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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

| Cultivar (TYPE) | Seeding rate (seeds per acre) | Plants per acre × 1,000 |
|----------------|-------------------------------|-------------------------|
|                | 100,000 | 175,000 | 250,000 | 325,000 | 400,000 | Mean  |
| 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     | 73.2     | 92.3     | 95.5     | 138.0    | ab     | 88.3 B |
| Mercedes (HYB) | 52.4     | 55.9     | 101.8    | 128.8    | 153.5    | a       | 98.5 A |
| Riley (OP)     | 32.6     | 38.0     | 75.1     | 83.9     | 100.6    | de      | 66.0 C |
| DKW44-10 (OP)  | 39.8     | 67.4     | 107.0    | 122.9    | 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     | 101.9 a  | 104.6 a  | 82.0 a-d | 87.3 a-d | 90.2   |
| OP             | 93.6     | 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 α = 0.05.
‡ Values within a set of type or cultivar × seeding rate combinations followed by the same lower case letter are not different at α = 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

| Cultivar (TYPE) | Seeding rate (seeds per acre) | Plants per acre × 1,000 |
|-----------------|-------------------------------|-------------------------|
|                 | 100,000 | 175,000 | 250,000 | 325,000 | 400,000 | Mean |
| 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    | 43.6    | 68.7    | 68.4    | 79.5    | 62.1  AB |
| 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    | 53.3    | 53.3    | 61.7    | 67.7    | 62.1  AB |
| 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    | 62.1  |

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

| Cultivar (TYPE) | Seeding rate (seeds per acre) | 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 α = 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

| Cultivar (TYPE) | Seeding rate (seeds per acre) | Manhattan-NT | Hutchinson-NT | Hutchinson-VT |
|-----------------|-------------------------------|--------------|--------------|---------------|
|                 | 100,000 | 175,000 | 250,000 | 325,000 | 400,000 | Mean | 100,000 | 175,000 | 250,000 | 325,000 | 400,000 | Mean |
|                 |         |         |         |         |         |      |         |         |         |         |         |      |
| Manhattan-NT    |         |         |         |         |         |      |         |         |         |         |         |      |
| HYB             | 43      | 43      | 47      | 47      | 47      | 45   | 48      | 49      | 50      | 45      | 49      | 45   |
| OP              | 42      | 43      | 47      | 45      | 47      | 45   | 48      | 47      | 48      | 45      | 48      | 45   |
| Safran (HYB)    | 43      | 41      | 48      | 48      | 48      | 45   | 50      | 45      | 48      | 48      | 48      | 45   |
| Mercedes (HYB)  | 43      | 44      | 46      | 48      | 48      | 45   | 52      | 46      | 45      | 52      | 45      | 45   |
| Riley (OP)      | 41      | 43      | 46      | 45      | 45      | 44   | 51      | 45      | 45      | 51      | 45      | 44   |
| DKW44-10 (OP)   | 43      | 43      | 48      | 45      | 49      | 45   | 51      | 45      | 42      | 51      | 45      | 45   |
| Mean            | 42      | 43      | 47      | 46      | 47      | 45   | 48      | 48      | 48      | 48      | 48      | 48   |

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

‡ Values within a set of type or cultivar × seeding rate combinations followed by the same lower case letter are not different at α = 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) | Bushels per acre |
|----------------|-------------------------------|-----------------|
|                | 100,000 | 175,000 | 250,000 | 325,000 | 400,000 | Mean |
| 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    |
| Mercedes (HYB) | 26      | 19      | 21      | 20      | 22      | 22    |
| Riley (OP)     | 26      | 23      | 26      | 19      | 27      | 24    |
| DKW44-10 (OP)  | 20      | 19      | 19      | 13      | 14      | 17    |
| 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 α = 0.05.
‡Values within a set of type, cultivar, or seeding rate means followed by the same upper case letter are not different at α = 0.05.
| Response parameter | Cultivar (TYPE) | Seeding rate (seeds per acre) | Fall stand | Winter survival | Harvested seed moisture | Yield |
|--------------------|-----------------|------------------------------|------------|-----------------|------------------------|-------|
|                    | DKW44-10 (OP)   | 500,000                      | 8.3        | 83              | 7.2                    | 40    |
|                    |                 | 750,000                      | 9.0        | 93              | 7.6                    | 38    |
|                    |                 | 1,000,000                    | 9.5        | 78              | 7.3                    | 35    |
|                    | Mean            |                              | 8.9        | 84              | 7.4                    | 38    |
|                    | DKW46-15 (OP)   | 500,000                      | 8.3        | 78              | 7.6                    | 35    |
|                    |                 | 750,000                      | 8.8        | 80              | 6.6                    | 37    |
|                    |                 | 1,000,000                    | 9.3        | 68              | 7.0                    | 34    |
|                    | Mean            |                              | 8.8        | 75              | 7.0                    | 35    |
|                    | Mean            |                              | 8.9        | 86              | 7.1                    | 38    |
|                    | Mean            |                              | 9.4        | 73              | 7.1                    | 35    |

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

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) | Rating† | Harvested seed moisture | Yield                      |
|------------------------------------|-------------------------------|---------|-------------------------|----------------------------|
|                                    | 150,000 225,000 300,000 375,000 450,000 Mean |         | Percent                |Bushels per acre            |
| Cultivar (TYPE)                    |                               |         |                         |                            |
| 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            |                               |         |                         |                            |
| 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                              |                               |         |                         |                            |
| 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 α = 0.06.
§Values within a set of type, cultivar, or seeding rate means followed by the same lower case letter are not different at α = 0.06.