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Do Winter Canola Hybrids and Open-Pollinated Varieties Respond Differently to Seeding Rate?

B. M. Showalter
Kansas State University, baylee@ksu.edu

K. Roozeboom
Kansas State University, kraig@ksu.edu

M. J. Stamm
Kansas State University, mjstamm@ksu.edu

See next page for additional authors

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Abstract

Several producers have turned to planting canola in 30-in. rows as a strategy to take advantage of residue management options (e.g. planter-mounted residue managers and strip tillage) to facilitate planting canola in high-residue cropping systems. Canola hybrids are gaining acres in the southern Great Plains and may require different management than the traditional open-pollinated cultivars. The objective of this study was to determine the effect of seeding rate on winter survival and yield of hybrid and open-pollinated winter canola cultivars in 30-in. and 9-in. rows. Experiments were conducted in 2013-2014, 2014-2015, and 2015-2016 at two K-State Research and Extension facilities. Treatments were four locally adapted cultivars (two hybrids and two open-pollinated cultivars) and three or five seeding rates for a total of twelve or twenty treatments in each experiment. Due to nearly complete winter stand loss of hybrids in the experiment planted in 2013, only open-pollinated cultivars were harvested. No experiments were harvested for yield in 2015 because of nearly complete stand loss in all treatments at all locations. In both row spacings, fall stands tended to increase with increasing seeding rates, and hybrids tended to establish more plants than open-pollinated cultivars. Differences in stands due to seeding rate were somewhat less evident in the spring, but stand differences due to cultivars were more evident. Winter survival tended to increase as the number of plants present in the fall decreased, whether that was due to seeding rate or other factors. Bloom occasionally was delayed, and harvested seed moisture tended to be greater when fewer plants were present in the spring, likely due to a greater percentage of buds forming on branches. Seeding rate had a minimal impact on yields in 30-in. rows, with hybrids and open-pollinated cultivars responding similarly in most cases. In 9-in. rows, seeding rate did not affect yields in 2014. In 2016, both hybrids and open-pollinated cultivars maximized yield at 300,000 seeds per acre in 9-in. rows, but hybrids maintained greater yields than open-pollinated cultivars at sub-optimal seeding rates.

Keywords

canola, seeding rates, row spacing, hybrids, open-pollinated

Authors

B. M. Showalter, K. Roozeboom, M. J. Stamm, and G. Cramer

Do Winter Canola Hybrids and Open-Pollinated Varieties Respond Differently to Seeding Rate?

B.M. Showalter, K.L. Roozeboom, M.J. Stamm, and G.L. Cramer

Summary

Several producers have turned to planting canola in 30-in. rows as a strategy to take advantage of residue management options (e.g. planter-mounted residue managers and strip tillage) to facilitate planting canola in high-residue cropping systems. Canola hybrids are gaining acres in the southern Great Plains and may require different management than the traditional open-pollinated cultivars. The objective of this study was to determine the effect of seeding rate on winter survival and yield of hybrid and open-pollinated winter canola cultivars in 30-in. and 9-in. rows. Experiments were conducted in 2013-2014, 2014-2015, and 2015-2016 at two K-State Research and Extension facilities. Treatments were four locally adapted cultivars (two hybrids and two open-pollinated cultivars) and three or five seeding rates for a total of twelve or twenty treatments in each experiment. Due to nearly complete winter stand loss of hybrids in the experiment planted in 2013, only open-pollinated cultivars were harvested. No experiments were harvested for yield in 2015 because of nearly complete stand loss in all treatments at all locations. In both row spacings, fall stands tended to increase with increasing seeding rates, and hybrids tended to establish more plants than open-pollinated cultivars. Differences in stands due to seeding rate were somewhat less evident in the spring, but stand differences due to cultivars were more evident. Winter survival tended to increase as the number of plants present in the fall decreased, whether that was due to seeding rate or other factors. Bloom occasionally was delayed, and harvested seed moisture tended to be greater when fewer plants were present in the spring, likely due to a greater percentage of buds forming on branches. Seeding rate had a minimal impact on yields in 30-in. rows, with hybrids and open-pollinated cultivars responding similarly in most cases. In 9-in. rows, seeding rate did not affect yields in 2014. In 2016, both hybrids and open-pollinated cultivars maximized yield at 300,000 seeds per acre in 9-in. rows, but hybrids maintained greater yields than open-pollinated cultivars at sub-optimal seeding rates.

Introduction

A successful winter canola crop is achieved through the multifaceted interaction of genetics, management, and environment. High-residue cropping systems have been particularly challenging for winter canola survival because of the winter stand loss that often accompanies no-tillage planting. Planting canola with a row-crop planter in 30-in. rows provides additional options for residue management and facilitates precise seed singulation and seed placement. One of the major differences between winter canola cultivars on the market today is whether they are open-pollinated versus hybrid cultivars. Hybrid canola cultivars typically have larger seed, making them particularly well suited for the seed singulation and precise metering facilitated by row-crop planters. We hypothesized that the more vigorous seedling growth and larger plant size often characteristic of canola hybrids may require fewer plants, and therefore reduced seeding rates, to maximize yield compared to open-pollinated varieties. In addition, the greater intra-row competition associated with 30-in. rows compared to narrower row spacings may be more detrimental for hybrids than for open-pollinated cultivars because of this increased vigorous growth. The objective of this series of experiments was to determine the effect of seeding rate on winter survival and yield of hybrid (HYB) and open-pollinated (OP) winter canola cultivars in both 30-in. and 9-in. rows. We wanted to answer the question: "Should seeding rates differ for HYB and OP?"

Procedures

30-In. Rows

Two experiments were planted 2014-2015 and three in 2015-2016 at two K-State Research and Extension facilities. Treatments were four locally adapted cultivars, two HYB (Safran, Mercedes) and two OP (Riley, DKW44-10), and five seeding rates (100,000, 175,000, 250,000, 325,000, and 400,000 seeds per acre) for a total of twenty treatments in each experiment. Plots were planted with planters equipped with Monosem seed meters mounted with canola plates on either Monosem or John Deere row units. Row units were equipped with Yetter residue managers adjusted to remove residue from above the seed furrow. Plots consisted of 4 rows 35 feet in length with data collected from the center two rows. Four of the experiments were planted into wheat stubble without tillage, one near Manhattan, KS (Manhattan-NT), and one near Hutchinson, KS (Hutchinson-NT). The fifth experiment was planted into vertically tilled wheat stubble near Hutchinson, KS in 2015 (Hutchinson-VT). Treatments were replicated four times in each experiment in a randomized complete block design with a factorial treatment structure in the Hutchinson experiments and a split plot treatment structure in the Manhattan-NT experiment, with seeding rates as the whole plots. Fall establishment was determined by counting two sections of row in each plot, each 3.3 feet in length. The number of living plants was counted in these same sections after green-up the next spring to determine spring plant density. Winter survival percent was calculated by dividing spring plant density by fall plant density and multiplying by 100. Bloom progression was estimated visually during mid bloom to determine if treatments influenced spring plant development.

9-In. Rows

One experiment was conducted in 2013-2014, two in 2014-2015, and two in 2015-2016 at two K-State Research and Extension facilities. Treatments were four locally adapted cultivars, two HYB (Hekip and Mercedes), and two OP (DKW44-10 and DKW46-15 in 2013-2014, Riley and HyCLASS115W in 2015-2016) and three or five seeding rates (500,000, 750,000, and 1,000,000 seeds per acre in 2013-2014 or 150,000, 225,000, 300,000, 375,000, and 450,000 seeds per acre in 2014-2015 and 2015-2016) for a total of twelve or twenty treatments in each experiment. Experiments were planted with a drill equipped with double-disc openers into tilled soil that had been rolled to establish a firm seedbed. Fall establishment and winter survival were estimated by visual ratings. Treatments were replicated three or four times in each experiment in a randomized complete block design with a split plot treatment structure with cultivar as the whole plots.

All Experiments

Plots were swathed at 40 to 60% seed color change. Several days after swathing, weight of canola seed from each plot was determined using a plot combine capable of weighing harvested seed and capturing samples for moisture and oil concentration analysis. Seed samples were sent to the Brassica Breeding and Research program at the University of Idaho (Moscow, ID) for near-infrared spectroscopy (NIRS) oil content estimation. Analysis of variance was used to determine significance of seeding rate, cultivar type (TYPE), cultivar, and their interaction effects ($\alpha = 0.05$). Treatment and interaction means were separated using pairwise t tests when a treatment or interaction effect was deemed significant.

Results

Fall establishment was excellent in all years. The HYB did not survive the winter in the experiment planted in 2013, and nearly complete stand loss occurred in all treatments resulting from a dramatic temperature drop in November 2014 so that no experiments were harvested in 2015. All four experiments planted in the fall of 2015 were harvested for yield in 2016.

Fall Stand Establishment in 30-In. Rows

Fall stands differed depending on seeding rate and TYPE, but the responses were not consistent at all locations (Table 1). Fall stands increased with increasing seeding rate in the Manhattan-NT and Hutchinson-NT experiments. The response was not consistent for all cultivars in Manhattan-NT, and the differences in response depended on individual cultivar rather than TYPE. Fall stands were greater on average for HYB than for OP at both locations. The separation between TYPE was caused primarily by the lower stands of Riley at all seeding rates in Manhattan-NT. In the Hutchinson-VT experiment, HYB and OP responded differently to seeding rate with HYB establishing more plants at 250,000 seeds per acre and fewer plants at 100,000 seeds per acre. Most often, HYB tended to establish more plants than OP, but a greater number of fall plants was associated with greater seeding rates at only two of the three locations.

Spring Stands in 30-In. Rows

Spring stands reflected trends similar to those observed for fall stands. In the Manhattan-NT experiment, all cultivars had greater spring stands as seeding rate increased (Table 2). Spring stands averaged less for OP than for HYB across seeding rates, but the difference was largely due to Riley having fewer plants than the other cultivars. Safran had fewer plants than Mercedes but was superior to Riley. In the Hutchinson-NT experiment, all cultivars had greater spring stands with increasing seeding rate, but the increase was minimal for the HYB. In the Hutchinson-VT experiment, spring stands for HYB were stable across seeding rates except for a drop off at the lowest seeding rate. The OP had greater spring stands at the lowest two seeding rates. Averaged across seeding rates, Mercedes had the most plants in the spring and Safran the fewest, with the

OP cultivars falling between those two. Differences in stands due to seeding rate tended to persist throughout the winter, and differences due to cultivar were accentuated.

Winter Survival in 30-In. Rows

A greater percentage of plants tended to survive when fewer plants were present the previous fall. In the Manhattan-NT and Hutchinson-NT experiments, winter survival decreased with increasing seeding rate for all four cultivars (Table 3). In the Hutchinson-NT experiment, winter survival was greater for OP than for HYB averaged across seeding rates. Inconsistent variation in winter survival values within treatments prevented detecting treatment differences in the Hutchinson-VT experiment.

Bloom Progression in 30-In. Rows

Bloom rate differed depending on seeding rate or the interaction of seeding rate at all three locations (Table 4). At Manhattan-NT, a greater percentage of the plants were blooming as seeding rate increased. This reflected the expectation that reduced stands are likely to produce more branches that tend to bloom slightly later than the main stem. The pattern was almost the opposite in the Hutchinson-VT experiment with the most rapid blooming associated with the lowest seeding rate. In the Hutchinson-NT experiment, bloom response to seeding rate differed with cultivar. Bloom progression was greater with greater seeding rates for Mercedes, following the expected response. Both Safran and DKW44-10 exhibited a minimal response of bloom progression to seeding rate except for an unexplained increase at 175,000 seeds per acre. Bloom progression did not differ with seeding rate for Riley. Delayed or extended bloom associated with reduced stands may impact yield in years with a shortened seed fill period.

Yield and Oil Concentration in 30-In. Rows

The only location where treatments had a significant effect on yield was at Manhattan-NT (Table 5). Yield was less for DKW44-10 and more for Riley than for the HYB regardless of seeding rate. Seeding rate did not affect yield at any of the locations except in the Manhattan-NT experiment where the OP cultivars produced four to seven fewer bushels per acre at 325,000 seeds per acre than at the other seeding rates. Seed oil concentration was influenced by treatment factors only in the Manhattan-NT experiment. Oil concentration was influenced by seeding rate, but the ranking of oil concentration did not follow the seeding rate ranking (data not shown). Oil concentration was 2 to 3% less for DKW44-10 than for the other cultivars at this location.

Fall Stand Establishment, Winter Survival, and Harvested Seed Moisture in 9-In. Rows

Fall stands, winter survival, and harvested seed moisture were affected by seeding rate in at least one of the two experiments. Fall stands increased with greater seeding rates in both experiments (Tables 6 and 7). Winter survival decreased as seeding rate increased in the 2013-2014 experiment (Table 6). Harvested seed moisture increased as seeding rate decreased, but the differences were significant only in the 2015-2016 experiment (Table 7).

Yield in 9-In. Rows

In 9-in. rows, seeding rate and cultivar affected yield only in 2015-2016 (Tables 6 and 7). The yield response to seeding rate differed with TYPE in this experiment (Table 7). Yield was maximized at the 300,000 seeds per acre seeding rate for both HYB and OP, but yield of HYB surpassed that of OP at the 150,000 seeds per acre seeding rate. Averaged over seeding rates, Mercedes yielded more than the other cultivars.

Conclusions

These results indicate that fall stands generally reflect differences in seeding rate, but spring stands tend to differ less because fewer plants are lost during winter when fewer plants are present in the fall. In 30-in. rows, seeding rates as low as 100,000 seeds per acre supported yields from 700 to 2100 pounds per acre in high residue, no-tillage or reduced tillage systems when residue was adequately removed from the seed row. Hybrid and open-pollinated winter canola cultivars responded similarly to seeding rate in these experiments, providing a preliminary indication that similar seeding rates could be used for both types of cultivars in 30-in. rows. Experiments producing greater yields may be more likely to detect influences of seeding rate and cultivar types on seed yield. In 9-in. rows, seeding rates of 300,000 seeds per acre or more supported maximum yields, ranging from 2,000 to 3,300 pounds per acre, but hybrids maintained yield better than open-pollinated cultivars at sub-optimal seeding rates. Within the range of environmental conditions and yields produced in these experiments, similar seeding rates can be used for hybrids and open-pollinated cultivars, but seeding rates can be less with wider row spacing.

Table 1. Fall stands of four canola cultivars planted at five seeding rates in 30-in. rows at three Kansas locations in 2015

	Seeding rate (seeds per acre)					
Cultivar (TYPE)	100,000	175,000	250,000	325,000	400,000	Mean
	Plants per acre × 1,000					
Manhattan-NT						
HYB	47.5	64.6	97.0	112.1	145.7	93.4 A†
OP	36.2	52.7	91.1	103.4	120.1	80.7 B
Safran (HYB)	42.6 kl‡	73.2 g-j	92.3 d-g	95.5 d-f	138.0 ab	88.3 B
Mercedes (HYB)	52.4 jk	55.9 i-k	101.8 c-e	128.8 b	153.5 a	98.5 A
Riley (OP)	32.6 l	38.0 kl	75.1 f-i	83.9 e-h	100.6 de	66.0 C
DKW44-10 (OP)	39.8 kl	67.4 h-j	107.0 cd	122.9 bc	139.6 ab	95.4 AB
Mean	41.9 D	58.6 C	94.0 B	107.8 B	132.9 A	
Hutchinson-NT						
HYB	75.0	84.0	104.2	126.5	116.5	101.2 A
OP	55.1	71.7	81.0	113.5	122.8	88.8 B
Safran (HYB)	65.7	79.7	98.9	132.1	116.2	98.5
Mercedes (HYB)	84.3	88.3	109.5	120.8	116.8	104.0
Riley (OP)	61.7	67.7	81.7	115.5	124.8	90.3
DKW44-10 (OP)	48.5	75.7	80.3	111.5	120.8	87.4
Mean	65.1 D	77.8 C	92.6 B	120.0 A	120.0 A	
Hutchinson-VT						
HYB	75.7 b-d	101.9 a	104.6 a	82.0 a-d	87.3 a-d	90.2
OP	93.6 a-c	97.6 ab	67.7 d	77.7 b-d	73.4 cd	82.0
Safran (HYB)	63.7	84.3	104.9	90.3	90.9	86.8
Mercedes (HYB)	87.6	119.5	104.2	73.7	83.6	93.7
Riley (OP)	103.6	98.3	60.4	77.7	71.0	82.2
DKW44-10 (OP)	83.6	96.9	75.0	77.7	75.7	81.8
Mean	84.6	99.7	86.1	79.8	80.3	

† Values within a set of type, cultivar, or seeding rate means followed by the same upper case letter are not different at $\alpha = 0.05$.
‡ Values within a set of type or cultivar × seeding rate combinations followed by the same lower case letter are not different at $\alpha = 0.05$.

Table 2. Spring stands of four canola cultivars planted at five seeding rates in 30-in. rows at three Kansas locations in 2015

	Seeding rate (seeds per acre)					
Cultivar (TYPE)	100,000	175,000	250,000	325,000	400,000	Mean
	Plants per acre × 1,000					
Manhattan-NT						
HYB	36.5	46.8	71.0	70.8	86.0	62.2 A[†]
OP	31.8	40.5	66.4	66.1	73.0	55.5 B
Safran (HYB)	33.9	47.8	66.4	61.9	85.0	59.0 B
Mercedes (HYB)	39.2	45.8	75.7	79.7	87.0	65.5 A
Riley (OP)	28.3	32.5	58.4	59.7	65.7	49.0 C
DKW44-10 (OP)	35.2	48.5	74.4	72.4	80.3	62.1 AB
Mean	34.1 D	43.6 C	68.7 B	68.4 B	79.5 A	
Hutchinson-NT						
HYB	53.4 cd[‡]	53.4 cd	58.4 a-c	56.1 bc	68.7 a	58.0
OP	43.8 d	53.1 cd	48.1 cd	67.4 a	66.7 ab	55.8
Safran (HYB)	57.8	51.8	52.4	61.7	71.7	59.1
Mercedes (HYB)	49.1	55.1	64.4	50.4	65.7	57.0
Riley (OP)	50.5	51.8	51.8	69.7	63.7	57.5
DKW44-10 (OP)	31.2	54.4	44.5	65.1	69.7	54.2
Mean	48.6 B	53.3 B	53.3 B	61.7 A	67.7 A	
Hutchinson-VT						
HYB	48.5 de	62.7 a-c	60.7 a-d	59.4 a-e	62.1 a-d	58.7
OP	70.7 a	67.6 ab	51.3 c-e	46.8 e	56.8 b-e	58.6
Safran (HYB)	39.3	58.4	51.8	63.7	53.8	53.4 B
Mercedes (HYB)	57.8	67.1	69.7	55.1	70.4	64.0 A
Riley (OP)	79.0	63.8	44.9	46.5	61.1	59.1 AB
DKW44-10 (OP)	62.4	71.4	57.8	47.1	52.4	58.2 AB
Mean	59.6	66.2	56.0	53.1	59.4	

[†] Values within a set of type, cultivar, or seeding rate means followed by the same upper case letter are not different at $\alpha = 0.05$.
[‡] Values within a set of type or cultivar × seeding rate combinations followed by the same lower case letter are not different at $\alpha = 0.05$.

Table 3. Winter survival of four canola cultivars planted at five seeding rates in 30-in. rows at three Kansas locations in 2015

	Seeding rate (seeds per acre)					
Cultivar (TYPE)	100,000	175,000	250,000	325,000	400,000	Mean
	------------------- % -------------------					
Manhattan-NT						
HYB	81	75	74	65	60	71
OP	81	82	75	67	63	74
Safran (HYB)	81	66	73	67	62	70
Mercedes (HYB)	81	84	74	62	58	72
Riley (OP)	75	88	79	72	67	76
DKW44-10 (OP)	87	76	71	62	60	71
Mean	81 A[†]	79 A	74 A	66 B	61 B	
Hutchinson-NT						
HYB	74	66	56	47	60	61 B
OP	79	78	61	63	56	67 A
Safran (HYB)	88	65	55	58	64	64
Mercedes (HYB)	59	67	57	46	57	57
Riley (OP)	82	78	64	66	51	68
DKW44-10 (OP)	76	78	59	60	60	67
Mean	76 A	72 A	59 B	55 B	58 B	
Hutchinson-VT						
HYB	78	65	63	74	78	71
OP	77	70	76	67	79	74
Safran (HYB)	75	67	53	71	71	67
Mercedes (HYB)	81	62	73	77	84	76
Riley (OP)	78	68	75	82	86	74
DKW44-10 (OP)	77	72	77	71	72	74
Mean	78	67	70	70	78	

[†]Values within a set of type, cultivar, or seeding rate means followed by the same upper case letter are not different at $\alpha = 0.05$.

Table 4. Bloom progression of four canola cultivars planted at five seeding rates in 30-in. rows at three Kansas locations in 2015

	Seeding rate (seeds per acre)					
Cultivar (TYPE)	100,000	175,000	250,000	325,000	400,000	Mean
	Progression of bloom (%)					
Manhattan-NT						
HYB	43	43	47	47	47	45
OP	42	43	47	45	47	45
Safran (HYB)	43	41	48	48	46	45
Mercedes (HYB)	43	44	46	46	48	45
Riley (OP)	41	43	46	45	45	44
DKW44-10 (OP)	43	43	48	45	49	45
Mean	42 C[†]	43 BC	47A	46 AB	47 A	
Hutchinson-NT						
HYB	48	52	43	49	53	49
OP	48	53	58	47	45	48
Safran (HYB)	48 cd[‡]	59 ab	43 d	45 cd	48 cd	48
Mercedes (HYB)	49 b-d	45 cd	44 cd	54 a-c	59 ab	50
Riley (OP)	49 b-d	46 cd	50 a-d	48 cd	46 cd	48
DKW44-10 (OP)	48 cd	60 a	45 cd	46 cd	44 cd	49
Mean	48	53	45	48	49	
Hutchinson-VT						
HYB	53	49	56	48	51	51
OP	55	51	49	48	51	51
Safran (HYB)	56	48	56	50	50	52
Mercedes (HYB)	49	51	56	45	53	51
Riley (OP)	51	48	49	50	51	50
DKW44-10 (OP)	59	55	50	46	50	52
Mean	54 A	50 AB	53 A	48 B	51 AB	

[†] Values within a set of type, cultivar, or seeding rate means followed by the same upper case letter are not different at $\alpha = 0.05$.
[‡]Values within a set of type or cultivar × seeding rate combinations followed by the same lower case letter are not different at $\alpha = 0.05$.

Table 5. Yield of four canola cultivars planted at five seeding rates in 30-in. rows at three Kansas locations in 2015

Cultivar (TYPE)	Seeding rate (seeds per acre) 100,000		175,000		250,000		325,000		400,000		Mean	
	Bushels per acre											
Manhattan-NT												
HYB	23	a[†]	20	ab	20	ab	22	a	22	ab	22	
OP	23	a	21	ab	23	a	16	b	20	ab	21	
Safran (HYB)	21		20		20		25		21		21	B[‡]
Mercedes (HYB)	26		19		21		20		22		22	B
Riley (OP)	26		23		26		19		27		24	A
DKW44-10 (OP)	20		19		19		13		14		17	C
Mean	23		20		21		19		21			
Hutchinson-NT												
HYB	23		27		21		24		26		24	
OP	24		21		23		23		22		23	
Safran (HYB)	20		28		22		21		27		24	
Mercedes (HYB)	26		26		19		27		24		24	
Riley (OP)	23		21		21		22		23		22	
DKW44-10 (OP)	25		21		24		25		21		23	
Mean	24		24		22		24		24			
Hutchinson-VT												
HYB	37		28		32		32		31		32	
OP	34		35		30		31		33		33	
Safran (HYB)	38		30		34		37		32		34	
Mercedes (HYB)	35		26		30		27		30		30	
Riley (OP)	32		37		34		37		32		34	
DKW44-10 (OP)	35		33		27		25		34		31	
Mean	35		32		31		32		32			

[†]Values within a set of type or cultivar × seeding rate combinations followed by the same lower case letter are not different at $\alpha = 0.05$.
[‡]Values within a set of type, cultivar, or seeding rate means followed by the same upper case letter are not different at $\alpha = 0.05$.

Table 6. Fall stand ratings, winter survival ratings, harvested seed moisture, and yield of four canola cultivars planted at five seeding rates in 9-in. rows at Hutchinson, KS, in 2013

Response parameter	Seeding rate (seeds per acre)			
Cultivar (TYPE)	500,000	750,000	1,000,000	Mean
	------------ Rating[†] ------------			
Fall stand				
DKW44-10 (OP)	8.3	9.0	9.5	8.9
DKW46-15 (OP)	8.3	8.8	9.3	8.8
Mean	8.3 B[‡]	8.9 A	9.4 A	
Winter survival	------------ Percent ------------			
DKW44-10 (OP)	83	93	78	84
DKW46-15 (OP)	78	80	68	75
Mean	80 A	86 AB	73 B	
Harvested seed moisture	------------ Percent ------------			
DKW44-10 (OP)	7.2	7.6	7.3	7.4
DKW46-15 (OP)	7.6	6.6	7.0	7.0
Mean	7.4	7.1	7.1	
Yield	------------ Bushels per acre ------------			
DKW44-10 (OP)	40	38	35	38
DKW46-15 (OP)	35	37	34	35
Mean	37	38	35	

[†] Rated 0 to 9 where 0 = no plants, 9 = full stand, no gaps.
[‡]Values within a set of cultivar, or seeding rate means followed by the same upper case letter are not different at α = 0.06.

Table 7. Fall stand ratings, harvested seed moisture, and yield of four canola cultivars planted at five seeding rates in 9-in. rows at Hutchinson, KS, in 2015

Response parameter	Seeding rate (seeds per acre)					
Cultivar (TYPE)	150,000	225,000	300,000	375,000	450,000	Mean
	Rating†					
Fall stand						
HYB	7.5	7.3	8.2	8.5	8.2	7.9 A‡
OP	6.5	7.4	7.3	7.8	7.8	7.4 B
Hekip (HYB)	8.0	7.7	8.0	8.3	8.3	8.1 A
Mercedes (HYB)	7.0	7.0	8.3	8.7	8.0	7.8 A
Riley (OP)	5.7	7.0	6.3	7.0	7.0	6.6 B
HyCLASS 115W (OP)	7.3	7.9	8.3	8.7	8.7	8.2 A
Mean	7.0 D	7.4 CD	7.8 BC	8.2 A	8.0 AB	
Harvested seed moisture	Percent					
HYB	6.7	6.6	6.5	6.4	6.5	6.5 A
OP	6.2	6.0	5.9	5.7	5.8	5.9 B
Hekip (HYB)	6.5	6.4	6.5	6.4	6.4	6.4
Mercedes (HYB)	6.8	6.8	6.5	6.5	6.6	6.7
Riley (OP)	6.3	6.3	6.0	5.8	6.2	5.8
HyCLASS 115W (OP)	6.0	5.8	5.8	5.7	5.5	6.1
Mean	6.4 A	6.3 AB	6.2 BC	6.1 C	6.2 BC	
Yield	Bushels per acre					
HYB	61 a-c§	57 bc	66 a	63 a-c	60 a-c	61
OP	49 d	56 c	64 ab	61 a-c	62 a-c	58
Hekip (HYB)	58	48	57	54	53	54 B‡
Mercedes (HYB)	64	66	74	71	67	68 A
Riley (OP)	49	54	68	63	66	60 B
HyCLASS 115W (OP)	48	58	60	59	57	56 B
Mean	55 C	56 BC	65 A	62 A	61 AB	

† Rated 0 to 9 where 0 = no plants, 9 = full stand, no gaps.
‡ Values within a set of type or cultivar × seeding rate combinations followed by the same upper case letter are not different at $\alpha = 0.06$.
§ Values within a set of type, cultivar, or seeding rate means followed by the same lower case letter are not different at $\alpha = 0.06$.