Industrial Hemp Performance in North Dakota - 2015
NDSU Langdon Research Extension Center

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After a 70-plus year absence in production, industrial hemp (*Cannabis sativa* L.*,* THC level of 0.3% or less) is being grown in university research trials in several states across the U.S. Our effort begins the process of defining the basic guidelines for production that will aid in crop commercialization in North Dakota. The objective of this study was to screen genotypes (Table 1) from various sources, monitor and record plant growth and development, determine grain and fiber yield, note pest incidence, and record agronomic traits.

Table 1. Industrial hemp cultivars and characteristics for the Langdon 2015 field studies.

Cultivar	Country	Type	Purpose	Maturity (d)
Alyssa	Canada	Monoecious	Dual	110+
Canda	Canada	Monoecious	Dual	110+
CFX-1	Canada	Dioecious	Dual	105+
CFX-2	Canada	Dioecious	Grain	103+
CRS-1	Canada	Dioecious	Grain	110+
FINOLA	Finland	Dioecious	Grain	100+
Fedora 17	France	Monoecious	Fiber	120+
Felina 32	France	Monoecious	Fiber	120+
Ferimon	France	Monoecious	Fiber	120+
Futura 75	France	Monoecious	Fiber	120+
Santhica 27	France	Monoecious	Fiber	120+
CHG	Australia	Monoecious	Fiber	120+

- Dual purpose cultivars are bred to be used for both grain and fiber production.
- Dioecious cultivars have separate male and female plants.
- Monoecious cultivars have separate male and female flowers on the same plant.
- Plant height is an important consideration in determining end use of the crop. Shorter cultivars tend to have less fiber and are more suited to grain production.
- Fiber and dual purpose cultivars are taller.

Materials and Methods

Seeding dates varied as to when the seed was received. The Canadian and Finland trial was planted on May 27 while the French trial was planted on June 5 and then replanted on June 9 due to a 2.36 inch rainfall in two hours on June 6 which resulted in severe soil crusting. The Australian cultivar was planted on June 16. Seeding rate was 12 pure live seeds/ft^2. Plot size was 21 feet long x 4 feet wide and consisted of four 12 inch spaced rows. Previous crop for the Canadian and Finland trial was fallow. Due to the replant, the French and Australian trials were moved to another area a short distance away where the previous crop was barley. The fiber harvest date was August 5 for the Canadian and Finland trial and August 29 and September 30 for French and the Australian cultivars, respectively. Fiber harvest consisted of one square meter cut from each plot. The samples were dried and leaves and petioles were removed prior to weighing to determine fiber yield. Grain harvest occurred on August 27 for FINOLA and September 3 for all other Canadian cultivars. Grain harvest was September 28 for the French cultivars while the Australian cultivar was late maturing and did not flower so no grain yield was obtained. A small plot combine was used to harvest the plots. Samples were dried than processed to determine yield, test weight and 1000 kwt. Seed samples of all cultivars planted and plant samples of the leaves and flowering heads of the cultivars were sent for laboratory analysis of THC. All samples were less than 0.3%.

Results

FINOLA (Table 2) had significantly lower grain yield, than all other cultivars in the Canadian and Finland trial. Because of its earlier maturity, it was harvested seven days earlier to avoid bird damage but an even earlier harvest date than August 27 may have been beneficial and resulted in a higher yield. Grain yield of CFX-1 was significantly higher than CRS-1 and FINOLA while Alyssa and Canda had significantly higher fiber yields than all other cultivars. Plant stands ranged from 2.2 to 6.2 plants/ft^2 with seedling mortality ranging from 48 to 75%. The dual purpose cultivars, Alyssa and Canda, had the greatest plant height. Growth rate for the cultivars ranged from 1.5 to 2.3 inches/day from June 18 to July 30, and 3.7 inches/day from June 25 and July 2 (data not shown).

Table 2. Grain and fiber yield and various agronomic traits of Canadian and Finland Industrial hemp cultivars.

Cultivar	Plant Stand (Plants/ft^2)	Seedling Mortality (%)	Seedling Vigor (0-9)	Plant Height (inches)	Fiber Yield (lbs/ac)	1000 KWT (g)	Test Weight (lbs/bu)	Grain Yield (lbs/ac)
Alyssa	2.2	82	3.8	98	7498	19.6	40.5	1154
Canda	4.7	61	6.5	93	6980	20.5	41.5	1263
CFX-1	5.7	53	7.8	83	4648	19.0	41.9	1363
CFX-2	6.2	48	7.8	81	4438	17.5	42.5	1189
CRS-1	3.0	75	3.8	89	5037	18.4	42.5	1062
FINOLA	4.9	59	6.8	71	2203	15.0	42.3	632
Mean	4.4	63	6.0	86	5134	18.3	41.9	1110
C.V. %	15.1	9.0	9.2	3.7	17.2	6.4	1.0	14.0
LSD 5%	1.0	7.0	0.8	4.8	1334	1.8	0.7	234
LSD 10%	0.8	8.6	0.7	3.9	1097	1.5	0.5	192

Plant stands in the French trial were severely reduced from soil crusting on the June 5 seeding date with an average seedling mortality of 93% (Table 3). Stands were much improved on the June 9 seeding date, but seedling mortality was still 52% while the Australian cultivar, seeded on June 16 had the lowest seedling mortality of 34% (Table 4). There was some lodging and stalk breakage, a result of high wind events on July 18, 19 and 28 mph with gusts to 35 to 43 mph. No significant differences were observed for plant height among the French cultivars. Grain yield of Santhica 27 was significantly less than other cultivars. Santhica 27 lower grain yield may be attributed to being a monoecious type plant with more male flowers than other cultivars. Santhica 27 is reported to have high fiber yield in France, which is its main purpose. Fiber yield did not differ significantly among cultivars in the French trial. Fiber harvest typically occurs when the plant is finished producing pollen and the first seeds are starting to develop. The Australian cultivar CHG was still in the vegetative stage of development when fiber harvest occurred in late September immediately after our first frost. Even though fiber yields of CHG were higher than the French lines, planted at an earlier date, its yield would have been greater if it had flowered and been harvested at the proper timing (Table 4).

Table 3. Grain and fiber yield and various agronomic traits of French industrial hemp cultivars.

	June 5		June 9								
Cultivar	Plant[1] Stand (Plants/ft^2)	Seedling Mortality[1] (%)	Plant Stand (Plants/ft^2)	Mortality (%)	Seedling Vigor (0-9)	Lodging (0-9)	Plant Height (inches)	Fiber Yield (lbs/a)	1000 KWT (g)	Test Weight (lbs/bu)	Grain Yield (lbs/a)
Fedora 17	1.0	91	5.7	53	8.5	2.5	96	7255	16.5	42.2	926
Felina 32	1.2	90	6.3	48	8.8	2.0	95	7029	15.2	42.3	797
Ferimon	1.1	91	6.3	48	8.5	3.8	93	6754	14.9	42.2	749
Futura 75	0.7	94	5.3	56	7.8	2.5	99	7320	17.0	41.4	888
Santhica 27	0.4	97	5.6	54	7.8	3.3	98	6527	15.5	40.6	434
Mean	0.9	93	5.8	52	8.3	2.8	96	6977	15.8	41.7	759
C.V. %	66.5	5.3	20.8	19.6	6.4	36.7	2.1	17.8	2.2	1.0	16.5
LSD 5%	NS	NS	NS	NS	NS	NS	3.1	NS	0.5	0.6	193
LSD 10%	NS	NS	NS	NS	0.7	NS	2.5	NS	0.4	0.5	158

[1]Plant stand for June 5 planting prior to working up, recorded on June 16.

Table 4. Fiber yield and various agronomic traits of the Australian industrial hemp cultivar.

Cultivar	Plant Stand (Plants/ft^2)	Mortality (%)	Seedling Vigor (0-9)	Lodging (0-9)	Plant Height (inches)	Fiber Yield (lbs/a)
CHG	7.9	34	9.0	3.5	105	8162

Conclusions

- Most industrial hemp cultivars tested appear to be suitable to the Langdon region of North Dakota.
- Grain and fiber yields were comparable to research data from Southern Manitoba, Canada.
- French cultivars, planted 10 days later, had lower grain yields, but higher fiber yields than Canadian and Finland cultivars. The Australian cultivar planted on June 16 was the tallest and had the greatest fiber yield of all cultivars tested even though it was harvested in the vegetative stage as compared to the end of flowering stage for the other cultivars.
- Seed mortality is an important issue in hemp production and not well understood and requires further research for improvement.
- Additional studies to identify superior cultivars plus other crop production practices are needed.

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