2015 Industrial Hemp Row Spacing Trial

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Materials and Methods

A trial was conducted on the UK Agricultural Experiment Station Spindletop Farm in Fayette County, KY evaluating the effects of row spacing on yield and quality of industrial hemp grown for fiber. Row spacing treatments were drilled on 8” rows, drilled on 16” rows, and broadcast seeding followed by cultipacking.

The experimental design was a randomized complete block with four replications. Plot size was 8’ x 20’. The soil at the site is a Maury silt loam. The variety used was Futura 75, a monoecious line originating from France. The seeding rate was 60#/A. Plots were seeded with a modified research plot drill at an average planting depth of 0.25 inch. Broadcast seeding was accomplished with an 8’-wide Gandy drop-type seeder with an 8’-wide cultipacker attached behind. Conventional tillage was used to prepare the site, and 50 units of N/A were applied during pre-plant cultivation in the form of urea (46-0-0). The trial was seeded on 7 Jul. No additional fertility or inputs of any kind were applied (herbicides, insecticides, irrigation, etc.).

Three response variables were measured. Plant densities were determined post-harvest by counting residual plant stems (stubble) within a randomly selected 1 m² area within each plot avoiding plot edges. These data were transformed to number of plants/A. Plots were harvested on 16 Oct; 101 days after seeding (DAS). A 4’ x 16’ section from the center of each plot (avoiding plot edges) was harvested manually by walk-behind sickle bar mower. Thirty randomly selected stems were collected from each plot and bundled separately from the remaining plant material and were later used to determine stem diameters. Diameters (mm) were measured just above the first node from the bottom of the stem using a micrometer. All harvested plant material was dried by heated forced air for 48h, at which time the combination of the subsamples for diameter measurements and the remaining plant material from each plot were weighed to determine dry matter (DM) yields. Yields are expressed as pounds DM/A.

The data was analyzed using PROC ANOVA of SAS (SAS Institute, Cary, NC). Means were separated by F-protected LSD at α=0.05.

Results

Plot establishment was excellent without additional inputs. Table 1 provides the analysis of variance statistics for this trial.

Table 1. Analysis of variance statistics for 2015 row spacing trial.

<table>
<thead>
<tr>
<th>ANOVA Statistic</th>
<th>Yield (#DM/A)</th>
<th>Plants/A</th>
<th>Stem Diameter (MM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-Value Rep</td>
<td>0.24</td>
<td>0.25</td>
<td>0.0547</td>
</tr>
<tr>
<td>P-Value Row Spacing</td>
<td>0.51</td>
<td>0.0063</td>
<td>0.0121</td>
</tr>
<tr>
<td>CV</td>
<td>12.06</td>
<td>17.75</td>
<td>9.77</td>
</tr>
</tbody>
</table>
As indicated in Table 1 and illustrated in Figure 1, there were no significant effects (P>0.05) of row spacing on DM yields. Mean DM yields ranged from 2225-2460 pounds/A.

Figure 1. The effects of row spacing on mean dry matter yields (pounds DM/A) harvested 101 DAS.

There were significant differences (P<0.0063) among plant densities due to row spacing (Table 1). Both the 8” and 16” row spacing produced significantly higher plant densities than the broadcast seeding treatment (Fig. 2). Mean plant densities ranged from 347,012-679,859 plants/A.

Figure 2. The effects of row spacing on mean plant density (plants/A).
There were also significant effects (P<0.0121) from row spacing on stem diameters (Table 1.) Mean stem diameters in the 8” and 16” row spacing were approximately 20% lower than found in the broadcast seeding treatment (Fig. 3).

Figure 3. The effects of row spacing on mean stem diameters (mm).

The range of stem diameters was larger in the broadcast treatment (2.4-10.4mm) relative to the 8” (1.7-8.3mm) and 16” (1.7-8.4mm) drilled treatments. Figures 4-6 are scatter plots of the 120 data points (30 stems from each of 4 replications) of measured stem diameters from each treatment. The variation in stem diameters increased from 8” to 16” to broadcast seeded treatments.

Conclusions

This trial was planted very late in the growing season relative to what would be considered optimal; somewhere in the range of 9-10 weeks later than desired. Because hemp is very sensitive to photo period, late planting almost certainly had significant effects on yields, plant densities, and individual plant morphology (stem diameters). That said, it is thought that smaller and highly uniform stem diameters will contribute to increased efficiency during decortication and further processing of the fibers. It is therefore useful to quantify the effects of row spacing on these parameters even considering a significantly abbreviated growing season.

Dry matter yields were not impacted by row spacing, but higher plant densities did result in smaller and somewhat more uniform stems within the drilled row spacing treatments. These would generally be considered highly desirable traits for industrial hemp grown for fiber. Future research must evaluate these treatments over the course of an entire growing season. Additionally, the effects of these treatments on the physical and chemical properties of bast and hurd fibers should be investigated.
Fig. 4. Scatter plot of stem diameter measurements (mm) from the 8" drilled treatment

Fig. 5. Scatter plot of stem diameter measurements (mm) from the 16" drilled treatment

Fig. 6. Scatter plot of stem diameter measurements (mm) from the broadcast seeded treatment