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Industrial Hemp Cultivar Evaluations in North Dakota

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Introduction and Objectives

After a 70-plus-year absence in production, industrial hemp (*Cannabis sativa L.*) is being grown in university research trials in several states across the United States. Our effort begins the process of defining the basic guidelines for production that will aid in crop commercialization in North Dakota.

The objectives of this study were to screen cultivars from various sources and evaluate factors influencing stand establishment, plant growth and development, and crop performance.

Materials and Methods

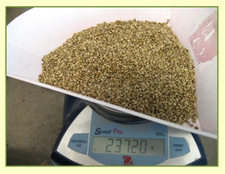
- Five Canadian (Table 1) and five French industrial hemp cultivars were grown in 2015.
- French hemp cultivars were for fiber purposes.
- Nine Canadian industrial hemp cultivars were grown in 2016 (Table 1).
- Seeding dates varied depending on seed availability and replanting incidence.
  - 2015 Canadian - May 27; French - June 5, soil crusting replant June 9
  - 2016 Canadian - May 24; glyphosate drift replanted June 20
- Seeding rate targeted stands at 12 plants/ft^2.
- Separate trials were conducted for each seeding date.
- Experimental design was a RCBD with four replications.
- Plot size was four rows at a 12 inch row spacing and a row length of 25 feet.
- Traits evaluated include stand establishment, seedling mortality, plant height, growth progression, grain yield, and fiber yield.

Study Location

Location: 48.760° N -98.345° W
Elevation: 1,616 ft.

U.S. Industrial hemp field research in 2015

HI, OR, CO, ND
TN, IN, KY, VT



Industrial hemp seed

Table 1. Canadian industrial hemp cultivars evaluated in 2015 and 2016.

Cultivar	Company†	Type	Purpose	Maturity (d)
Alyssa	PIHG	Monoecious	Dual‡	110+
Canda	PIHG	Monoecious	Dual	110+
CFX-1	HGI	Dioecious	Dual	105+
CFX-2	HGI	Dioecious	Grain	103+
CRS-1	HGI	Dioecious	Dual	110+
Delores	PHIG	Monoecious	Dual	110+
Grandi	HGI	Dioecious	Grain	105+
Katani	HGI	Dioecious	Grain	105+
Joey	PIHG	Monoecious	Dual	110+
Picolo	HGI	Dioecious	Grain	105+

† PIHG (Parkland Industrial Hemp Growers); HGI (Hemp Genetics International)

‡ Dual purpose cultivars are suitable for grain and fiber production.

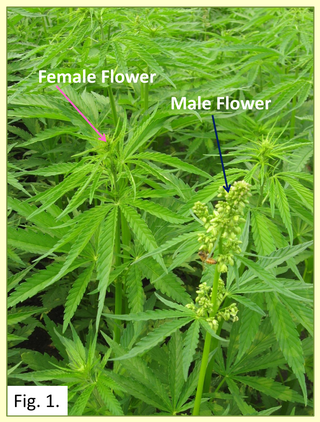


Fig. 1.

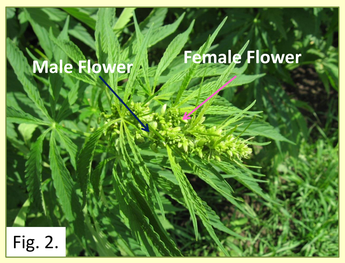


Fig. 2.

- Fig. 1. Dioecious - separate male and female plants
- Fig. 2. Monoecious - male and female flowers on the same plant
- Industrial hemp is day-length (photo-period) sensitive and flowers during the same time period each year.
- Photo at Roblin, Manitoba crop field day July 23, 2015; crop industrial hemp; personnel North Dakota and Canadian industrial hemp researchers.

Results

- Live seed mortality (LSM) ranged from 48 to 82% among Canadian hemp cultivars at Langdon, ND, in 2015 (Fig. 3).
- Stand densities among Canadian cultivars ranged from 2.2 to 6.2 plants/ft^2.
- Stand densities ranged from 18 to 52% of targeted stands.

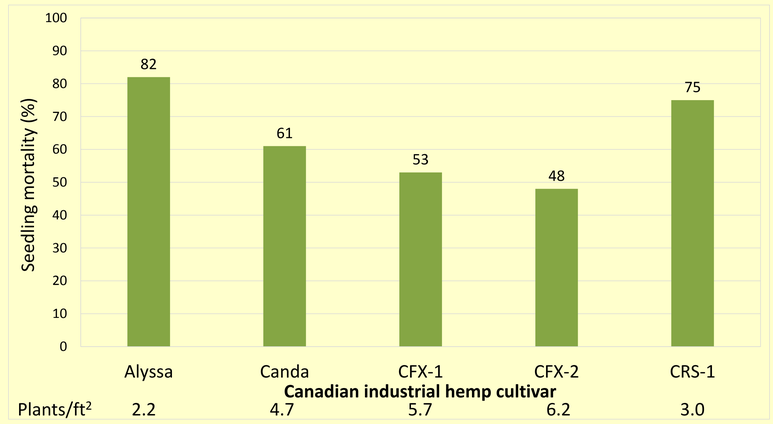


Fig. 3. Mean seedling mortality and plants/ft^2 for five Canadian industrial hemp cultivars sown on May 27, 2015 at Langdon, ND.

- Live seed mortality ranged from 91 to 96% for French hemp cultivars sown on June 5, 2015 (Fig. 4).
- High rainfall (1.92 inches) on June 6 resulted in soil crusting and replanting.
- Live seed mortality ranged from 48 to 56% for French hemp cultivars sown on June 9, 2015.
- Stand densities among French cultivars ranged from 5.3 to 6.3 plants/ft^2 for the later June 9 seeding date.
- Stand densities ranged from 44 to 53% of targeted stands for the later seeding date.

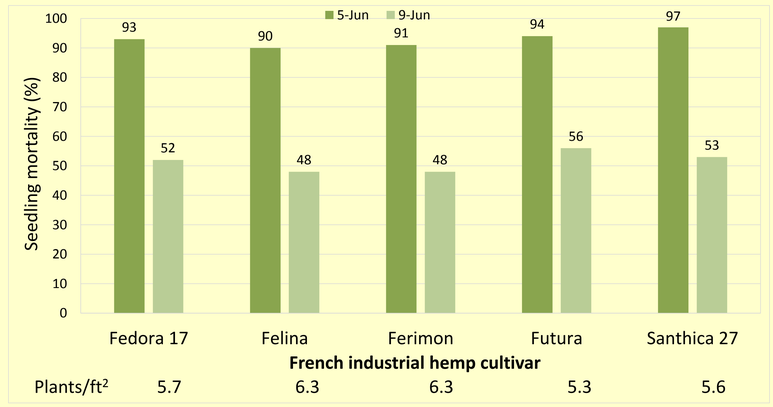


Fig. 4. Mean seedling mortality and plants/ft^2 for five French industrial hemp cultivars sown on June 5 and June 9, 2015 at Langdon, ND.

- Live seed mortality ranged from 39 to 58% for Canadian hemp cultivars sown on May 24, 2016 (Fig. 5).
- Live seed mortality ranged from 64 to 72% for Canadian hemp cultivars sown on June 20, 2016.
- Live seed mortality was greater for all cultivars at the later seeding date where wet soil conditions persisted.
- LSM (**germ. %**) were 57 (**69**) Joey; 56 (**82**) CFX-1; 58 (**88**) Delores; 56 (**88**) Katani for the early seeding and indicate similar mortalities at varying germination levels.
- LSM (**germ. %**) were 72 (**69**) Joey; 70 (**82**) CFX-1; 71 (**85**) CFX-2; 71 (**85**) CRS-1 for the later seeding.
- Seed count among cultivars ranged from 21,723 seeds/lb to 30,267 seeds/lb.

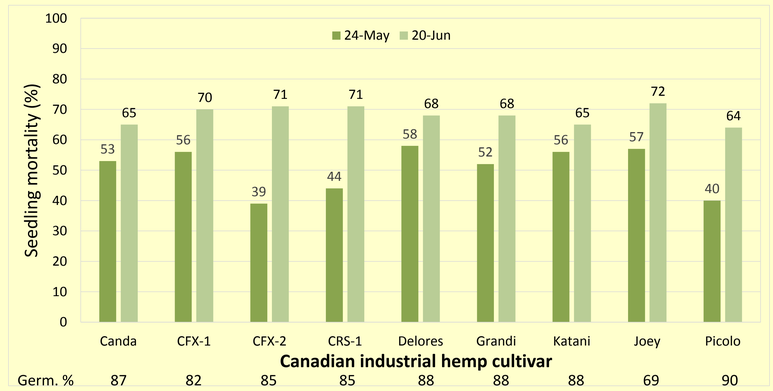


Fig. 5. Mean seedling mortality and germination for nine Canadian industrial hemp cultivars sown on May 24 and June 20, 2016 at Langdon, ND.

- Dual purpose cultivars Alyssa and Canda had significantly higher fiber yield than the other cultivars (Fig. 6).
- Seed yield was higher for CFX-1 than CRS-1 with other cultivar yields similar to both.
- Harvest index (HI) ranged from 13 to 23% among cultivars and was generally higher for grain types than fiber types.

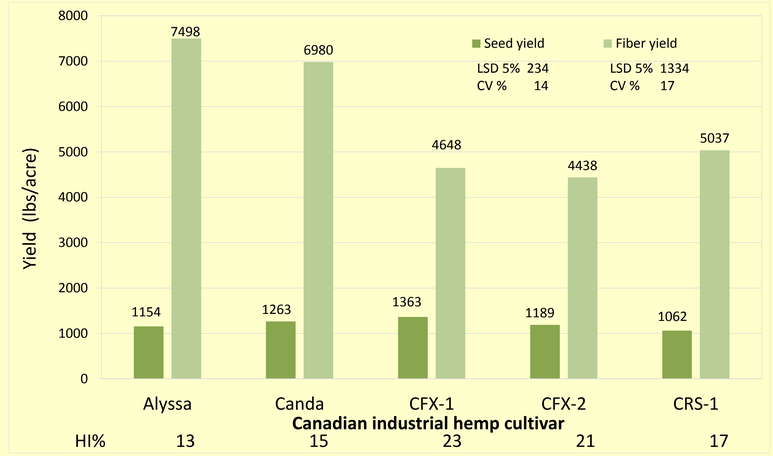


Fig. 6. Mean seed and fiber yield and harvest index (HI) for five Canadian industrial hemp cultivars grown at Langdon, ND, in 2015.

- Fiber yield was similar among the French fiber purpose cultivars (Fig. 7).
- Seed yield was lower for Santhica 27 than the other French fiber purpose cultivars.
- Harvest index (HI) ranged from 6 to 11% among the French fiber type cultivars.

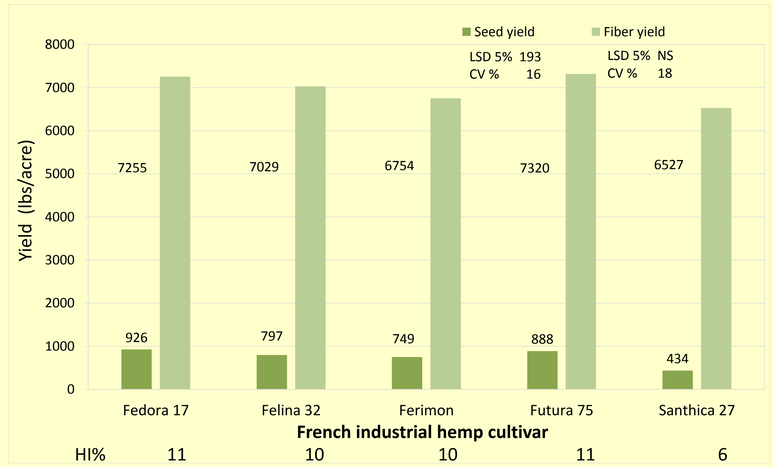


Fig. 7. Mean seed and fiber yield and harvest index (HI) for five French industrial hemp cultivars grown at Langdon, ND, in 2015.

- Live seed mortality was greater than 90% (Fig. 4) and ranged from 64 to 72% (Fig. 5) under soil crusting and wet field conditions, respectively.
- Live seed mortality was lowest ranging from 39 to 58% (Fig. 5) when conditions were normal; this is 2 to 3 times greater than crops such as wheat, corn, and soybean and indicates hemp's low seed vigor.
- Higher or lower germination was not consistently associated with low or high live seed mortality in this study (Fig. 5).
- Although stands ranged from 18 to 53% of normal, grain and fiber yield were not greatly affected by stand indicating yield component compensation among plants.
- Harvest index for hemp ranged from 6 to 23% and was generally highest for grain, than dual purpose, and lowest for fiber cultivars.
- Harvest index for wheat, corn, and soybean commonly range from 40 to 50%.

Conclusions

- Industrial hemp appears to be adapted to northeastern North Dakota.
- Grain and fiber yields were comparable to hemp production in Canada.
- Live seed mortality is greater for hemp than commonly grown agronomic crops and requires careful grower management regarding planting date, seeding rate and depth, cultivar selection, and seed quality.

Acknowledgements

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