# LIVING MODIFIED ORGANISM (LMO)

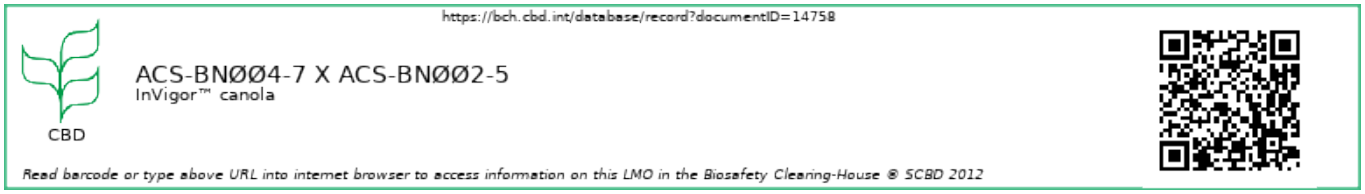
BCH-LMO-SCBD-14758-7

? Decisions on the LMO ? Risk Assessments

LAST UPDATED: 23 JUL 2013

## Living Modified Organism identity

The image below identifies the LMO through its unique identifier, trade name and a link to this page of the BCH. Click on it to download a larger image on your computer. For help on how to use it go to the LMO quick-links page.




Name

InVigor™ canola | EN

Transformation event

PGS2 (MS1 x RF2) (B91-4 x B94-2)

Unique identifier

ACS-BNØØ4-7 x ACS-BNØØ2-5

Developer(s)

- ORGANIZATION: BAYER CROPSCIENCE | BCH-CON-SCBD-7088-7

**ORGANIZATION**

Bayer CropScience
Website: http://www.bayercropscience.com

Description

The stacked canola lineACS-BNØØ4-7 x ACS-BNØØ2-5 was obtained through the conventional cross breeding of each of the parental organisms. This results in a line with male-sterility, fertility restoration, pollination control system displaying glufosinate herbicide tolerance | EN

Recipient Organism or Parental Organisms

The term “Recipient organism” refers to an organism (either already modified or non-modified) that was subjected to genetic modification, whereas “Parental organisms” refers to those that were involved in cross breeding or cell fusion.

BCH-ORGA-SCBD-9845-4 ORGANISM | BRASSICA RAPA (CANOLA PLANT)

Crops

BCH-LMO-SCBD-14756-5 LIVING MODIFIED ORGANISM | ACS-BNØØ4-7 - INVIGOR™ CANOLA |
Changes in physiology and/or production - Reproduction - Male sterility Resistance to antibiotics - Kanamycin Resistance to herbicides - Glufosinate

BCH-LMO-SCBD-14754-5 LIVING MODIFIED ORGANISM | ACS-BNØØ2-5 - INVIGOR™ CANOLA |
Changes in physiology and/or production - Fertility restoration Resistance to antibiotics - Kanamycin Resistance to herbicides - Glufosinate

Related LMO(s)

BCH-LMO-SCBD-14757-7 | ACS-BNØØ4-7 x ACS-BNØØ1-4 - InVigor™ canola | Changes in physiology and/or production - Reproduction - Male sterility Resistance to antibiotics - Kanamycin Resistance to herbicides - Glufosinate
Show detection method(s)

BCH-LMO-SCBD-101077-7 | ACS-BNØØ4-7 x ACS-BNØØ3-6 - InVigor™ canola | Bayer CropScience (Aventis CropScience (AgrEvo)) | Changes in physiology and/or production (Reproduction, Male sterility), Resistance to antibiotics (Kanamycin), Resistance to herbicides (Glufosinate)
Show detection method(s)

## Characteristics of the modification process

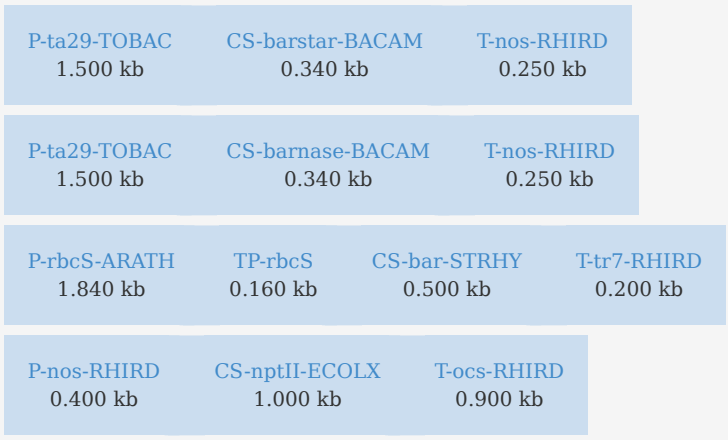
Vector

pTVE743RE and pTTM8RE EN

Techniques used for the modification

Cross breeding

Genetic elements construct




Introduced or modified genetic element(s)
Some of these genetic elements may be present as fragments or truncated forms. Please see notes below, where applicable.

BCH-GENE-SCBD-14972-12 PHOSPHINOTHRICIN N-ACETYLTRANSFERASE GENE |
Protein coding sequence | Resistance to herbicides (Glufosinate)

BCH-GENE-SCBD-14973-6 BARNASE |

Protein coding sequence | Changes in physiology and/or production (Reproduction, Male sterility)

BCH-GENE-SCBD-14974-7 BARSTAR

Protein coding sequence | Changes in physiology and/or production (Fertility restoration)

BCH-GENE-SCBD-15001-5 NEOMYCIN PHOSPHOTRANSFERASE II | (BACTERIA)

Protein coding sequence | Resistance to antibiotics (Kanamycin)

BCH-GENE-SCBD-101407-6 PTA29 POLLEN SPECIFIC PROMOTER | (TOBACCO PLANT)

Promoter

BCH-GENE-SCBD-100269-8 NOPALINE SYNTHASE GENE TERMINATOR

Terminator

BCH-GENE-SCBD-103851-5 RBCS PROMOTER | (THALE CRESS)

Promoter

BCH-GENE-SCBD-101902-4 RBCS TRANSIT PEPTIDE | (THALE CRESS)

Transit signal

BCH-GENE-SCBD-103067-9 TRANSCRIPT 7 GENE 3' UNTRANSLATED REGION

Terminator

BCH-GENE-SCBD-100270-6 NOPALINE SYNTHASE GENE PROMOTER

Promoter

BCH-GENE-SCBD-100271-5 OCTOPINE SYNTHASE GENE TERMINATOR

Terminator

Notes regarding the genetic elements present in this LMO

| | |
|---|---|
| **DNA insert from ACS-BNØØ4-7 vector pTTM8RE**<br>ACS-BNØØ4-7 is a male-sterile canola line that cannot produce viable pollen due to the presence of the barnase gene. The line also contributes a copy of the bar gene which confers tolerance to the herbicide glufosinate.<br><br>**DNA insert from ACS-BNØØ2-5 vector pTVE743RE**<br>ACS-BNØØ2-5 is a fertility restorer canola line that inhibits the action of the barnase ribonuclease through the expression of the barstar gene. The line also contributes a copy of the bar gene which confers tolerance to the herbicide glufosinate.<br><br>For additional information on this LMO, please refer to the records of the parental LMOs. | EN |

## LMO characteristics

Modified traits

- Resistance to herbicides
  - Glufosinate
- Resistance to antibiotics
  - Kanamycin
- Changes in physiology and/or production
  - Reproduction
    - Male sterility
    - Fertility restoration

Common use(s) of the LMO

Food
Feed

## Detection method(s)

External link(s)

? Event-specific Method for the Quantification of Oilseed Rape RF2 Using Real-time PCR *( English )*

? Event-specific Method for the Quantification of Oilseed Rape MS1 using Real-time PCR *( English )*

## Additional Information

Additional Information

The canola lines MS1 and RF2 were developed using genetic engineering techniques to provide a pollination control system for the production of hybrid oilseed rape (MS1xRF2) expressing male sterility and tolerance to glufosinate ammonium. The novel hybridization system involves the use of two parental lines, a male sterile line MS1 and a fertility restorer line RF2. The transgenic MS1 plants do not produce viable pollen grains and cannot self-pollinate. In order to completely restore fertility in the hybrid progeny, line MS1 must be pollinated by a modified plant containing a fertility restorer gene, such as line RF2. The resultant F1 hybrid seed, derived from the cross between MS1 x RF2, generates hybrid plants that produce pollen and are completely fertile.

The male-sterile trait was introduced in MS1 by inserting the barnase gene, isolated from Bacillus amyloliquefaciens, a common soil bacterium that is frequently used as a source for industrial enzymes. The barnase gene encodes for a ribonuclease enzyme (RNAse) that is expressed only in the tapetum cells of the pollen sac during anther development. The RNAse affects RNA production, disrupting normal cell functioning and arresting early anther development, thus leading to male sterility.

The transgenic line RF2 was produced by genetically engineering plants to restore fertility in the hybrid line. Transgenic RF2 plants contain the barstar gene, also isolated from Bacillus amyloliquefaciens. The barstar gene codes for a ribonuclease inhibitor (barstar enzyme) expressed only in the tapetum cells of the pollen sac during anther development. The ribonuclease inhibitor (barstar enzyme) specifically inhibits barnase RNAse expressed by the MS1 line. Together, the RNAse and the ribonuclease inhibitor form a very stable one-to-one complex, in which the RNAse is inactivated. As a result, when pollen from the restorer line RF2 is crossed to the male sterile line MS1, the resultant progeny express the RNAse inhibitor in the tapetum cells of the anthers, allowing hybrid plants to develop normal anthers and restoring fertility.

Both transgenic lines MS1 and RF2 were also engineered to express tolerance to glufosinate ammonium, the active ingredient in phosphinothricin herbicides (Basta®, Rely®, Finale®, and Liberty®). Glufosinate chemically resembles the amino acid glutamate and acts to inhibit an enzyme, called glutamine synthetase, which is involved in the synthesis of glutamine. Essentially, glufosinate acts enough like glutamate, the molecule used by glutamine synthetase to make glutamine, that it blocks the enzyme's usual activity. Glutamine synthetase is also involved in ammonia detoxification. The action of glufosinate results in reduced glutamine levels and a corresponding increase in concentrations of ammonia in plant tissues, leading to cell membrane

disruption and cessation of photosynthesis resulting in plant withering and death.

Glufosinate tolerance in these canola lines was the result of introducing a gene encoding the enzyme phosphinothricin-N-acetyltransferase (PAT) isolated from the common aerobic soil actinomycete, Streptomyces hygroscopicus. The PAT enzyme catalyzes the acetylation of phosphinothricin, detoxifying it into an inactive compound. The PAT enzyme is not known to have any toxic properties.

This line is a product of traditional plant breeding, and therefore is not automatically subject to regulation in all jurisdictions as are transgenic plants resulting from recombinant DNA technologies. Certain jurisdictions may request notification in advance of the release of a stacked hybrid, or may request information to conduct an environmental and food safety assessment.

Other relevant website addresses and/or attached documents

? ACS-BNØØ4-7 x ACS-BNØØ2-5 - OECD *( English )*

? ACS-BNØØ4-7 x ACS-BNØØ2-5 - CERA *( English )*

? MS1_RF1_RF2 - Aventis.pdf *( English )*

? ACS-BNØØ4-7×ACS-BNØØ1-4 - ANZFA.pdf *( English )*

? ACS-BNØØ4-7×ACS-BNØØ1-4 - Japan.pdf *( English )*

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## Further Information

Questions about the Cartagena Protocol on Biosafety or the operation of the Biosafety Clearing-House may be directed to the Secretariat of the Convention on Biological Diversity.

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