

Canola Oil Yield and Quality as Affected by Production Practices in Virginia*

David E. Starner, Anwar A. Hamama, and Harbans L. Bhardwaj

Rapeseed (*Brassica napus* and *B. rapa* L., Brassicaceae), is now the third most important source of vegetable oil in the world. Canola (CANada Oil-Low Acid, an international registered trademark owned by the Canola Council of Canada) is the name given to a group of rapeseed cultivars that are low in erucic acid (22:1) and low in glucosinolates. Canola oil is considered healthy for human nutrition due to its lowest content of saturated fatty acids among vegetable oils and moderate content of poly-unsaturated fatty acids. The annual demand for canola oil by US consumers has increased from about 45 million kg to over 635 million kg, worth over \$400 million (USCA 1997). The US production of canola increased from virtually zero in 1986 to over 150,000 ha in 1996 but at this level, meets less than 10% of domestic demand.

The two Land Grant Universities in Virginia have attempted to develop canola as an alternate cash crop to substitute for winter wheat. Field research conducted from 1993–1995 in Virginia indicated that canola could yield about 2000 kg/ha which compares well with yield from other US and foreign locations (Starner et al. 1996). The objective of the present studies was to characterize the effects of production practices (nitrogen fertilizer rates, planting dates, and seeding rates) on yield and quality of canola oil in Virginia.

METHODOLOGY

Five canola cultivars (Cascade, Ceres, Cobra, Doublol, and Jetton) were planted in replicated field experiments during 1994–95 crop season to determine the effects of three planting dates (Sept. 13, 28, and Oct. 7) on yield and quality of canola oil. Other experiments evaluated seeding rates (5.4, 3.6, and 1.8 kg seed/ha) and nitrogen application (0, 50, 100, 150, and 200 kg N/ha) with 'Jetton' cultivar. The seeding rate and nitrogen rate experiments were planted on Sept. 28, 1994. All plots were harvested at maturity, approximately during the first week of June, 1995.

Lipids were extracted from 20 g of ground seed three times at room temperature by homogenization with hexane/isopropanol (3:2, v/v) (St. John and Bell 1990). The fatty acid methyl esters (FAME) of the lipid were prepared (Dahmer et al. 1989) and analyzed in a Varian model Vista 6000 Gas Chromatograph equipped with a fused silica capillary column (SP-wax10, 25 m × 0.25 mm i.d.), a flame ionization detector and a Spectra Physics model 4290 integrator. The carrier gas was He at a column flow rate 0.8 ml/min with a split ratio of 1:80. Oven, injector, and detector temperatures were maintained at 210, 240 and 260°C, respectively. Peaks were identified by comparison to retention of FAME standards and quantified by the aid of 17:0 as an internal standard. The data were analyzed using GLM procedure in version 6.11 of SAS (SAS 1996).

EXPERIMENTAL RESULTS

Significant planting date effects existed for seed yield, oil content, oil yield, and the content of 16:1 fatty acid (Table 1) but the interaction between entries and planting dates was, generally, non-significant. The mean oil yield during 1994–95 season was 922 kg/ha (Sept. 13 planting), 799 kg/ha (Sept. 28 planting), and 543 kg/ha (Oct. 7 planting). Delayed planting reduced both seed yield and oil content. The planting date did not effect contents of 14:0, 16:0, 18:0, 20:0, 18:1, 18:2, 18:3, 20:1, and 22:1 fatty acids but planting delay from either Sept. 13 or 28 to Oct. 7 increased the content of 22:0 by almost 3 and 7 times, respectively. The highest content of 16:1 fatty acid (1.05%) was observed from the Sept. 28 planting which was significantly higher than in canola planted on Sept. 13 (0.77%) and Oct. 7 (0.71%). Planting dates did not effect the content of saturated or unsaturated fatty acids. In general, planting date did not affect the quality of canola oil. Our results indicate that canola in the Northern Virginia should be planted from Sept. 13 to 28.

*This research was supported by funds allocated to New Crops Program of Virginia State University by National Canola Research Program (Mid-Western Region) of U.S. Department of Agriculture through University of Southern Illinois, Carbondale.

Table 1. Effects of production practices on canola in Virginia.

| Production practice | Seed yield (kg/ha) | Oil yield (kg/ha) | Oil content (%) | Fatty acid profile (Mol %) | | | | | | |
|----------------------------|--------------------|-------------------|-----------------|----------------------------|-------|------|-------------|------|------|------|
| | | | | Saturated | | | Unsaturated | | | |
| | | | | 14:0 | 16:0 | 18:0 | 16:1 | 18:1 | 18:2 | 18:3 |
| Planting date ^z | | | | | | | | | | |
| Sept. 13 | 2530a | 922a | 35.8a | 0.1 | 4.6 | 0.7 | 0.8b | 51.4 | 32.4 | 9.4 |
| Sept. 28 | 2433a | 799a | 32.8b | 0.1 | 4.5 | 0.8 | 1.1a | 52.0 | 33.0 | 8.2 |
| Oct. 7 | 1651b | 543b | 32.7b | 0.1 | 4.7 | 0.7 | 0.7b | 50.2 | 33.1 | 9.8 |
| Nitrogen rate ^y | | | | | | | | | | |
| 0 | 2448 | 871 | 35.5 | 0.1 | 3.9 | 0.6 | 1.0 | 54.0 | 31.2 | 7.2 |
| 50 | 2673 | 883 | 33.2 | 0.1 | 3.9 | 0.7 | 0.7 | 61.2 | 26.1 | 6.9 |
| 100 | 2516 | 943 | 37.4 | 0.1 | 3.4 | 0.5 | 0.6 | 57.6 | 24.4 | 9.8 |
| 150 | 2202 | 827 | 37.8 | 0.1 | 4.9 | 0.7 | 1.0 | 49.6 | 34.2 | 8.5 |
| 200 | 2259 | 827 | 36.1 | 0.1 | 4.2 | 0.7 | 0.7 | 59.0 | 27.5 | 7.3 |
| Seeding rate ^y | | | | | | | | | | |
| 1.8 | 3031c | 1098c | 36.2 | 0.1 | 5.3b | 0.9 | 0.8a | 56.7 | 27.4 | 7.9 |
| 3.6 | 3436b | 1246b | 36.2 | 0.1 | 6.0a | 0.9 | 0.4b | 53.4 | 30.5 | 8.1 |
| 5.4 | 3823a | 1402a | 36.7 | 0.1 | 5.6ab | 0.9 | 0.6ab | 54.4 | 28.8 | 8.6 |

^zAll means are from Cascade, Ceres, Cobra, Doublol, and Jetton cultivars. The Entry × Planting Date Interaction was non-significant. Mean separation by Duncan's Multiple Range Test, 5% level.

^yAll data from Jetton cultivar planted on Sept. 28. Mean separation by Duncan's Multiple Range Test, 5% level.

The effects of nitrogen rates on canola oil yield and quality were not significant (Table 1) but there was a trend towards increasing seed yield for nitrogen rate up to about 100 kg/ha. We consider the previously established rate of approximately 100 kg N/ha ideal for most Virginia locations.

Seeding rate significantly affected the seed and oil yield but not oil content or fatty acid profile. Oil yield increased from 1098 to 1402 kg/ha when seeding rate increased from 1.8 to 5.4 kg/ha (Table 1). Seeding rate of 5.4 kg/ha resulted in the highest seed yield of 3823 kg/ha. An increase in seeding rate from 1.8 to 3.6 kg/ha resulted in higher contents of 16:0 fatty acid.

CONCLUSIONS

Canola oil quality was, generally, unaffected by production practices investigated. The contents of saturated fatty acids in the oil of Virginia-grown canola varied from 4.0% to 7.0% indicating that the quality of oil from canola produced in Virginia is comparable to that from other locations. The mean saturated fatty acid in oil from canola produced in Virginia (5.5%) was in fact lower than the mean content of 7.1% reported in the United States (USDA 1998). In spite of these positive results, and our experience indicating profitability of canola in Virginia, locally available crushing facilities are needed before canola can be commercially grown in Virginia. Small crushers, capable of crushing canola produced on a few hundred hectares, offer an opportunity in this situation. The recent low market prices of winter wheat have encouraged Virginia farmers to look for alternative winter crops such as canola.

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