Evolve Roundup Ready® high erucic acid, low glucosinolate hybrid summer rape
R.W. Duncan, P.B.E. McVetty, J.A. Nugent-Rigby, W.G.D. Fernando, and G. Li

Abstract: Evolve is the world’s first ogu INRA (Institut national de la recherche agronomique) CMS (cytoplasmic male sterility) hybrid summer rape (Brassica napus L.) Roundup Ready® high erucic acid, low glucosinolate cultivar. On average, Evolve yielded 12.4% more seed, 6 g kg⁻¹ more seed oil, and 5 g kg⁻¹ less meal protein than Red River 1861, an open-pollinated Roundup Ready® high erucic acid, low glucosinolate summer rape. Evolve has an erucic acid content of 52.3% in isolated field trials of high erucic acid rapeseed genotypes and is adapted to the southern B. napus growing regions of western Canada.

Key words: ogu INRA CMS, hybrid, rape, Roundup Ready® high erucic acid, HEAR, low glucosinolate, cultivar description.

Introduction

Tested as 13OH76 in the Western Canada Canola/Rapeseed Recommending Committee (WCC/RRC) Contract Registration Tests in 2016 and 2017, Evolve is the world’s first ogu INRA (Institut national de la recherche agronomique) CMS (cytoplasmic male sterility) hybrid Roundup Ready® summer rape (Brassica napus L.) cultivar having a high content of erucic acid in the seed oil (52.3%) and low content of glucosinolates in the seed meal (8.3 μmol total glucosinolates g⁻¹ seed at 8.5% H₂O). On average, Evolve yielded 12.4% more seed, 6 g kg⁻¹ more seed oil, and 5 g kg⁻¹ less meal protein than the open-pollinated Roundup Ready®, high erucic acid, low glucosinolate summer rape cultivar Red River 1861, the high euric acid rapeseed (HEAR) check designated by the WCC/RRC Evolve was issued a Certificate of Restricted Registration No. 8433 on 23 Feb. 2018 by the Variety Registration Office, Plant Products Division of the Canadian Food Inspection Agency, Ottawa, ON. The terms of the restricted registration state that the registrant of Evolve (i.e., Bunge Canada) shall implement and maintain a quality control system as reviewed and approved by the registrar.

Pedigree and Breeding Methods

Evolve (13OH76) Roundup Ready® HEAR hybrid cultivar was developed using the ogu INRA CMS system to develop female and male parent lines. The pedigree of Evolve is RA13018/11DH137. The female parent RA13018 has the pedigree UM11-03/5*RRHR8706. RA13018 is a male-sterile genotype (A-line in the ogu INRA CMS pollination control system) of B. napus summer rape with...
Table 1. Seed yield, days to flowering, days to maturity, height, lodging, seed oil content, meal protein content, erucic acid content, and total glucosinolate content of summer rape (*Brassica napus* L.) cultivars Evolve (Hybrid 13OH76) and Red River 1861 (open-pollinated) in the Western Canada Canola/Rapeseed Recommending Committee Contract Registration Tests 2016–2017.

| Cultivar               | Seed yield (kg ha\(^{-1}\)) | Long-season zone\(^a\) | Mid-season zone\(^b\) | Days to flowering | Days to maturity | Height (cm) | Lodging\(^c\) | Seed oil\(^d\) (g kg\(^{-1}\)) | Meal protein\(^e\) (g kg\(^{-1}\)) | Erucic acid\(^f\) (%) | Total glucosinolates\(^g\) (μmol g\(^{-1}\)) | Blackleg disease severity\(^h\) (0–5) | Fusarium wilt class\(^i\) |
|------------------------|-----------------------------|------------------------|-----------------------|-------------------|------------------|-------------|---------------|-------------------------------|-------------------------------|-------------------|---------------------------------|------------------|---------------------|
| Evolve (13OH76)        | 2494                        | 3172                   | 2901                  | 48                | 94               | 105         | 1.9           | 507                           | 476                           | 52.3               | 8.3                             | 1.3              | R                   |
| Red River 1861         | 2220                        | 2821                   | 2581                  | 48                | 94               | 101         | 2.4           | 501                           | 481                           | 52.7               | 7.7                             | 1.4              | R                   |
| LSD (0.05)\(^j\)      | 167                         | 155                    | 110                   | 0.7               | 0.5              | 6.6         | 0.2           | 2.9                           | 5.8                           | 0.3                | 0.8                             | —                | —                   |
| Tests (2016 + 2017)    | 8                           | 12                     | 20                    | 7                 | 17               | 6           | 16           | 18                            | 18                            | 18                 | 18                              | 3                | 2                   |

\(^a\)Tests grown at Carman, MB (2016–2017); Holland, MB (2016–2017); Rosebank, MB (2016–2017); and Thornhill, MB (2016–2017).

\(^b\)Tests grown at Killam, AB (2016); Lake Lenore, SK (2017); Marquis, SK (2017); North Battleford, SK (2016); Pense, SK (2016); Rosetown, SK (2016–2017); Saint Albert, AB (2016–2017); Vanscoy, SK (2017); Watrous, SK (2017); and Yellow Grass, SK (2016).

\(^c\)1 = erect, 5 = prostrate.

\(^d\)Oil content (whole-seed zero-moisture basis), by near infrared measurements.

\(^e\)Protein content (nitrogen × 6.25 in oil-free meal, zero-moisture basis), by near infrared measurements.

\(^f\)Erucic acid (% of total fatty acids in seed oil), by gas chromatography, from seed grown in isolated fields of high euric acid rapeseed materials.

\(^g\)Total glucosinolates (whole seed, 8.5% moisture basis), by near infrared measurements.

\(^h\)Tests grown at Carman (2016–2017) and North Battleford (2017). Westar mean 3.7 in these trials.

\(^i\)Tests grown at Star City (2016–2017); R, resistant.

\(^j\)LSD derived from cultivar-by-test interaction mean square.
high erucic acid in the oil, developed through five backcrosses initiated in 2011 and completed in 2012. UM11-03 is a canola quality summer rape (B. napus) line tolerant to glyphosate (transformation event RT73) that is the donor for ogu INRA CMS. Line RRHR8706 is a high erucic acid B. napus oilseed summer rape genotype tolerant to glyphosate (transformation event RT73). The male-sterile F₁ was used as the female and backcrossed five times (BC₅F₁) to RRHR8706 to produce RA13018. The presence and purity of the gene for glyphosate tolerance was monitored in all parents and every generation by spraying and marker testing, and the purity of the transformation event RT73 was also tested and confirmed in the Breeder/Certified Seed. The male parent restorer (R), 11DH137 has the pedigree UM10-06/RRHR6818. 11DH137 was developed from a cross made in 2010 between two lines carrying the gene for tolerance to glyphosate herbicide. (transformation event RT73), UM10-06 and RRHR6818. UM10-06 is a canola quality summer rape (B. napus) line and RRHR6818 is a high erucic acid, low glucosinolate (B. napus) line. F₁ donor plants were grown in 2010 and microspores were subjected to a standard doubled haploid protocol. Seed from DH₂ plants was harvested in 2011 and selection was based on Rfo (fertility restoration gene in the ogu INRA CMS pollination control system), glyphosate tolerance, and high erucic acid content. The DH₁ was selected for the following traits: Rfo, glyphosate tolerance, erucic acid content, phenotype, oil, protein and glucosinolate content. The presence of the gene for glyphosate tolerance was monitored in every generation by spraying, and the purity of the transformation event RT73 was tested and confirmed in the Breeder/Certified Seed.

Hybrid seed for 13OH76 was made in the field in tents in Manitoba in 2013 and in the field in tents at counter-season nurseries in Chile in subsequent years. 13OH76 was evaluated in preliminary yield trials in 2014 for agronomic performance and seed quality. 13OH76 was evaluated in advanced yield trials in 2015 for agronomic performance, seed quality, and resistance to blackleg [Leptosphaeria maculans (Desm.) Ces. & de Not. (anamorph Phoma lingam (Tode ex Fr.) Desm.] and fusarium wilt caused by Fusarium oxysporum f. sp. conglutinans (Wollenweb.) W.C. Snyder & H.N. Hans.]. 13OH76 was advanced to the 2016 and 2017 HEAR Recommending Committee Contract Registration Tests based on its superior agronomic performance, seed quality, and blackleg and fusarium wilt resistance.

Performance

Evolve was evaluated in 2016 and 2017 in the mid- and long-season zones of the WCC/RRC HEAR Contract Registration Tests. It surpassed Red River 1861 in yield in both zones and had an average yield advantage of 12.4% (Table 1). Evolve matured in 94 d, identical to Red River 1861. Evolve had a lower lodging score (1.9) compared with Red River 1861 (2.4). Evolve had an average seed oil content of 507 g kg⁻¹, 6 g kg⁻¹ higher than Red River 1861, and an average meal protein content of 476 g kg⁻¹, 5 g kg⁻¹ lower than Red River 1861. The erucic acid content of Evolve seed averaged 52.3% of the total fatty acids in the seed oil, 0.4% lower than the erucic acid content of Red River 1861 seed produced in 18 high erucic acid rapeseed contract registration trials. The average total glucosinolate content of Evolve whole seed on an 8.5% moisture basis over the 2 yr of official trials was 8.3 μmol g⁻¹ seed, higher than that for Red River 1861 (7.7 μmol g⁻¹ seed).

Other Characteristics

Evolve was evaluated in disease resistance evaluations conducted in 2016 and 2017. Based on the results from these tests, Evolve was classified as moderately resistant to blackleg disease and resistant to fusarium wilt disease (Table 1).

Maintenance and Distribution of Pedigreed Seed

Breeder seed of RA13018 (ogu INRA CMS A-line parent) and 11DH137 (ogu INRA CMS R-line parent) is maintained by Nutrien Ag. Solutions Canada Inc., PO Box 5234, High River, AB T1V 1M4, Canada. Evolve hybrid Certified Seed is also produced by Nutrien Ag. Solutions Canada Inc. Evolve Certified Seed has at least 90% fertile F₁ hybrid seed. Certified Seed of Evolve also has a minimum of 85% of the plants resistant to glyphosate herbicide. Certified Seed of Evolve is retailed by Nutrien Ag. Solutions Canada Inc. under contract to Bunge, Bag #1, Nipawin, SK S0E 1E0, Canada.

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