trial and 15 cultivars in the later maturing "dual-purpose" trial. We initially believed that the June 6 grain trial would be unsalvageable, so no stand counts were taken. In the June 24 replant, stand counts in seedlings per square foot ranged from 7.7 - 18.9 (Fig. 3).

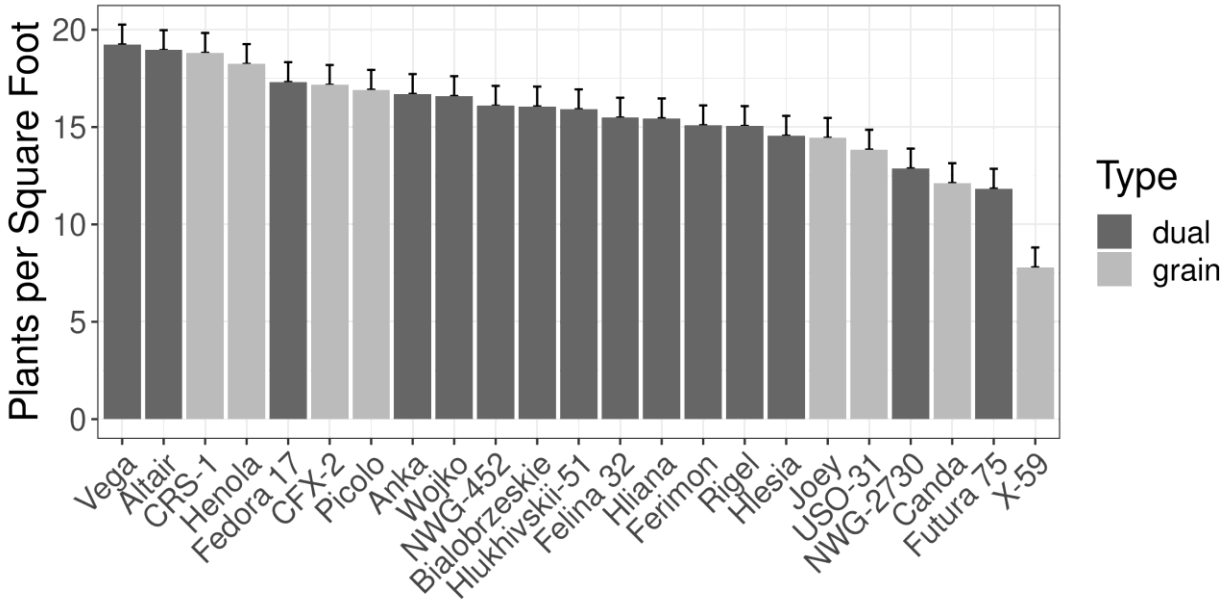

Figure 3. 2020 NY hemp seedling establishment for grain and dual-purpose cultivars.

Harvest yields – 'Grain' cultivars at different planting dates

Cultivars were harvested independently when each had reached 60% ripe seed, then threshed grain was cleaned and dried to 8% moisture. Harvest dates ranged from August 21 through September 26. Eight cultivars were harvested from both the June 6 and June 24 trials. Cultivars consistently reached maturity 8 days earlier in the June 24 trial than in the June 6 trial. Means heights and grain yields for these cultivars are presented below (Fig. 4 and 5). In the trial planted June 6, cultivars were on average 41.3cm taller and produced 763.7 more lbs. of grain per acre.

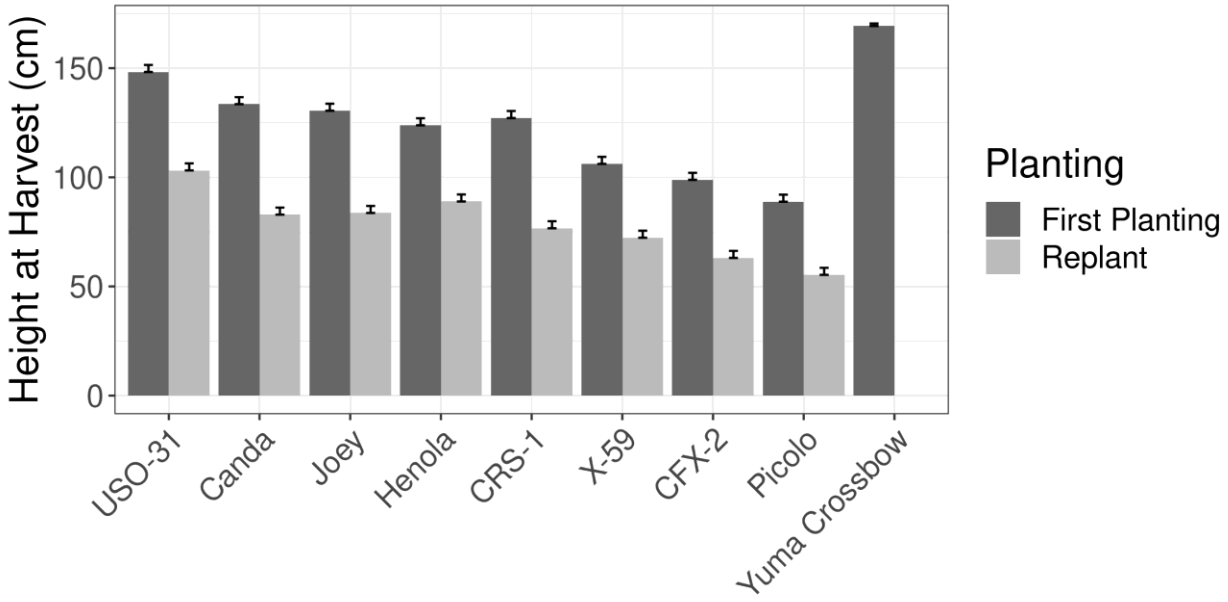

Figure 4. 2020 NY hemp height at harvest by cultivar and planting date.

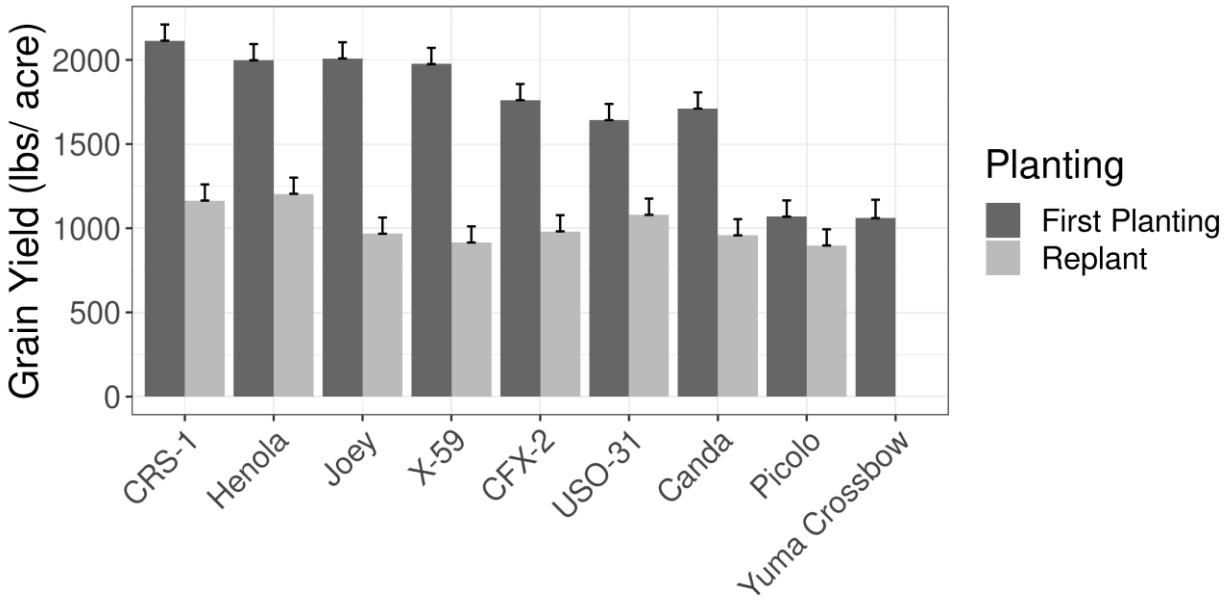

Figure 5. 2020 NY hemp grain yield by cultivar and planting date.

Harvest yields – All cultivars in trials replanted on June 24

Plots planted on June 24 were harvested from September 3 through September 26. Because the cutter bar on our plot combine is unable to cut above 75 cm, instead of reporting fiber yields, we are reporting the mean heights of cultivars (Fig. 6). The mean height of the tallest entry was 79 cm taller than the shortest entry. By cultivar, grain yields ranged from 412 to 1660 pounds/acre (Fig. 7).

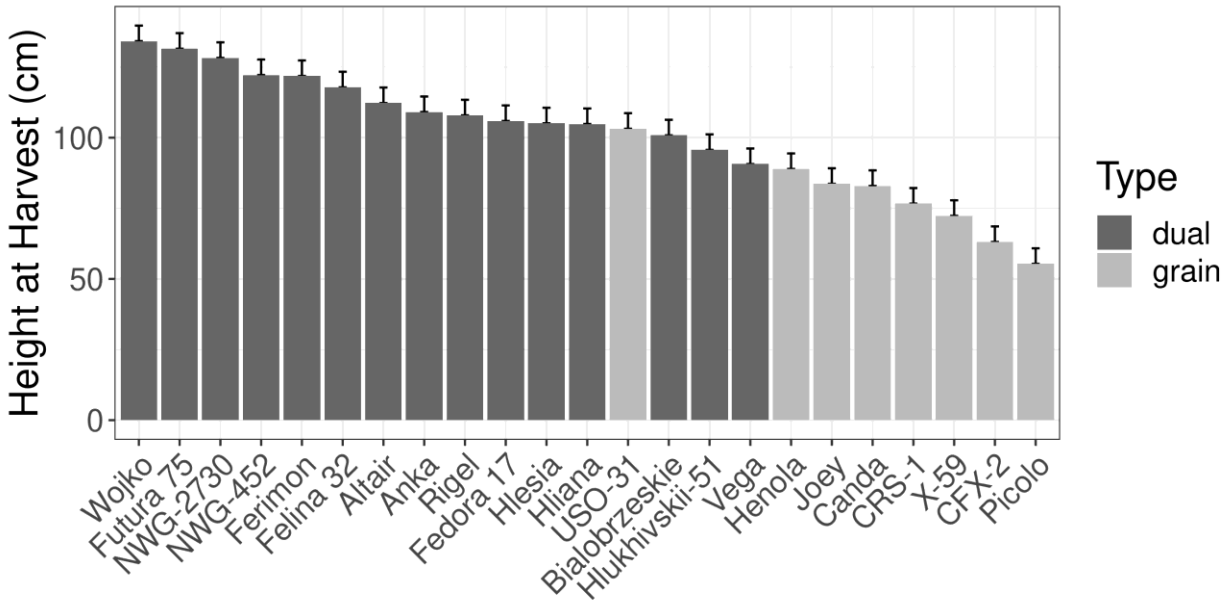

Figure 6. 2020 NY hemp grain yield by cultivar for entries planted on June 24.

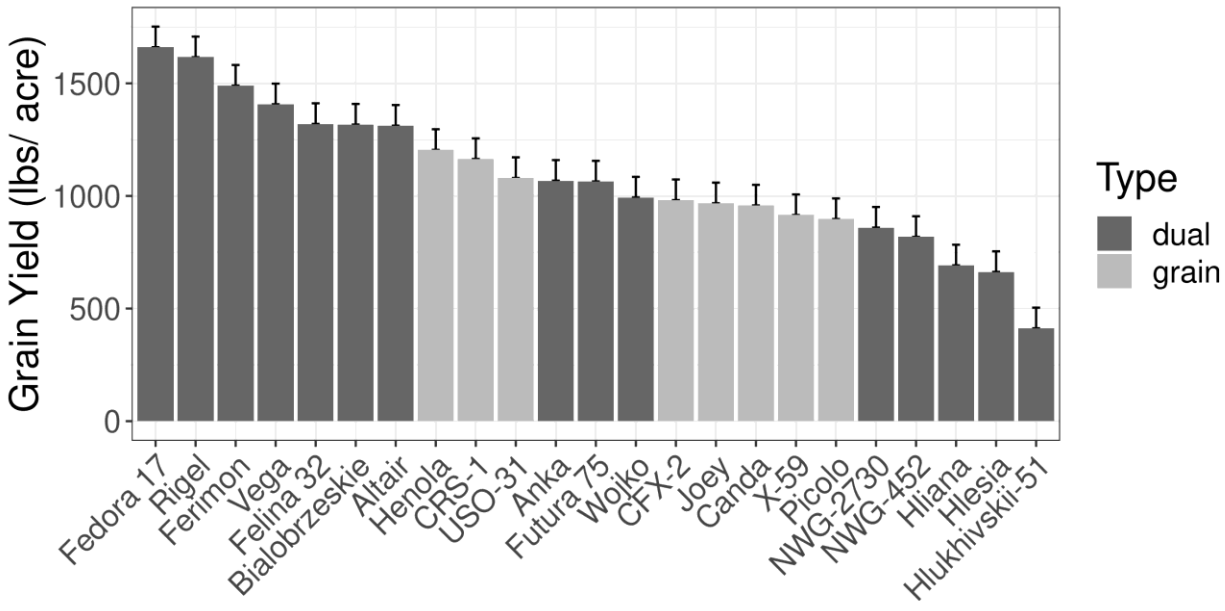

Figure 7. 2020 NY hemp heights cultivar for all entries planted on June 24.

Grain quality

Harvested grain had different quality characteristics both among cultivars and planting dates. The thousand kernel weight (TKW) of the largest seeded entry was more than half again as heavy as the smallest one (11.6-18.9 grams). TKW was higher in the grain plots planted on June 6 than those planted on June 24 (Fig. 8). Percent crude protein ranged from 25.1-29.2% of the dry weight and was somewhat inversely correlated with the seed size (Fig. 9).

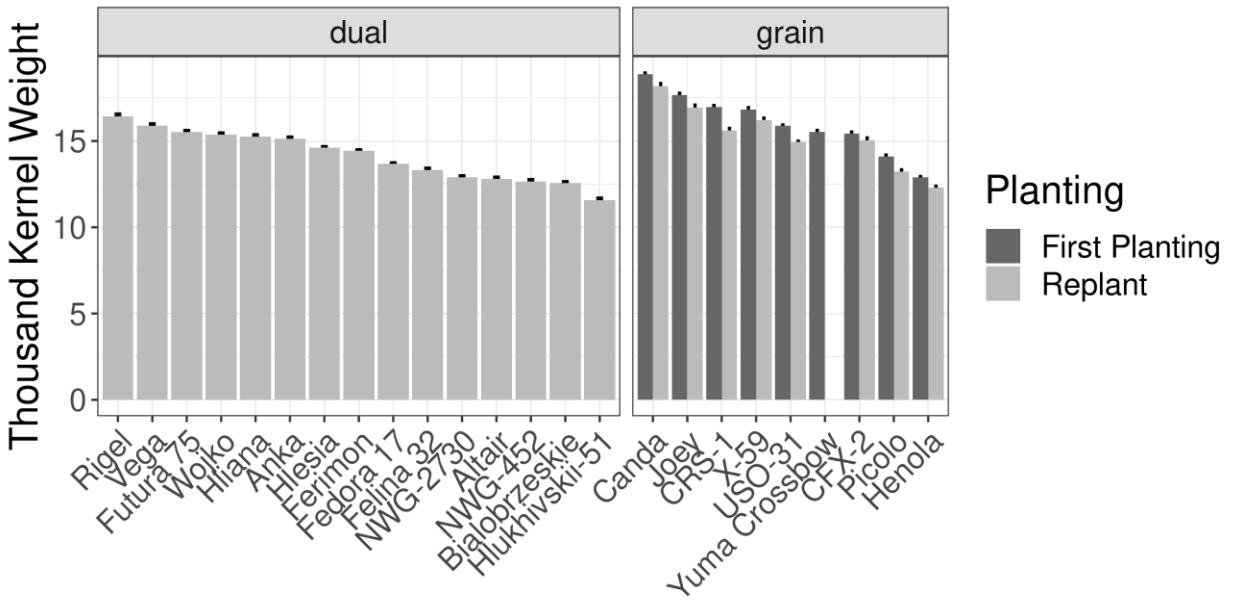

Figure 8: 2020 Thousand kernel weights (TKW) for all harvested for grain by cultivar.

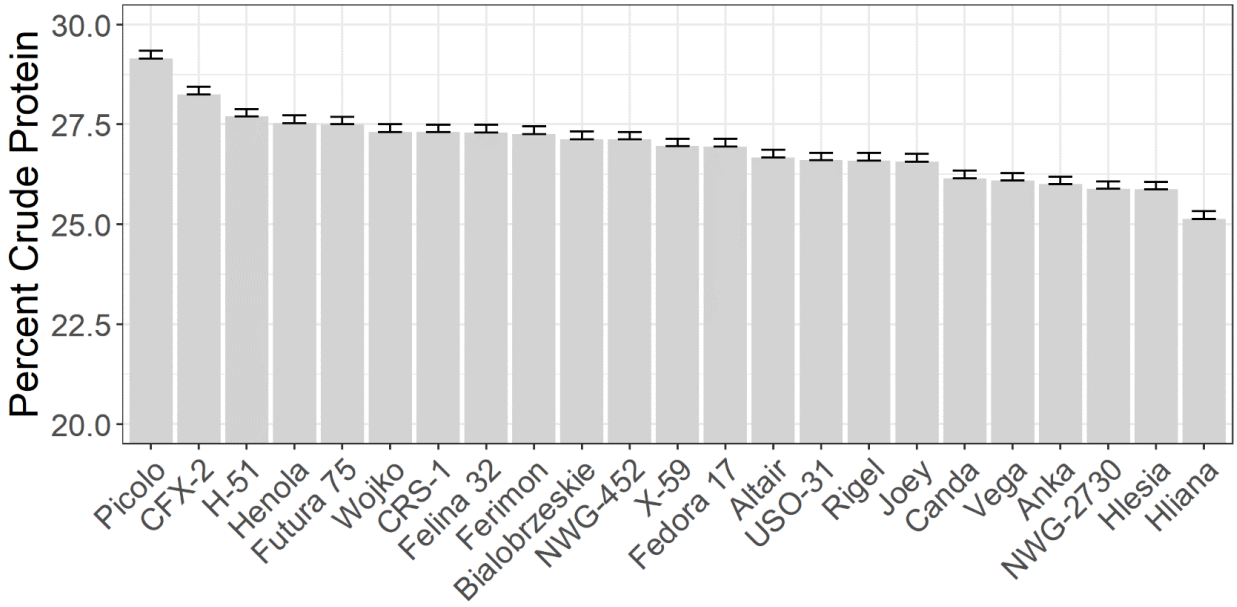

Figure 9: 2020 Crude protein content for all harvested grain by cultivar.

Total fatty acids ranged from 26.6-30.8% of the dry weight with Omega-3s averaging 4.6% and Omega-6s averaging 16.8% of the dry weight (Fig. 10).

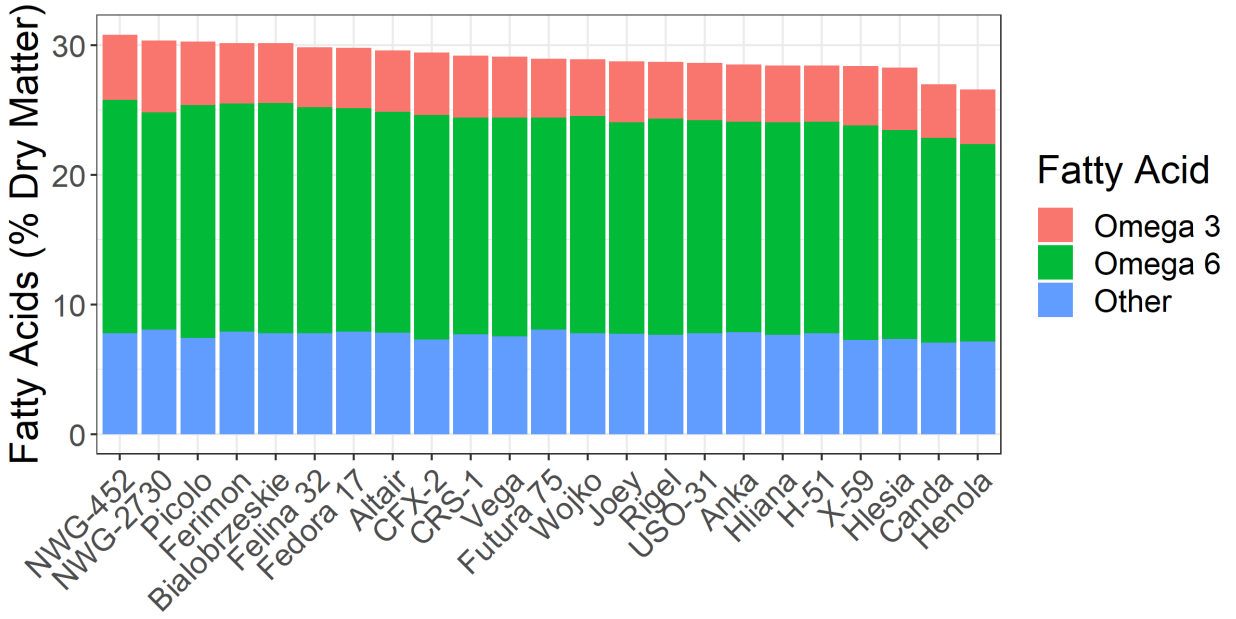

Figure 10: 2020 Fatty acid content for all harvested grain by cultivar.

Cannabinoids

Analysis of cannabinoids was conducted on the top 5 cm of female flower shoots from all plots. No cultivars exceeded the mean Δ^9-THC content 0.3% (Fig. 11) and so all were compliant with current New York regulatory standards. Two cultivars did exceed 0.3% total THC content ('Jinma' and 'Carmagnola Selezionata') (Fig. 12).

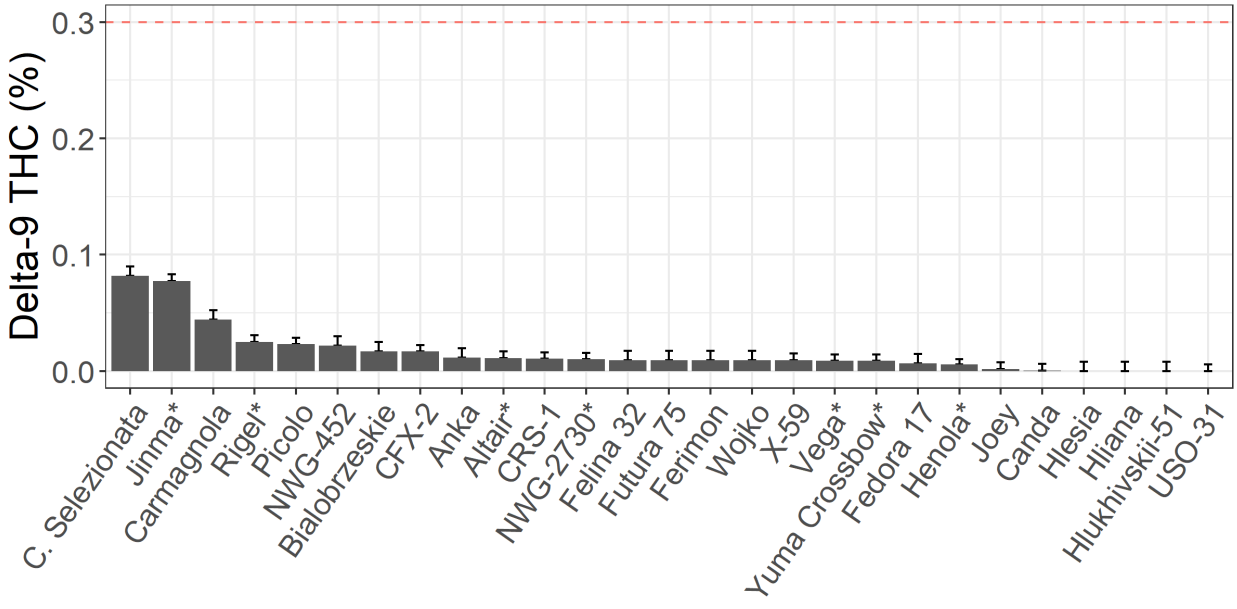

Figure 11. Δ^9-THC by % dry weight by cultivar (*averaged over multiple trials).

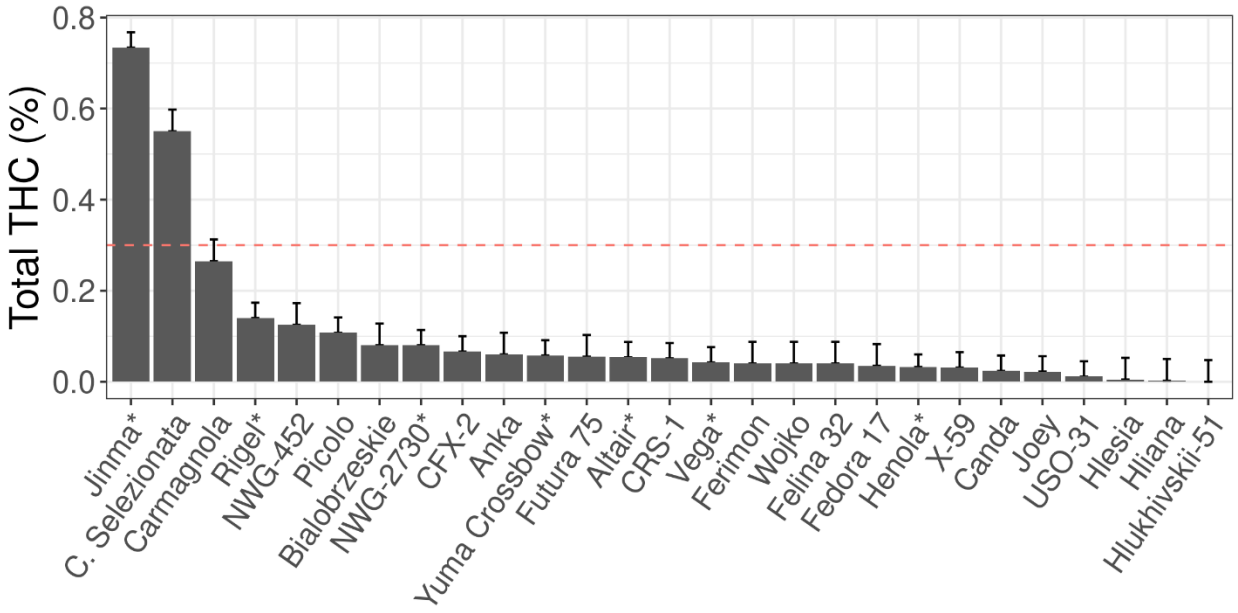

Figure 12. Total THC by % dry weight by cultivar (*averaged over multiple trials).

Total CBD (CBD + 0.88*CBDA) varied significantly by cultivar, with trial averages ranging from 0.06% ('Jinma') to 2.01% ('NWG-2730') (Fig. 13).

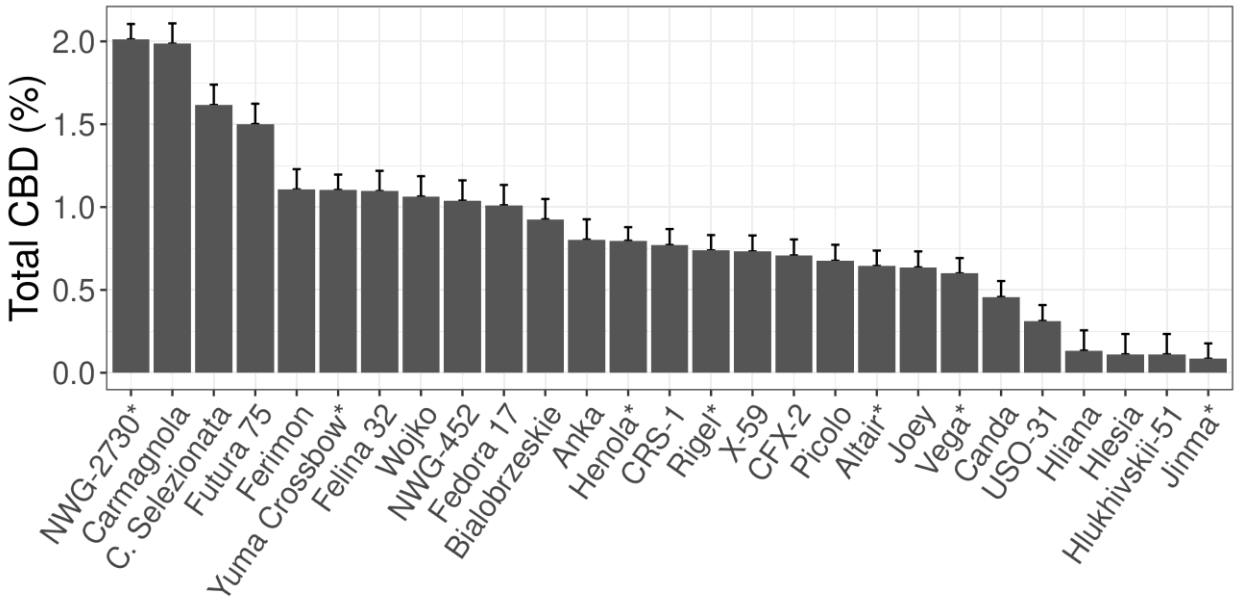

Figure 13. Total CBD by % dry weight by cultivar (*averaged over multiple trials).

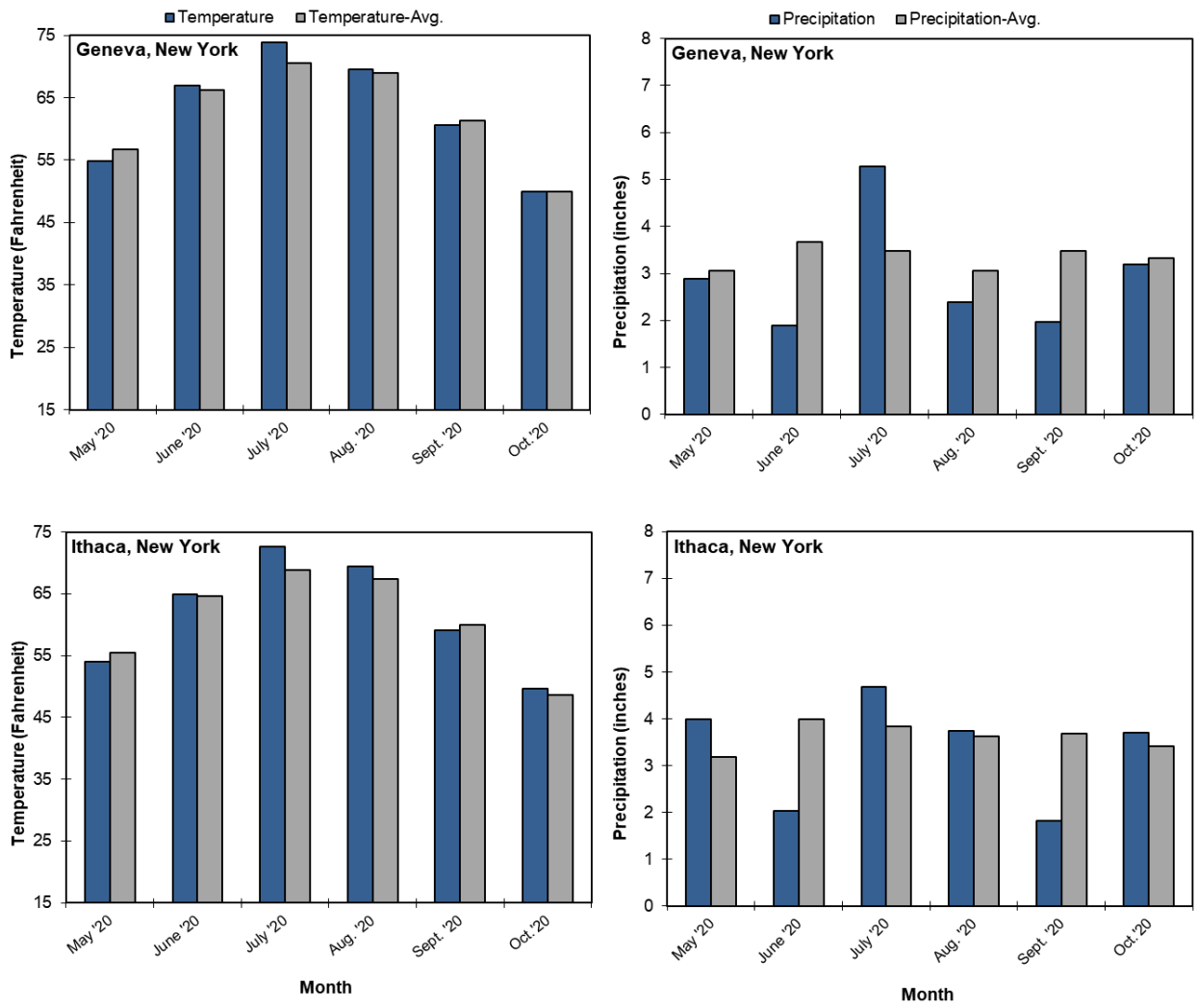

Figure 14. Growing season temperature and precipitation for locations: Geneva, and Ithaca, NY (May 2020 - October 2020). Weather data from the Northeast Regional Climate Center at Cornell University (http://www.nrcc.cornell.edu/).

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