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Industrial Hemp Stand Establishment in North Dakota

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Introduction and Objective

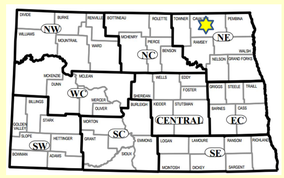
Industrial hemp (*Cannabis sativa* L.) pure live seedling emergence (PLSE) is lower and often substantially lower than for corn, soybean, wheat, and most other agronomic crops where 85% or greater PLSE is common and expected under average to good growing conditions. Fungicide seed treatments are a cost effective, common practice for improving PLSE in crops, and they become more important when stand establishment conditions are less than ideal. Presently, there are no labeled seed treatments either fungicide or insecticide for industrial hemp in the USA or Canada.

The objective of this study was to evaluate seeding date, variety, and seed treatment effects on industrial hemp stand establishment and grain yield.

Materials and Methods

- Experiment was a RCBD with four replications at Langdon, ND.

  Location: 48.760° N -98.345° W
  Elevation: 492 m



- Split-plot design
  - Main plot – seeding date
    - Date 1 – May 20
    - Date 2 – June 1
    - Date 3 – June 12
  - Subplot – factorial arrangement of variety and seed treatment
    - Variety (Table 1)
      - Delores
      - Katina
    - Fungicide
      - Metalaxyl
      - Metalaxyl + Ipconazole
      - Non-treated check
- Plots were four rows, each spaced 30 cm apart and 7.62 m in length (Fig. 1)
- Traits evaluated
  - Plants per m^2 (Fig. 2)
    - Determined from counting emerged seedlings from a 1-m section from each of the center two plot rows
  - Pure live seedling emergence (PLSE) (Fig. 2)
    - = # of emerged seedlings / # of live seed planted and then multiplied by 100
  - Mortality
    - = 100 – PLSE
    - Indicates the percent of live seed that did not establish a seedling
  - Grain yield
    - Determined from harvesting the entire 4-row plot with a plot combine (Fig. 3)

Table 1. Canadian industrial hemp varieties evaluated in 2017

Variety	Company†	Type	Purpose‡	Maturity (d)
Delores	PIHG	Monoecious	Dual	110+
Katani	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. Plot configuration

Fig. 2. Seedlings and seeds

Fig. 3. Harvesting a four-row plot

Results

- ANOVA indicated significant seeding date and seed treatment main effects for stand density, PLSE, and mortality (Table 2)
- ANOVA indicated grain yield was only affected by seeding date
- ANOVA did not indicate any significant interactions for the traits evaluated

Table 2. Sources of variation (SOV) and significant *F*-tests for industrial hemp traits evaluated at Langdon, ND, in 2017

SOV	Stand density	PLSE†	Mortality	Grain yield
Date (D)	*	*	*	*
Variety (V)	ns	ns	ns	ns
D x V	ns	ns	ns	ns
Seed trt (S)	*	*	*	ns
D x S	ns	ns	ns	ns
V x S	ns	ns	ns	ns
D x V x S	ns	ns	ns	ns

† PLSE = pure live seedling emergence
* = significant at $P \leq 0.05$; ns = not significant

- Stand density was greater for Date 1 than Dates 2 and 3 which were equivalent (Table 3)
- PLSE was greater for Date 1 than Dates 2 and 3 which were equal
- Mortality was greater for Dates 2 and 3 than Date 1
- Grain yield was similar for Dates 1 and 2 and higher than for Date 3

Table 3. Industrial hemp stand density, pure live seed emergence (PLSE), and mortality for six seed treatments at Langdon, ND, in 2017

Seed treatment	Stand density	PLSE†	Mortality	Grain yield
	Plants/m^2	%	%	kg/ha
Date 1	145	84	16	2101
Date 2	128	75	25	2170
Date 3	129	75	25	1752
LSD (0.05)	10	6	6	234

† PLSE = pure live seed emergence
Mortality = 100 - PLSE

- Stand density was greater for the Metalaxyl + Ipconazole seed treatment compared with the Check (Table 4).
- PLSE was greater for the Metalaxyl + Iponazole seed treatment compared with the Check.
- Mortality was lower for the Metalaxyl + Iponazole seed treatment compared with the Check.
- The Metalaxyl seed treatment was similar to the Metalaxyl + Ipconazole and the Check.
- Grain yield was not influenced by seed treatment.

Table 4. Industrial hemp stand density, pure live seed emergence (PLSE), and mortality for three seed treatments at Langdon, ND, in 2017

Seed treatment	Stand density	PLSE†	Mortality	Grain yield
	Plants/m^2	%	%	kg/ha
Metalaxyl (M)	132	77	23	1943
M + Ipconazole	143	83	17	2059
Check	126	73	27	2020
LSD (0.05)	13	7	7	ns

† PLSE = pure live seed emergence
Mortality = 100 - PLSE

Discussion

- PLSE averaged 78% across seeding dates and 84, 75, and 75% at Dates 1, 2, and 3, respectively, in 2017 (Table 3). These PLSE values are comparable to conventional crops such as wheat, corn, and soybean and are approximately two to three times (or more) greater than previous industrial hemp studies at the Langdon REC in 2015 and 2016.
- PLSE from previous studies ranged from 18 to 52% (May 27, 2015), 3 to 9% (June 5, 2015), 44 to 52% (June 16, 2015), and 42 to 61% (May 24, 2016) and 28 to 36% (June 20, 2016) (Johnson et al., 2016).
- Stand density was approximately 17 plants/m^2 less for Dates 2 and 3 compared with Date 1 (145 plants/m^2) (Table 3). Rainfall of 6.50 cm during the first two weeks of June may have contributed to wet soil conditions that reduced stand density for Dates 2 and 3, compared with Date 1, where rainfall from May 1 to May 22 was 2.21 cm (NDAWN).
- Soil crusting after planting on June 5, 2015 and saturated soil conditions after planting on June 20, 2016 reduced PLSE that ranged from 3 to 9% and 28 to 36%, respectively (Johnson et al., 2016).
- Seed treatment with Metalaxyl + Ipconazole increased stand density 17 plants/m^2, compared with the untreated Check (126 plants/m^2) (Table 4).
- Seed treatment with Metalaxyl + Ipconazole increased PLSE 10% compared with the untreated Check (73%).
- Stand densities for seeding dates and seed treatments were within the targeted range from 105 to 160 plants/m^2 for commercial grain production.
- PLSE and mortality for Date 1 and the Metalaxyl + Ipconazole seed treatment were comparable with normally expected levels of 85% and 15%, respectively, for commercial crops such as wheat, corn, and soybean.
- 18% lower grain yield was observed for Date 3, compared with the average yield of Dates 1 and 2. At a current grain value of $1.10/kg, this represents $422/ha less gross return.

Conclusions

- Seeding date influenced stand density, PLSE, mortality, and grain yield.
- The late seeding date resulted in reduced grain yield; however, seed treatment did not affect grain yield.
- Seed treatment with Metalaxyl + Ipconazole improved stand density and PLSE, and reduced mortality, compared with the untreated Check. This could lower seeding rates and seed cost/hectare.
- Industrial hemp PLSE, mortality, and stand establishment are sensitive to soil crusting and wet soil conditions.
- Live seed mortality is often greater for industrial hemp than commonly grown agronomic crops and requires careful grower management regarding planting date, seeding depth, variety selection, and seed quality.

References

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- NDAWN. North Dakota Agricultural Weather Network. https://ndawn.ndsu.nodak.edu/

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