

## Biosafety Clearing-House (BCH)

LIVING MODIFIED ORGANISM (LMO)


BCH-LMO-SCBD-115140-1

[? Decisions on the LMO ? Risk Assessments](#)

LAST UPDATED: 23 AUG 2019


### 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.



https://bch.cbd.int/database/record?documentID=115140

Viral resistant cassava with increased levels of zinc and iron



Read barcode or type above URL into internet browser to access information on this LMO in the Biosafety Clearing-House © SCBD 2012

Name

Viral resistant cassava with increased levels of zinc and iron

EN

Transformation event

D9001-914004

Developer(s)

- [ORGANIZATION](#): NATIONAL ROOT CROPS RESEARCH INSTITUTE | [BCH-CON-SCBD-115138-1](#)

#### ORGANIZATION

National Root Crops Research Institute

Academic or research institute

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Website: <https://nrcri.gov.ng/>

Description

Cassava (*Manihot esculenta* Crantz) was modified to express *Arabidopsis thaliana* FERRITIN 1 and IRON-REGULATED TRANSPORTER 1 to increase the levels of iron and zinc. The modified cassava additionally contains an RNAi cassette to target the coat proteins of Cassava Brown Streak Virus and Ugandan Cassava Brown Streak Virus and convey resistance to these viruses, the causal agents of Cassava brown streak disease.

EN

Previous overexpression of FER1 and IRT1 increased iron and zinc levels by 7-18 times 3-10 times, respectively.

A selectable marker, *Escherichia coli* neomycin phosphotransferase II, was also included for selection of transformants using kanamycin.

#### 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-112539-1](#) ORGANISM | MANIHOT ESCULENTA (CASSAVA, BRAZILIAN ARROWROOT, YUCA, MANIOC, MANDIOCA, MANES) |  
Crops

#### Point of collection or acquisition of the recipient organism or parental organisms

Cassava cultivar: TMS 91/02324

EN

#### Related LMO(s)

[BCH-LMO-SCBD-115144-1](#) | Viral resistant cassava with increased levels of zinc and iron | Dr Ihuoma Okwuonu | Changes in quality and/or metabolite content, Increased iron levels, Increased zinc levels, Resistance to antibiotics (Kanamycin), Resistance to CBSV, Resistance to diseases and pests (Viruses), Resistance to UCBSV, Selectable marker genes and reporter genes

[BCH-LMO-SCBD-115141-1](#) | Cassava modified for increased levels of iron and zinc | National Root Crops Research Institute(NRCRI) | Changes in quality and/or metabolite content, Increased levels of iron, Increased levels of zinc, Resistance to antibiotics (Kanamycin), Selectable marker genes and reporter genes

[BCH-LMO-SCBD-115143-1](#) | Cassava brown streak disease-resistant cassava | National Root Crops Research Institute(NRCRI) | Resistance to antibiotics (Kanamycin), Resistance to CBSV, Resistance to diseases and pests (Viruses), Resistance to UCBSV, Selectable marker genes and reporter genes

[BCH-LMO-SCBD-115142-1](#) | Cassava modified for increased levels of iron and zinc | National Root Crops Research Institute(NRCRI) | Changes in quality and/or metabolite content, Increased levels of iron, Increased levels of zinc, Resistance to antibiotics (Kanamycin), Selectable marker genes and reporter genes

### Characteristics of the modification process

#### Vector

p9001

EN

#### Techniques used for the modification

Agrobacterium-mediated DNA transfer

#### Genetic elements construct

T-nos-RHIR	CBS	UCBS	I-pdk	UCBSV-CP	CBSV-CP	P-35S-CaMV
0.270 kb	0.89	0.89	0.780	0.899 kb	0.897 kb	0.520 kb

T-AtPP2-A1 0.600 kb	IF 1.0%	P-AtPP2-A14 2.760 kb
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Patatin UT 0.430 kb	AtF 0.7%	P-B33 1.040 kb
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T-nos-RHIR 0.250 kb	CS-nptII-EC 0.800 kb	P-e35S-CaMV 0.390 kb
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P-e35S-CaMV 0.390 kb
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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-101900-5** CSVMV PROMOTER |

Promoter

**BCH-GENE-SCBD-115108-1** COAT PROTEIN | CASSAVA BROWN STREAK VIRUS (CASSAVA BROWN STREAK VIRUS, CBSV) |

Double-stranded RNA

**BCH-GENE-SCBD-115110-1** COAT PROTEIN | UGANDAN CASSAVA BROWN STREAK VIRUS (UGANDAN CASSAVA BROWN STREAK VIRUS, UCBSV) |

Double-stranded RNA

**BCH-GENE-SCBD-103123-5** PYRUVATE ORTHOPHOSPHATE DIKINASE, INTRON 3 | (CLUSTERED YELLOWTOPS, SPEEDYWEED, FLAVERIA, YELLOW TWINSTEM) |

Intron

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

Terminator

**BCH-GENE-SCBD-115111-1** PHLOEM PROTEIN 2-A14 PROMOTER | (THALE CRESS) |

Promoter

**BCH-GENE-SCBD-115112-1** IRON-REGULATED TRANSPORTER 1 | (THALE CRESS) |

Protein coding sequence | Changes in quality and/or metabolite content, Increased levels of iron

**BCH-GENE-SCBD-115113-1** PHLOEM PROTEIN 2-A14 3' UNTRANSLATED REGION | (THALE CRESS) |

Terminator

**BCH-GENE-SCBD-100273-4** B33 GENE PROMOTOR | (POTATO) |

Promoter

**BCH-GENE-SCBD-115136-1** FERRITIN 1 | (THALE CRESS) |

Protein coding sequence | Changes in quality and/or metabolite content, Increased levels of iron, Tolerance to abiotic stress, Tolerance to excess iron

**BCH-GENE-SCBD-115137-1** PATATIN-1 3' UNTRANSLATED REGION | (POTATO) |

Terminator

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

Protein coding sequence | Resistance to antibiotics (Kanamycin)

**BCH-GENE-SCBD-100366-6** CAMV ENHANCED 35S PROMOTER |

Promoter

Notes regarding the genetic elements present in this LMO

**RNA interference cassette:**

Transcription of the cassette produces a hairpin RNA (hpRNA). RNA polymerase is recruited to the Cassava vein mosaic virus promoter and then transcribes: two segments of Cassava Brown Streak Virus (CBSV) and the Ugandan Cassava Brown Streak Virus (UCBSV) coat protein (sense orientation), the *Flaveria trinervia* pyruvate orthophosphate dikinase intron 3 (PDK), and CBSV and UCBSV coat protein (anti-sense orientation). Transcription stops at the *Agrobacterium tumefaciens* nopaline synthase (*nos*) terminator. The produced RNA then can form a double stranded segment due to the interstrand homology between the CBSV and UCBSV coat protein segments and the flexible linker/loop, PDK. The double stranded segment of the hpRNA is sufficient to trigger an RNA interference (RNAi) response. The host cell machinery then processes the hpRNA into small interfering RNA, which is used to guide the targeted degradation of RNA molecules with sequence homology. In this case, infecting viral transcripts are degraded by the host cell.

**Iron-regulated transporter cassette:**

Transcription of the *Arabidopsis thaliana* iron-regulated transporter 1 is under control of the *A. thaliana* phloem protein 2-A14 promoter and terminator.

**Ferritin-1 cassette:**

*Arabidopsis thaliana* ferritin-1 is under transcriptional control of the *Solanum tuberosum* patatin-1 promoter and terminator.

**Selectable marker cassette:**

Transcription of the *Escherichia coli* neomycin phosphotransferase II occurs from the duplicated enhanced Cauliflower Mosaic Virus 35S promoter and terminates at the *nos* terminator.

*Please note all genetic elements were in the anti-sense orientation.*

**LMO characteristics**

## Modified traits

Resistance to diseases and pests

Viruses

Resistance to antibiotics

Kanamycin

Changes in quality and/or metabolite content

Selectable marker genes and reporter genes

Other

Increased iron levels

Increased zinc levels

Resistance to CBSV

Resistance to UCBSV

## How the expression of the gene(s) was affected

The hpRNA cassette containing the coat proteins of CBSV and UCBSV is expected to be processed into small interfering RNA between 21-24 nucleotides in length. Due to this

processing, proteins are not expected to be produced from this transcript.

Common use(s) of the LMO

Food  
Research

## Additional Information

Additional Information

Please note:

Transformation event is a placeholder. The following transformation events are expected to have similar genetics: D9001-914004, D9001-914005, D9001-914006, D9001-914010, D9001-914012, D9001-914017, D9001-914018, D9001-914019, D9001-914022, D9001-914023, D9001-914026, D9001-914028 and D9001-914029.

This field will be updated as more information is provided and once an event has been chosen for commercialization.

Other relevant website addresses and/or attached documents

? [Biofortification of field-grown cassava.pdf](#) ( *English* )

? [Virus-Derived Stacked RNAi Construct Confers Robust Resistance to Cassava Brown Streak Disease.pdf](#) ( *English* )

[BCH-LMO-SCBD-115140-1](#)

## 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.

**Secretariat of the Convention  
on Biological Diversity**

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