Kansas Agricultural Experiment Station Research Reports

Volume 6
Issue 5 *Kansas Field Research*

Article 7

2020

Evaluation of Planting Technologies in Winter Canola

M. A. Secchi
Kansas State University, secchi@k-state.edu

Y. Wright
John Deere, Johnson, IA

C. Foster
John Deere, Johnson, IA

See next page for additional authors

Recommended Citation

Secchi, M. A.; Wright, Y.; Foster, C.; Stamm, M. J.; and Ciampitti, I. A. (2020) "Evaluation of Planting Technologies in Winter Canola," *Kansas Agricultural Experiment Station Research Reports*: Vol. 6: Iss. 5. https://doi.org/10.4148/2378-5977.7923

Evaluation of Planting Technologies in Winter Canola

Abstract

Winter canola (*Brassica napus* L.) stand establishment and winter survival are two of the most important limitations to canola production faced by farmers. We hypothesize that planting canola with a system that provides accurate in-row spacing will positively impact crop establishment, survivability, and reduce seed input costs. A planting system that provides a homogenous spatial and temporal distribution of canola plants will also positively affect yield. The objective of this study was to investigate the impact of three metering systems with different opener and seed delivery systems on stand establishment, spatial distribution, and yield at three seeding densities and under two potential yield levels within a field. To test this hypothesis, three on-farm research studies were evaluated in the south-central region of Kansas. Preliminary results indicate that in homogenous environments, new planting technologies have a positive impact on the spatial distribution of plants within a row.

Keywords

Brassica napus, stand establishment, canola distribution

Authors

M. A. Secchi, Y. Wright, C. Foster, M. J. Stamm, and I. A. Ciampitti

Evaluation of Planting Technologies in Winter Canola

M.A. Secchi, Y. Wright,[1] C. Foster,[1] M.J. Stamm, and I.A. Ciampitti

Summary
Winter canola (*Brassica napus* L.) stand establishment and winter survival are two of the most important limitations to canola production faced by farmers. We hypothesize that planting canola with a system that provides accurate in-row spacing will positively impact crop establishment, survivability, and reduce seed input costs. A planting system that provides a homogenous spatial and temporal distribution of canola plants will also positively affect yield. The objective of this study was to investigate the impact of three metering systems with different opener and seed delivery systems on stand establishment, spatial distribution, and yield at three seeding densities and under two potential yield levels within a field. To test this hypothesis, three on-farm research studies were evaluated in the south-central region of Kansas. Preliminary results indicate that in homogenous environments, new planting technologies have a positive impact on the spatial distribution of plants within a row.

Introduction
The introduction of winter canola into rotations with wheat (*Triticum aestivum* L.) could have both positive economic and agronomic impacts. The two main concerns for successful production are stand establishment and winter survival. Previous studies in Canada show canola stand uniformity had a significant impact on productivity (Chao et al., 2014). Non-uniform crop residue distribution and planting systems (planted versus drilled) are usually a cause of spatial variability (Liu et al., 2004). A different establishment can be explained from delayed germination due to seed quality problems (Egli, 2015), limited soil water availability (Nafziger et al., 1991), differences in planting depth within-row (Andrade and Abbate, 2005), and low soil temperature (Garcia-Huidobro et al., 1982). These factors can lead to temporal variability. Because of their indeterminate nature, canola plants have different compensatory mechanisms and possess the ability to compensate for poor spatial and temporal stand distribution; which could be the response that explains yield penalties or benefits.

Precision planting systems for canola are lacking, thus, improved technologies to reduce seed inputs and improve stand establishment and spatial patterns are needed. The objective of this study was to investigate the impact of three metering systems with different opener and seed delivery systems on 1) spatial distribution, and 2) yield at three seed densities and two potential yield levels within a field.

[1] John Deere, Johnson, IA.

Procedures

Three on-farm studies were carried out by canola growers in southern Kansas. The fields were located at 1) Hutchinson, KS (HUT); 2018-2019 growing season 2) Harper, KS (HAR); 2019-2020 growing season and 3) Caldwell, KS (CAL); 2019-2020 growing season. Nine treatments were established using combinations of the three metering systems and three seeding rates.

1. Air Volumetric Seeder - single disk opener, 1 lb/acre (SV-1).
2. Planter Singulated - double-disk opener, 1 lb/acre (PL-1).
3. Air Singulated Seeder - single disk opener, 1 lb/acre (SS-1).
4. Air Volumetric Seeder - single disk opener, 3 lb/acre (SV-3).
5. Planter Singulated - double-disk opener, 3 lb/acre (PL-3).
6. Air Singulated Seeder - single disk opener, 3 lb/acre (SS-3).
7. Air Volumetric Seeder - single disk opener, 5 lb/acre (SV-5).
8. Planter Singulated - double-disk opener, 5 lb/acre (PL-3).
9. Air Singulated Seeder - single disk opener, 5 lb/acre (SS-5).

The experimental design was a split-plot arranged in a randomized complete block with three replications. Historical yield information and/or satellite imagery were used to establish high and low-yield environmental zones. All experiments followed conventional tillage practices and were kept weed free before planting. Herbicide applications were performed by the producers using their preferred best management practices. For each location, the planting date, planting system, row spacing, environment, and variety information are presented in Table 1.

At the HUT site, only two planting systems were tested. The planter treatments were "double planted" to achieve a 7.5-in. row spacing. N-P-S fertilizer (nitrogen-phosphorus-sulfur) 120-46-6 lb/acre, respectively, was applied in a three-way split (before planting, winter, and early spring). Soil characterization was performed at the 6-in. depth for several parameters (Table 2). A desiccant was sprayed 7 days before harvest. Yield data were collected using the producer's yield mapping system and calibrated with scale weights for each treatment. Weather data were extracted from Google Climate Engine (Huntington et al., 2017). All statistical analyses were performed using R software (R Core Team, 2018).

Measurements

In each plot, 10-ft^2 subplots were assigned to take the following measurements:

- Stand counts were performed at establishment and before harvest (counted as stems with fertile pods).
- Spatial distribution was measured as the distance between plants within a row. Coefficient of variation, (CV, %), was calculated as (std(σ))/(mean(μ)) in three linear feet of three rows within each treatment and site.

Aerial imagery was taken at regular intervals in the spring after winter dormancy to evaluate the normalized difference vegetation index (NDVI).

Yields were adjusted to 10% moisture.

Results

Spatial Distribution

Lower coefficient of variation CV (%) values (Figure 1) indicate better spatial distribution. The analysis of variance (ANOVA) results for the main factors show significant differences in the planting systems only between locations. The means comparison was significantly different ($P > 0.05$) averaged across all seeding rates in HUT1 for the planter treatments and HAR2 for seeder singulated treatments (Table 3). There were no differences between the mean comparisons of the remaining treatments.

Yields HUT1 and HUT2 in 2018-2019

Only seeder volumetric and the planter treatments were evaluated in HUT1 and HUT2. In terms of yield in both environments, for each seeding rate the planting systems effect had the same behavior and did not differ. HUT2 yielded less than HUT1 (on average -18.4 bushels/acre), and 5 pounds/acre yielded more than 3 and 1 pounds/acre (on average + 4.4 and + 7.5 bushels/acre). We then compared the treatments by removing the environmental effect and treating the main two environments as individual trials. HUT1 presents significant differences in the interaction between planting systems and seeding rates (Table 4). HUT2 did not show differences. At 1 lb/acre, the seeder volumetric portrayed greater yield than the planter system. For 3 and 5 lb/acre rate levels, there were no statistical differences, but the planter showed greater yields more than the seeder volumetric treatments. Within each planting system, the yield was the same for all seeding rates for the seeder volumetric. For the planter, the 5 and 3 lb/acre seeding rates yielded more than the 1 lb/acre (Table 5).

Preliminary Conclusions

The HUT1 and HAR2 environments presented more homogenous field conditions, resulting in lower CV % for the planter (-17%) and the seeder singulated (-15%) treatments. For fields with more heterogeneity, treatment differences were not clearly identified. In HUT1, at lower seeding rates (1 lb/acre), the planter double pass negatively affected stand establishment and thus yields were penalized (-3.4 bushels/acre). At higher seeding rates (3 and 5 lb/acre), the planter technology presented a trend to show greater yields (+0.6 and +1.7 bushels/acre, respectively).

References

Andrade, F.H., and P.E. Abbate. 2005. Response of maize and soybean to variability in stand uniformity. Agron. J. 97(4): 1263–1269. doi: 10.2134/agronj2005.0006.

Chao, Y., H.R. Kutcher, R. Gulden, B. Irvine, and W.E. May. 2014. Up to 32 % yield increase with optimized spatial patterns of canola plant establishment in western Canada. doi: 10.1007/s13593-014-0218-5.

Egli, D.B. 2015. Relationship of uniformity of soybean seedling emergence to yield. 60(1970): 149–157.

Garcia-Huidobro, J., J.L. Monteith, and G.R. Squire. 1982. Time, Temperature and Germination of Pearl Millet (*Pennisetum typhoides* S . & H .). J. Exp. Bot. 33(133): 288–296.

Huntington, J.L., K.C. Hegewisch, B. Daudert, C.G. Morton, J.T. Abatzoglou, et al. 2017. Climate engine: Cloud computing and visualization of climate and remote sensing data for advanced natural resource monitoring and process understanding. Bull. Am. Meteorol. Soc. 98(11): 2397–2409. doi: 10.1175/BAMS-D-15-00324.1.

Liu, W., M. Tollenaar, G. Stewart, and W. Deen. 2004. Impact of planter type, planting speed, and tillage on stand uniformity and yield of corn. Agron. J. 96(6): 1668–1672. doi: 10.2134/agronj2004.1668.

Nafziger, E.D., P.R. Carter, and E.E. Graham. 1991. Response of Corn to Uneven Emergence. Crop Sci. 31(3): 811–815. doi: 10.2135/cropsci1991.0011183x00310 0030053x.

R Core Team. 2018. R: A Language and Environment for Statistical Computing.

Table 1. Planting dates, planting systems, row spacing, environments, and seed varieties information for every location

Location	Planting date	Seeding rates	Planting systems	Row spacing	Environments	Seed variety
Hutchinson (HUT)	10/1/2018	1, 3, 5 lb/acre	-(SV) MY15 John Deere 1990 CCS, 7.5-in. row spacing - air seeder. -(PL) MY14 John Deere 1790, 15-in. row spacing planter.	7.5 inches	2 HUT1 HUT2	Winfield Croplan CP2225W
Harper (HAR)	10/1/2019	1, 3, 5 lb/acre	-(SV) Horsch Anderson 500i, 7.5-in. row spacing air seeder. -(PL) MY15 John Deere 1745, 15-in. row spacing planter. -(SS) John Deere N540C, 7.5-in. row spacing with prototype singulation system.	15 inches	2 HAR1 HAR2	Winfield Croplan CP320WRR
Caldwell (CAL)	10/2/2019 10/10/2019 (SS)	1, 3, 5 lb/acre	-(SV) MY15 John Deere 1910, 7.5-in. row spacing - air seeder. -(PL) MY15 John Deere 1745, 15-in. row spacing- planter. -(SS) John Deere N540C, 7.5-in. row spacing with prototype singulation system.	15 inches	1 CAL	Torrington

Table 2. Chemical characteristics of soil in Hutchinson, KS, at 6-in. and 24-in. depth, collected right before the onset of the experiment

Location	CEC	OM LOI	pH	Ca	Mg	Na	P-M	NO_3-N	NH_4-N	K
	meq/100 q	%		----------	----------	----------	ppm	----------	----------	----------
Hutchinson 1	14	2.2	5.5	1178	191	82	23	7	11	102
Hutchinson 2	16	2.4	5.7	1574	201	33	25	14	11	129

CEC = cation exchange capacity. OM LOI = organic matter loss on ignition. Ca = calcium. Mg = magnesium. Na = sodium. P = phosphorus, Mehlich-3. N-NO_3 = nitrates. N-NH_4 = ammonium. K = potassium.

Table 3. Mean comparison of CV(%) between planting systems in different locations

Location	Planting system	Mean (%)	Group
Hutchinson 1	Seeder volumetric	101	a
	Planter	83	b
Harper 2	Seeder volumetric	120	a
	Planter	108	ab
	Seeder singulated	105	b

Different group letters represent differences across planting systems at (P < 0.05) using Tukey comparison.

Table 4. ANOVA table for main factors in yields using F-test in HUT1

Factor test	*P*-value
Seeding rate	0.077.
Planting system	0.600
Seeding rate: planting system	0.038*

Significance level: 0.01(*) and 0.05(.).

Table 5. Mean comparison between seeding rates and planting systems

Seeding rate	Planting systems	Mean (bushels/acre)	Group
1	Seeder volumetric	40.5	a
	Planter	37.1	b
3	Seeder volumetric	42.5	a
	Planter	43.1	a
5	Seeder volumetric	43.3	a
	Planter	45.0	a

Planting systems	Seeding rate	Mean (bushels/acre)	Group
Seeder volumetric	5	43.3	a
	3	42.5	a
	1	40.5	a
Planter	5	45.0	a
	3	43.1	a
	1	37.1	b

Different letters represent differences at (P < 0.05).

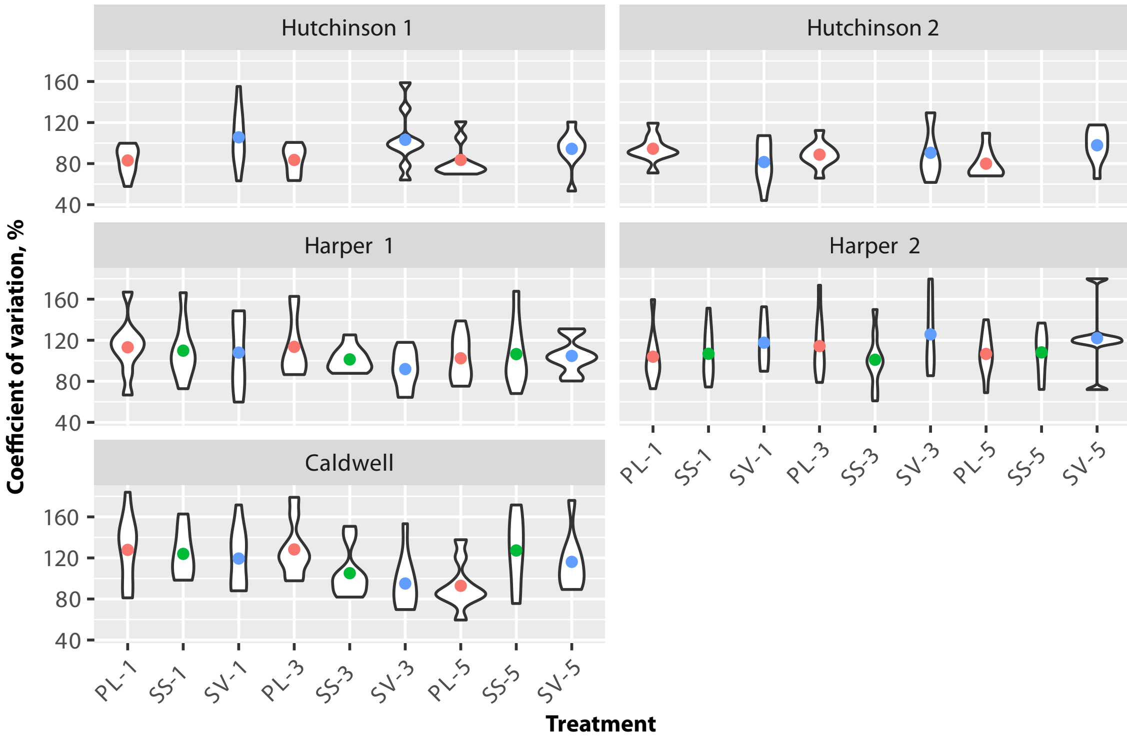

Figure 1. Violin charts of the coefficient of variation (CV, %) of each treatment for every location and environment. Dots represent means. Red dots show planter (PL) treatments, green dots show seeder singulated (SS) treatments, and blue dots show seeder volumetric (SV) treatments. Number 1 represents a seeding rate of 1 lb/acre; number 3, 3 lb/acre; and number 5, 5 lb/acre.