Seeding Date, Variety, and Seed Treatment Influence on Industrial Hemp Performance in North Dakota-2018
NDSU Langdon Research Extension Center

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Cultivation of industrial hemp (*Cannabis sativa* L., THC level of 0.3% or less) is now legal in the U.S. with the passage of the 2018 Farm Bill, but it can still only be grown in North Dakota through the North Dakota Department of Agriculture. It has been over 70 years since industrial hemp has been raised in North Dakota. The NDSU Langdon Research Extension Center began conducting industrial hemp variety evaluations in 2015. To gain a better understanding of hemp production in North Dakota common production practices, such as proper seeding date, need to be investigated. Pure live seedling emergence (PLSE) of industrial hemp is lower, often substantially, than for wheat, soybean, and corn 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 common cost effective practice for improving PLSE in crops and they become more important when stand establishment conditions are less than ideal. There are no labeled fungicide seed treatments currently available for industrial hemp in the USA. The objective of this study was to evaluate seeding date, variety, and seed treatment effects on industrial hemp stand establishment, grain and fiber dry stalk yield and other agronomic traits. This is the second year of the study and only 2018 results are presented.

Materials and Methods

Industrial hemp varieties utilized for this study are listed in Table 1. Seeding dates for the study were May 22, June 4, and June 18. The seeding rate was 12 pure live seeds/ft^2 and was adjusted for germination and 1000 kwt (kernel weight) with an additional 25 percent added to allow for seedling mortality. Planting depth was one-half inch. Plot size was 21 feet in length x 4 feet in width and consisted of four 12-inch spaced rows. The experimental design was a randomized complete block split-split-plot with four replications. The main plot treatment was seeding date, the subplot was variety and the sub-sub plot was seed treatment. Seed treatments were Metalaxyl (3 fl oz/100 lbs. of seed), Metalaxyl+Ipconazole (1 fl oz/100 lbs. of seed), and the untreated check. The previous crop was soybeans. Nitrogen fertility additions were based on soil test N and previous crop soybean N credit together providing 150 lbs./acre N. Phosphorous soil test results indicated 11 ppm with an additional 39 lbs/acre applied. The fiber dry stalk yield harvest date was August 7. Mortality was equal to 100 minus PLSE. Fiber harvest consisted of one linear 10-foot row cut from each plot. The plant samples were air-dried and leaves were removed prior to weighing to determine dry stalk yield. Fiber yield and plant height were only determined on the untreated check plots. Grain harvest occurred on August 30, Sept. 6, and Sept. 14 for seeding dates May 22, June 4, and June 18, respectively. A small plot combine was used to harvest the plots. Samples were dried and then processed to determine grain yield, test weight, and 1000 kwt. Plant samples of all varieties, which included leaves and flowering heads, were tested for THC content. All samples tested less than the 0.3% THC which is the limit for industrial hemp classification.

Table 1. Industrial hemp varieties and characteristics for the Langdon 2018 trial.

Variety	Country	Company†	Type	Purpose
Katani	Canada	HGI	Dioecious	Grain
Delores	Canada	PIHG	Monoecious	Dual

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

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

Results and Discussion

The trait sources of variation for the various treatments and their interactions are presented in Table 2.

Stand Establishment

Significant differences occurred for stand density, PLSE, and mortality for seeding date and variety. Stand density and PLSE was greater for the May 22 seeding date compared to the June 18 seeding date (Table 3). Seedling mortality was highest at the June 18 seeding dates (Table 3). Rainfall the first seven days after emergence was 0.22, 0.11 and 0.23 inches for seeding dates of May 22, June 4, and June 18, respectively. Stored soil moisture reserves in the top two inches were becoming limited by the June 18 seeding date and may have resulted in lower PLSE. Pure live seed emergence averaged 78% across seeding dates in 2018. This value is comparable to conventional crops such as wheat, soybeans and corn and is approximately two to three times (or more) greater than previous industrial hemp studies at the Langdon REC in 2015 and 2016. In 2015 soil crusting after planting on June 5, 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). The variety Delores had greater stand density, PLSE and lower mortality compared to the variety Katani (Table 6). Seed treatments had no effect on stand density, PLSE or mortality.

Grain and Fiber Stalk Yield

Grain yield was significantly lower at each of the subsequent seeding dates with the June 18 seeding date yielding 40% less than the May 22 seeding date (Table 3). Yield response to seeding dates was similar in trials conducted in Manitoba, Canada in 2014 and 2015. (Kostuik et al, 2014 and McEachern et al., 2015). Katani grain yield was 33% greater than Delores when averaged across seeding dates and seed treatments (Table 6). Although stand density, PLSE, and mortality were not affected by seed treatments, grain yield of seed treated with Metalaxyl and Metalaxyl+Ipconazole was significantly higher than the untreated check (Table 4). Fiber dry stalk yield was significantly greater at the May 22 and June 4 seeding dates compared to the June 18 seeding date (Table 3). The taller dual purpose variety, Delores, had greater fiber yields compared to Katani (Table 6), but differences between the two decreased at later seeding dates resulting in a significant seeding date x variety interaction (data not shown).

Test Weight, 1000 KWT, and Plant Height

The seeding date x variety interaction was significant for test weight and indicated test weight decreased as seeding date advanced for Katani, but seeding date did not affect weight for Delores (Table 5). The variety Katani had a significantly higher test weight and 1000 kwt compared to Delores (Table 6). Plant height was greater for Delores compared to Katani (Table 6) and was significantly less at the June 18 seeding date compared with the two earlier seeding dates (Table 3).

Table 2. Sources of variation (SOV) and significant F-tests for industrial hemp traits evaluated at Langdon, ND, in 2018.

SOV	Stand Density	PLSE	Mortality	Test Weight	1000 KWT	Grain Yield	Fiber Dry Stalk Yield	Height
Date (D)	*	*	*	*	*	*	*	*
Variety (V)	*	*	*	*	*	*	*	*
D X V	ns	ns	ns	*	ns	ns	*	ns
Seed trt (S)	ns	ns	ns	ns	ns	*	--	--
D x S	ns	ns	ns	ns	ns	ns	--	--
V x S	ns	ns	ns	ns	ns	ns	--	--
D x V x S	ns	ns	ns	ns	ns	ns	--	--
CV %	10.9	10.9	34.8	2.7	7.3	6.8	9.3	2.9

*=significant at $P \leq 0.05$, ns = not significant.

Table 3. Industrial hemp stand density, pure live seed emergence, mortality, 1000 kwt, plant height, grain yield and fiber dry stalk yield averaged over varieties and seed treatments at Langdon, ND, in 2018.

Seeding Date	Stand Density	PLSE	Mortality	1000 KWT	Plant Height	Grain Yield	Fiber Dry Stalk Yield
	Plants/ft^2	%	%	g	In	lb/a	lb/a
May 22	13.6	85	15	15.4	60.0	1512	4820
June 4	12.8	80	20	14.7	59.2	1296	4424
June 18	11.0	68	32	14.1	54.2	907	3080
LSD (0.05)	0.9	6	6	0.7	3.9	117	639

Table 4. Industrial hemp grain yield for three seed treatments averaged over seeding date and varieties at Langdon, ND in 2018.

Seed Treatment	Grain Yield
	lb/a
Metalaxyl	1285
Metalaxyl + Ipconazole	1303
Check	1127
LSD (0.05)	49

Table 5. Industrial hemp test weight for seeding date and variety averaged over seed treatment at Langdon, ND in 2018.

Seeding Date	Test Weight (lb/bu)	
	Katani	Delores
May 22	40.8	36.6
June 4	38.8	36.4
June 18	37.7	36.2
LSD(0.05)	Date x Variety =0.6	

Table 6. Industrial hemp variety effect for several factors averaged over seeding date and seed treatment at Langdon, ND in 2018.

Variety	Stand Density	PLSE	Mortality	Test Weight	1000 kwt	Plant Height	Grain Yield	Fiber Dry Stalk Yield
	Plants/ft^2	%	%	lb/bu	g	in	lb/a	lb/a
Katani	11.6	73	27	39.1	15.6	48.2	1417	2778
Delores	13.3	83	17	36.4	13.8	67.4	1060	5438
LSD (0.05)	0.8	5.2	5.2	0.3	0.7	1.5	113	351

Conclusions

- Reduced grain and fiber yields were observed at later seeding dates.
- Seed treatments improved grain yield but had no effect on stand density, PLSE or mortality.

References

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