2018 University of Kentucky Industrial Hemp Variety Trials for Dual-Purpose Production

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Introduction

Variety trials for dual-purpose industrial hemp production were conducted at three locations planted on 1 May, 1 Jun, and 1 Jul +/- 5 days as weather and travel permitted. Experimental designs were randomized complete blocks with 3 replications. Each respective planting date and location was analyzed as an individual trial. Locations, soil types, and specific planting dates are provided in Table 1. Varieties evaluated and their owners are provided in Table 2.

Table 1. Locations, soil types, and planting dates for 2018 dual-purpose variety trials.

Location	Soil Type	Planting Dates
UK-RCARS[1], Breathitt County	Nolin-Grigsby silt loam	1 May, 5 Jun, 11 Jul
UK-LRC[2], Woodford County	Maury silt loam	2 May, 6 Jun, 5 Jul
UK-REC[3], Caldwell County	Crider silt loam	7 May, 11 Jun, 6 Jul

[1]UK Robinson Center for Appalachian Resource Sustainability, Jackson, Breathitt County, KY
[2]UK C. Oran Little Research Center, Versailles, Woodford County, KY
[3]UK Research and Education Center, Princeton, Caldwell County, KY

Table 2. Varieties evaluated in 2018 and their owners.

Variety Name	Owner
Felina 32	Terres Inovia, Thiverval-Grignon, France (standard entry)
Tygra	Schiavi Seeds, Lexington, KY
NWG 331	New West Genetics, Fort Collins, CO
NWG Elite	New West Genetics, Fort Collins, CO
CFX-2	Hemp Genetics International, Saskatoon, SK, Canada
CRS-1	Hemp Genetics International, Saskatoon, SK, Canada
Grandi	Hemp Genetics International, Saskatoon, SK, Canada
Katani	Hemp Genetics International, Saskatoon, SK, Canada
Picolo	Hemp Genetics International, Saskatoon, SK, Canada

Fields were prepared using conventional tillage practices. Granulated urea (46-0-0) was applied by broadcast on the day of seeding at a rate of 100 lbs. of N/A. Hemp seed was planted using the Mundell Modified Soybean Plot Planter at a rate of 30 lbs/A. Seeding depth was calibrated to 0.25 inch. No additional pesticides or irrigation were used for the duration of the studies.

Grain was harvested when seed heads contained ~75% brown mature seed. Stalks were cut at the base of the flower using pruners from two independent 1m^2 sub-plots from within each main plot, careful to avoid plot edges. Harvested flowers were placed in paper bags and air-dried. Once dried, grain was thrashed from harvested flowers by hand and subsequently cleaned by manual screening to obtain dry grain yields. The remaining stalks after grain harvests were also harvested from the same sub-plots using a handheld sickle mower. Stems were field-retted onsite at the UK-RCARS following harvests. Data collected from stalks were plant populations, straw yields measured as fresh weight (FW) and retted dry weight (DW), stalk heights, and stalk diameters at the base of the stem. All data were analyzed using the ANOVA procedure of SAS 9.4 (SAS Institute, Cary, NC). Means were separated by a Fisher's Protected LSD (α=0.05) where the main effect of variety was significant.

Results

The majority of trials were failures across all planting dates and locations due almost entirely to untimely precipitation, often extreme in amount and/or rate, occurring either very soon after planting or emergence (see Appendix 1). Additional, individual variety failures resulted in either variety deletions and/or incomplete data collection among planting dates and at all locations. ANOVA statistics for each successful planting date/location are provided in Table 3, A-B. Data are presented in Tables 4 and 5 for the only successful trials, the June plantings at the UK-RCARS and UK-LRC locations, respectively.

Table 3; A-B. ANOVA statistics for the June planting date at the UK-RCARS (A) and the UK-LRC (B) 2018 dual-purpose variety trials.

A. June planting-UK-RCARS

ANOVA Statistic	Grain Yield	Dry Straw	Fresh Straw	Percent Moisture	Plant Density	Stem Length	Stem Diameter
P-Value Model	0.5531	0.2044	0.1903	0.1836	0.3671	0.0611	0.1425
P-Value Replication	0.3452	0.2931	0.4291	0.4404	0.6067	0.6408	0.7017
P-Value Variety	0.7361	0.1487	0.1071	0.1009	0.2158	0.0244	0.0620

B. June planting UK-LRC

ANOVA Statistic	Grain Yield	Dry Straw	Fresh Straw	Percent Moisture	Plant Density	Stem Length	Stem Diameter
P-Value Model	0.0631	0.0084	0.0679	0.0447	0.0037	0.0014	0.0462
P-Value Replication	0.0211	0.0511	0.0344	0.0844	0.0167	0.0100	0.0098
P-Value Variety	0.3560	0.0057	0.1938	0.0426	0.0030	0.0010	0.8565

Data in Tables 4 and 5 are expressed as the means of:

Dry grain yield=pounds of dry grain per acre after threshing.
Dry weight straw yield=pounds of retted straw per acre.
Fresh weight straw yield=pounds of fresh straw per acre measured at harvest.
Percent moisture=100-([dry weight/fresh weight]*100).
Plant population=number of individual plants harvested per acre.
Stem length=crop height measured in inches after retting.
Stem diameter=diameter at the base of the stem measured in millimeters (mm) after retting.
CV=coefficient of variation, a statistical measure of consistency of the data. Single-digit CV values are most desirable. A CV value >25 may indicate excessive variation in the data, thus reducing our confidence in any conclusions derived from that data.

Table 4. UK-RCARS dual-purpose trial-June planting. Means followed by the same letters are not significantly different (α=0.05).

Variety	Dry Grain Yield	Dry Weight Straw Yield	Fresh Weight Straw Yield	Percent Moisture	Plant Population	Stem Length	Stem Diameter
NWG 331	1,053.0	1,598.2	4,126.4	61.3	199,265	44.3 a	5.7
Felina 32	972.7	1,537.5	4,268.5	64.4	191,174	33.8 b	5.8
NWG Elite	901.1	890.1	2,023.0	55.3	215,450	34.6 b	4.5
CV	23.4	28.4	30.9	6.43	6.98	8.23	9.58

Table 5. UK-LRC dual-purpose trial-June planting. Means followed by the same letters are not significantly different (α=0.05).

Variety	Dry Grain Yield	Dry Weight Straw Yield	Fresh Weight Straw Yield	Percent Moisture	Plant Population	Stem Length	Stem Diameter
NWG 331	1,046.1	2,791.7 a	6,230.8	54.6 c	385,382 a	59.5 a	8.44
Felina 32	829.1	2,023.0 b	5,482.3	63.0 a	227,588 bc	40.8 c	8.33
Tygra	819.9	1,942.0 b	5,361.0	62.3 ab	202,300 c	44.2 bc	7.95
NWG Elite	860.8	2,036.5 b	4,639.4	55.8 bc	286,590 b	47.1 b	8.28
CV	18.1	8.95	14.1	5.69	12.9	6.07	8.67

Conclusions

Among all of the locations and planting dates, only the June planting date was successful and only at the UK-RCARS and UK-LRC. All trials were impacted by untimely precipitation which was the leading cause for trial/variety failure. Severe weed pressure (not quantified) was also experienced at all locations, especially within and among plots that were unable to produce a closed canopy. It is worthy to note that dedicated fiber variety trials were planted at each location at the same time (date) as were these dual-purpose trials; i.e. with the same equipment and personnel and at the very same time. Many of the varieties in the dedicated fiber trials were able to establish successful closed canopies under the same exact conditions that caused many failures among varieties in these dual-purpose trials. While no parameters were measured to quantify the differences in establishment between the fiber and dual-purpose trials, it is clear that several varieties in dedicated fiber trials exhibited increased capacities to establish successfully (i.e., increased seedling vigor, tolerance to untimely precipitation, adaptation to latitude) relative to the results reported here among the dual-purpose entries.

As a result of these natural pressures only three varieties were harvested for the June planting date at the UK-RCARS (Table 4). While grain yields were acceptable among the varieties, no significant differences ($P>0.05$) among any measured parameters were evident excepting stem length data.

Four varieties were harvested from the June planting at the UK-LRC (Table 5). Again, grain yields were very acceptable but not significantly different among varieties ($P>0.05$). There were significant differences among the varieties in dry straw yields, but these yields were rather low with a maximum of 1.39 tons dry matter per acre, only about half as much as would be desirable. Dual-purpose crops would be much more profitable at ~3 tons dry matter straw yields per acre.

Continued evaluations of individual varieties are an absolute necessity to define the most appropriate genotypes for Kentucky farmers. It is further noted that among those varieties that failed at all three locations and planting dates, reproductive growth often appeared relatively soon after planting thus reducing or prohibiting canopy closure via additional vegetative growth. This could be a function of several factors, but genetic regulation of floral initiation as a function of day length is the most probable factor, followed by environmental stresses as were experienced across these trials in 2018. We note again that other hemp varieties planted at exactly the same time, at the same location, and by the exact same protocol did provide a closed canopy fully allowing for harvestable crops. While the yields from those trials were usually not considered optimal, they also were not complete failures as were experienced in these dual-purpose trials.

There's little doubt that the lack of any pesticide applications (specifically herbicides on hemp) has a significant impact on crop development and ultimate yields. Hopefully, research efforts will move forward in the near future allowing for the inclusion of hemp on appropriate pesticide labels. Use of appropriate pesticides will have a large and significant impact on ultimate yields. This is especially true for grain/seed production as evaluated in this trial.

Acknowledgements

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Appendix 1: Weather data for each of the 3 locations with variety trials in 2018. We express our direct appreciation to the WKU Mesonet for making these data available for this report.

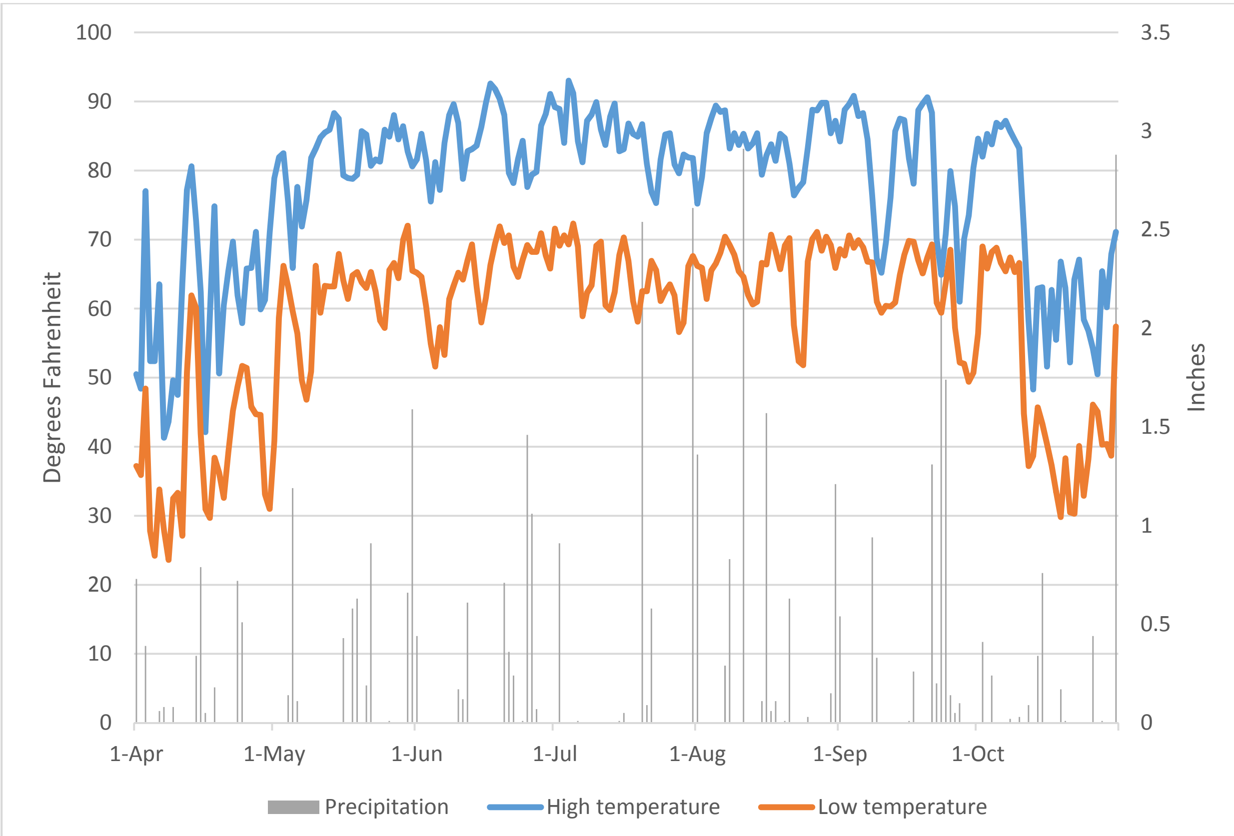

Figure 1. High/low temperature (left axis) and precipitation (right axis) data as a function of date for the UK-RCARS located in Quicksand, KY throughout the 2018 growing season. Low (orange line) and high (blue line) temperatures are expressed as degrees Fahrenheit. Precipitation (gray bars) is expressed in inches. Planting dates were 1 May, 5 Jun, 11 Jul.

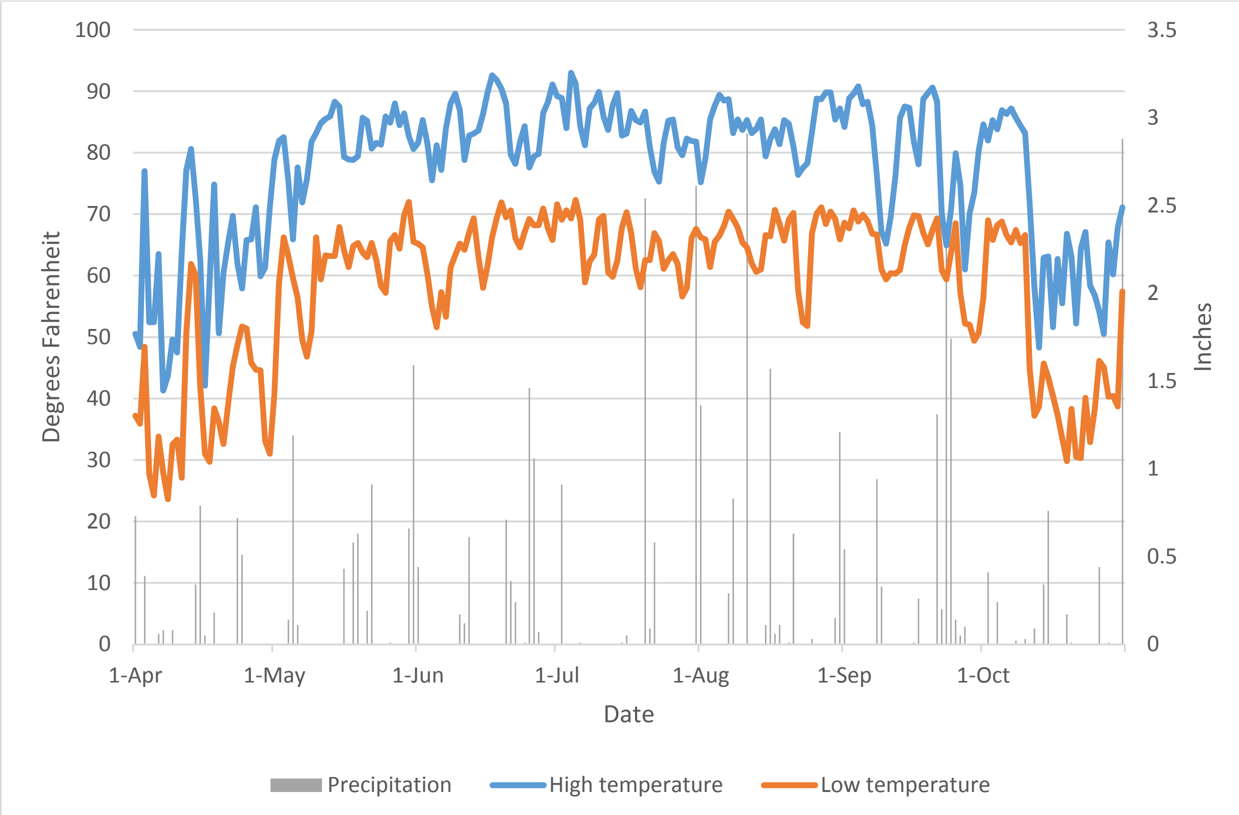

Figure 2. High/low temperature (left axis) and precipitation (right axis) data as a function of date for the UK-LRC located in Woodford County, KY throughout the 2018 growing season. These data were collected from the Kentucky State University Mesonet site in Franklin County. Low (orange line) and high (blue line) temperatures are expressed as degrees Fahrenheit. Precipitation (gray bars) is expressed in inches. Planting dates were 2 May, 6 Jun, and 5 Jul.

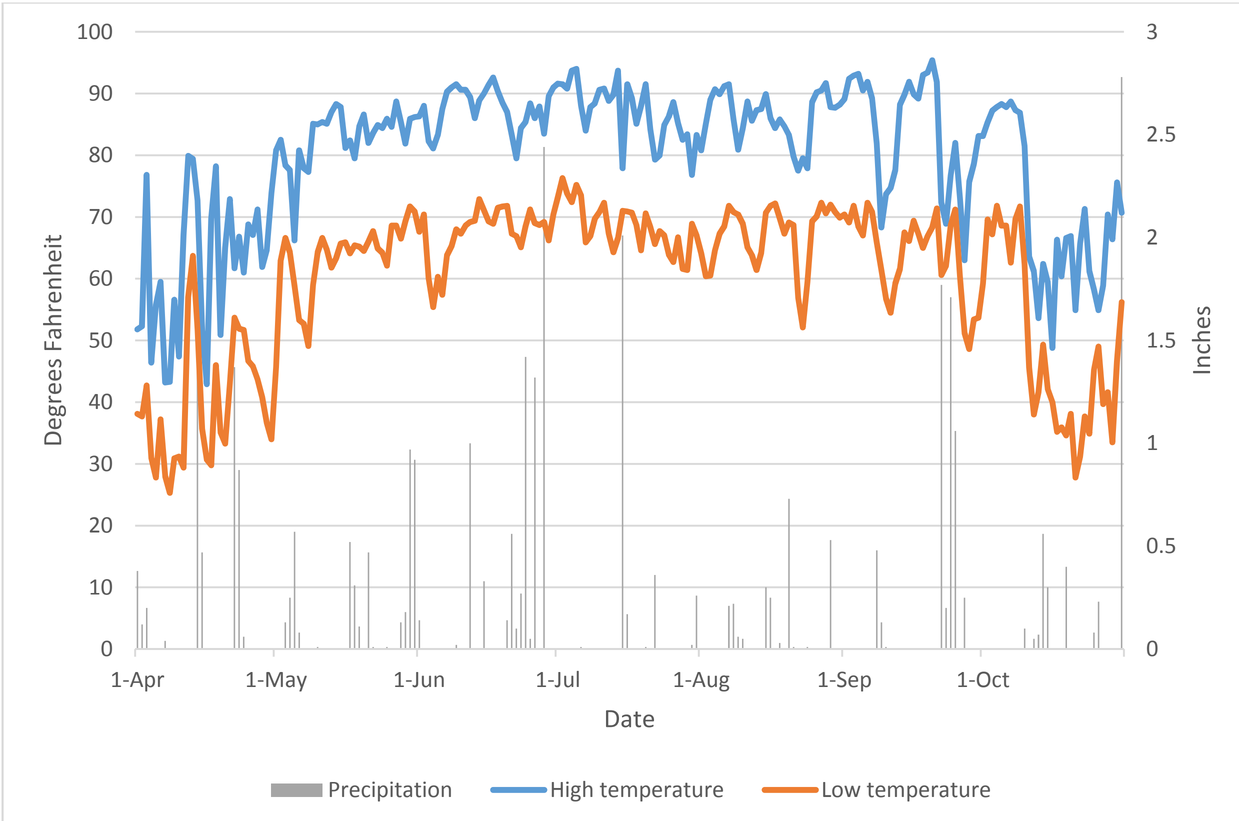

Figure 3. High/low temperature (left axis) and precipitation (right axis) data as a function of date for the UK-REC located in Princeton, KY throughout the 2018 growing season. Low (orange line) and high (blue line) temperatures are expressed as degrees Fahrenheit. Precipitation (gray bars) is expressed in inches. Planting dates were 7 May, 11 Jun, and 6 Jul.