



PotatoPlus: Precision Breeding for durable disease resistance

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BioPotatoes

The Sainsbury Laboratory
TSL

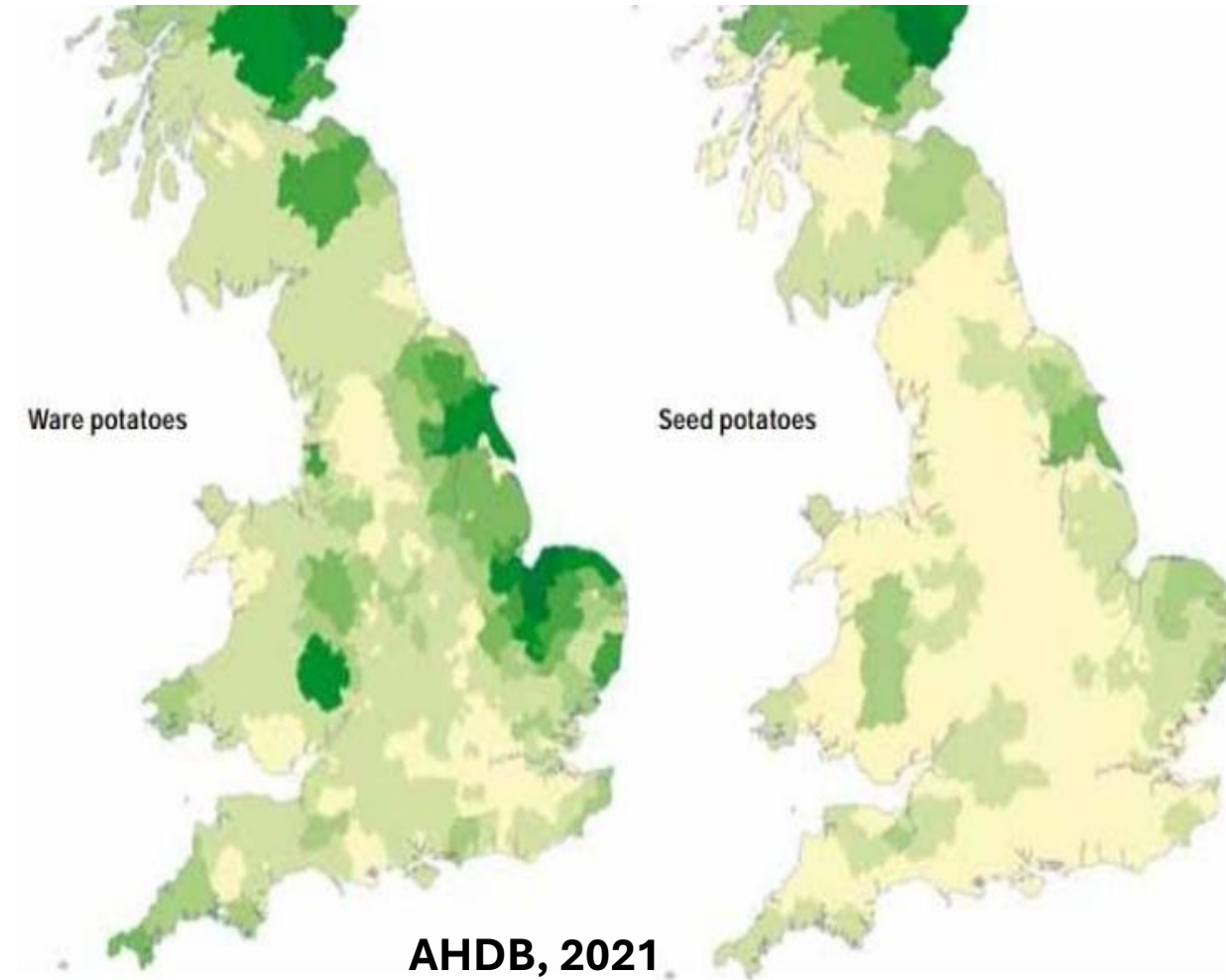


biopotatoes.com

Phytophthora infestans, the plant and livelihood destroyer



UK seed potato production: threatened by viruses, relies on geography and insecticides



Crop protection is increasingly difficult

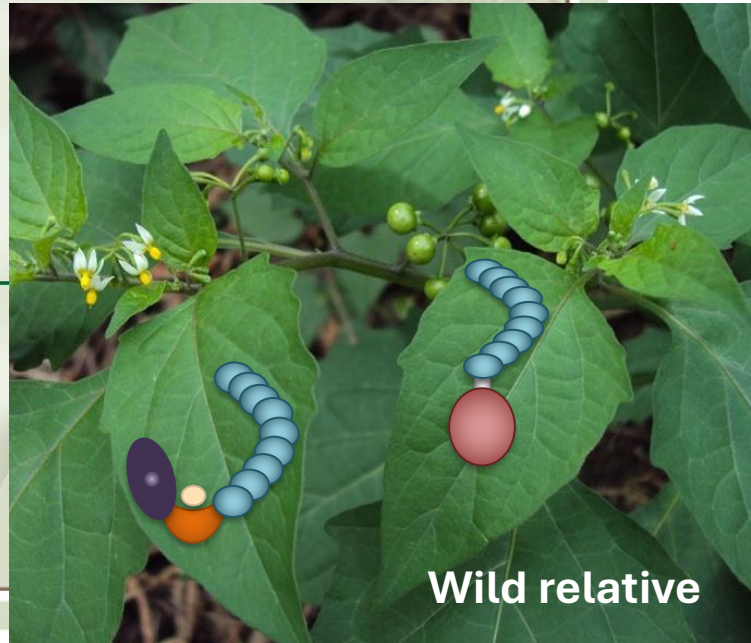
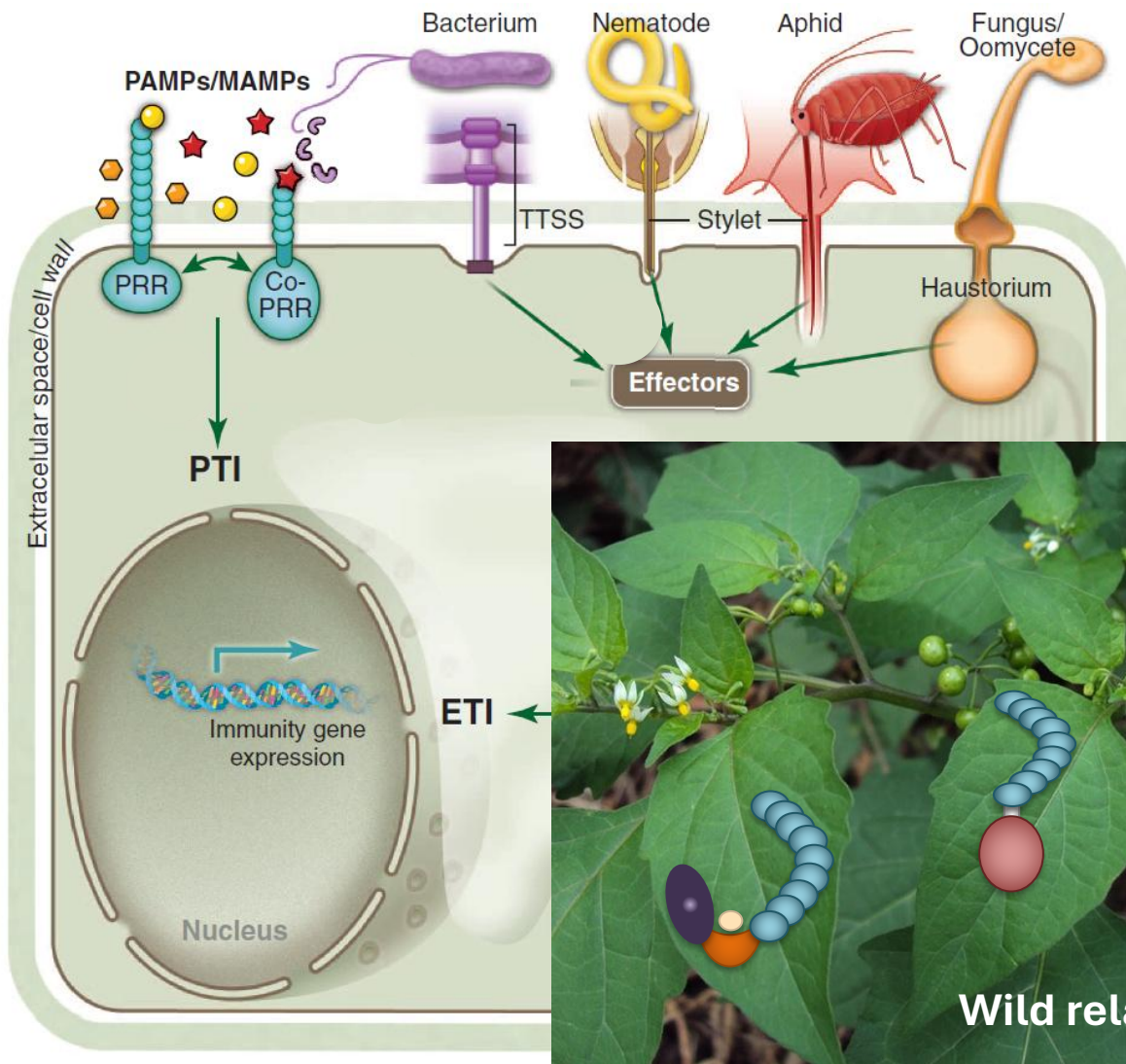


Loss of agrochemicals
Fungicide resistance
Health and environmental concerns

Natural diversity of wild relatives: a vast resource for crop improvement

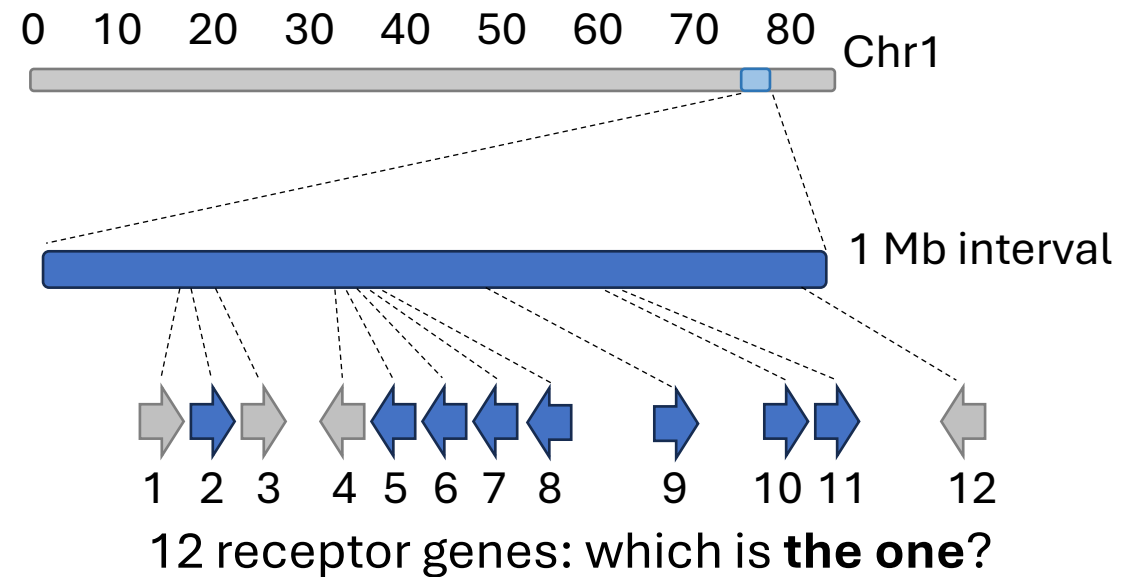
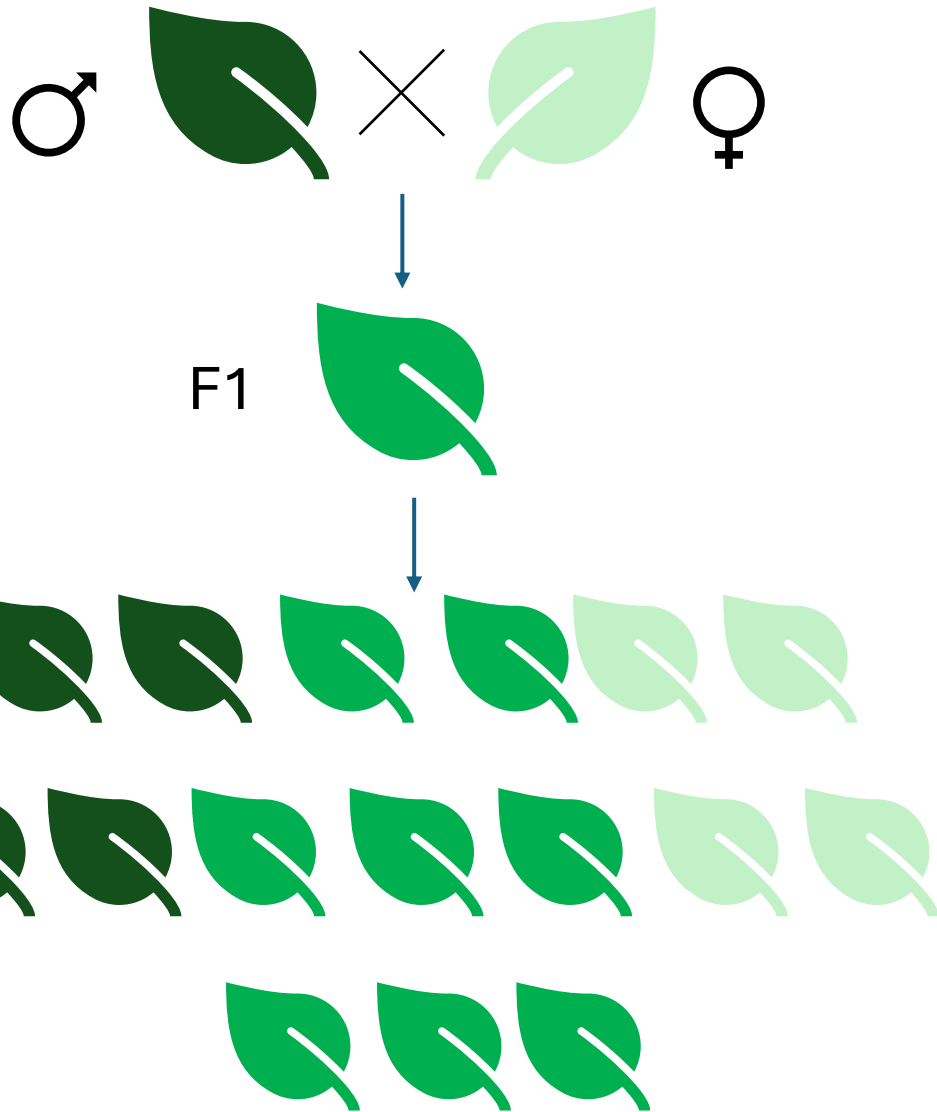


Plant immune system: resistance requires recognition

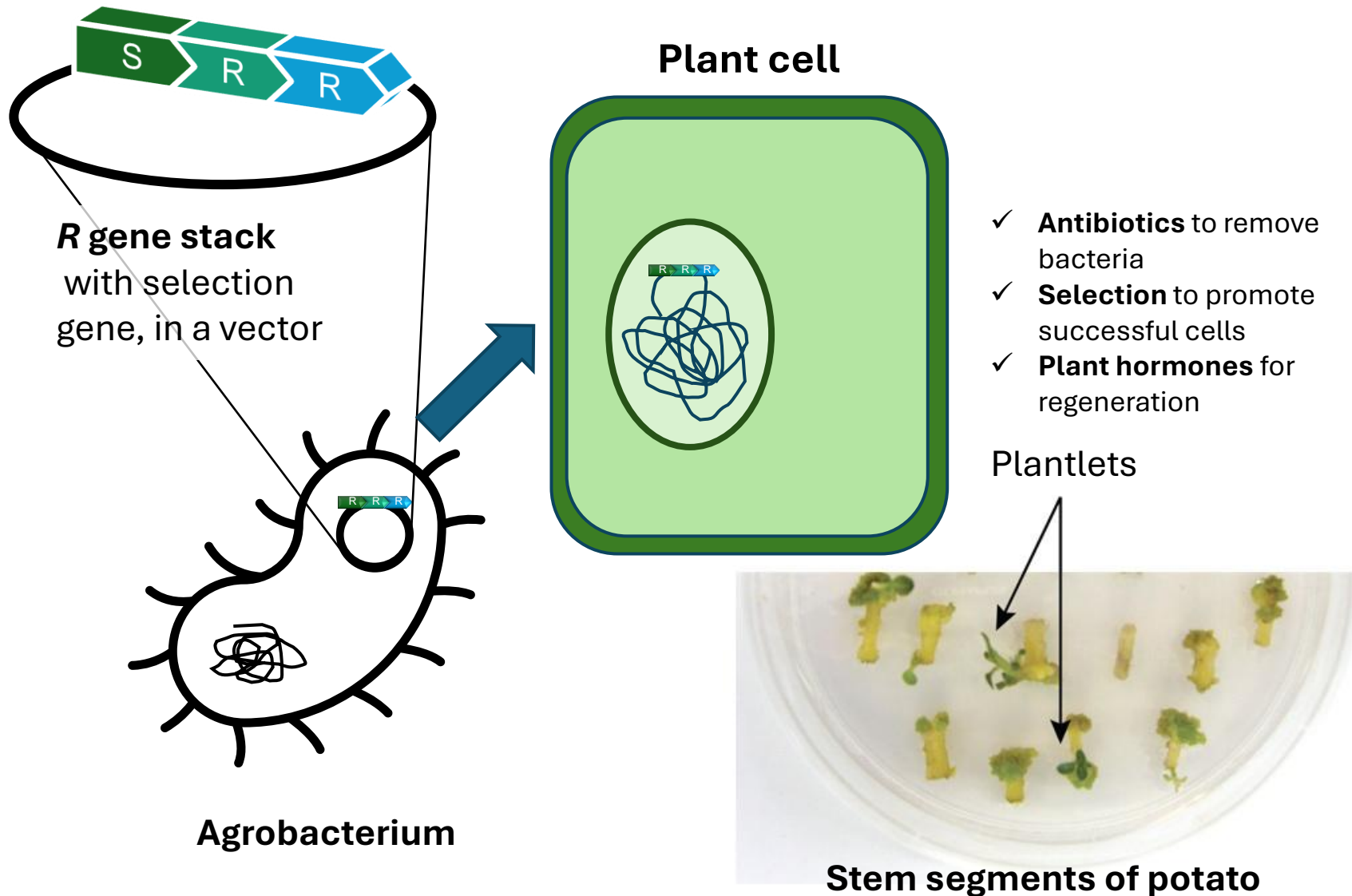


Adapted from Dangl et al. 2013

Resistance gene identification

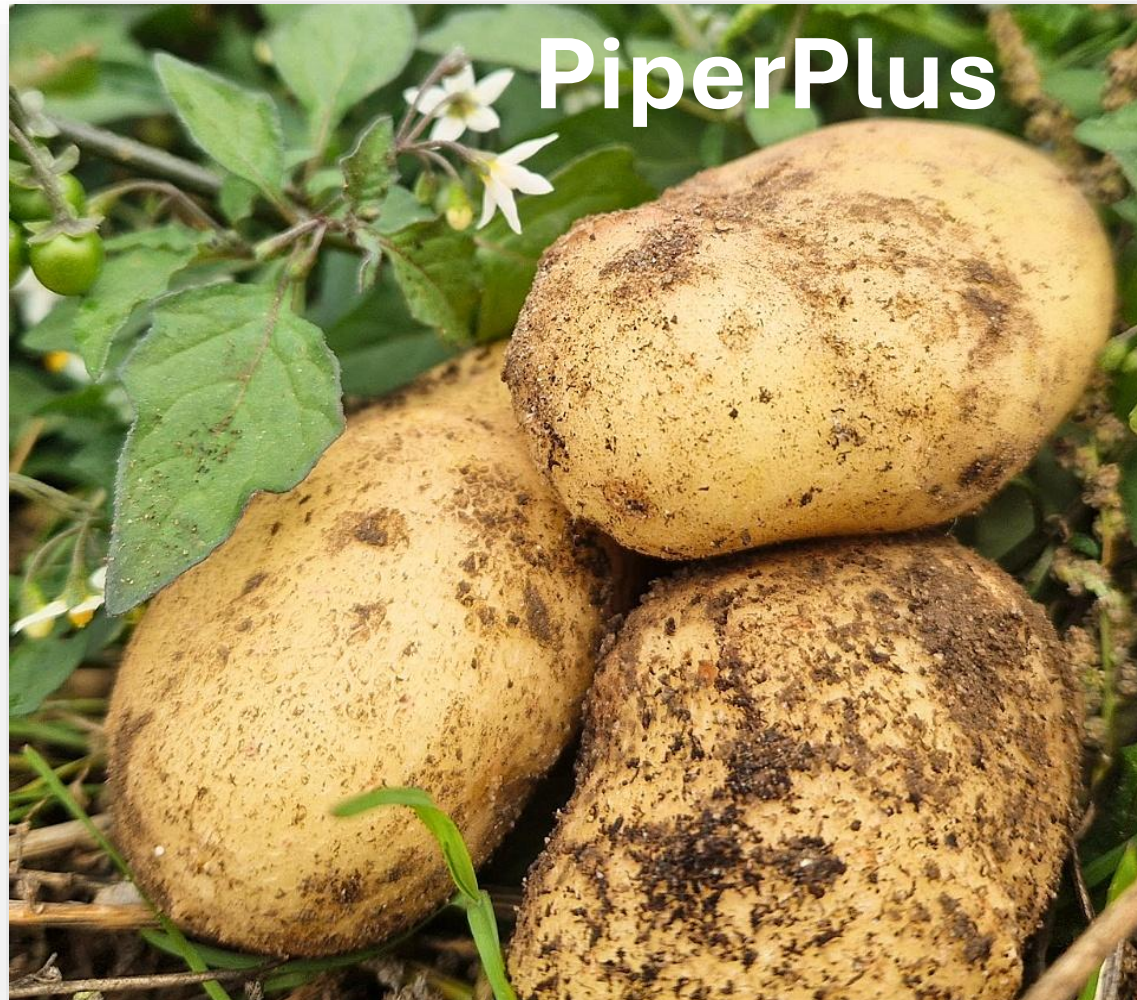


Resistance gene stacks are delivered to plant cells



**Regenerated
cisgenic plants**

Nature's solution: three late blight and two virus resistance genes from wild relatives of potato, stacked together



PiperPlus vs late blight: resistance genes in action

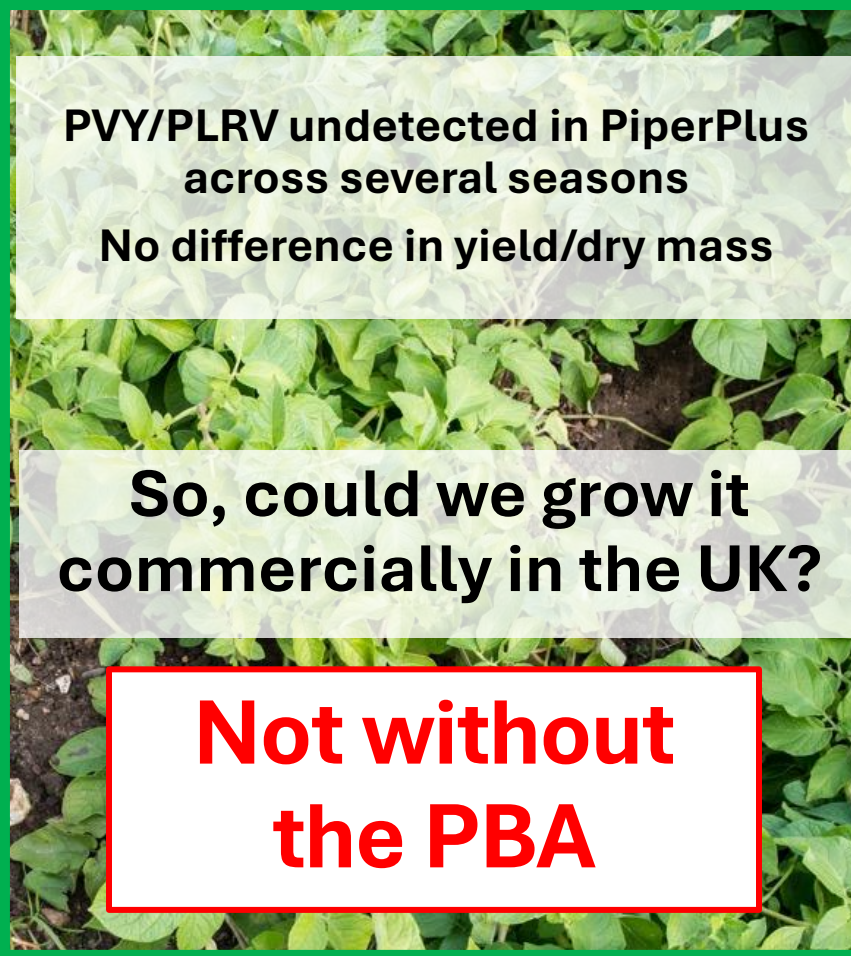
Maris Piper

KILLED BY LATE BLIGHT



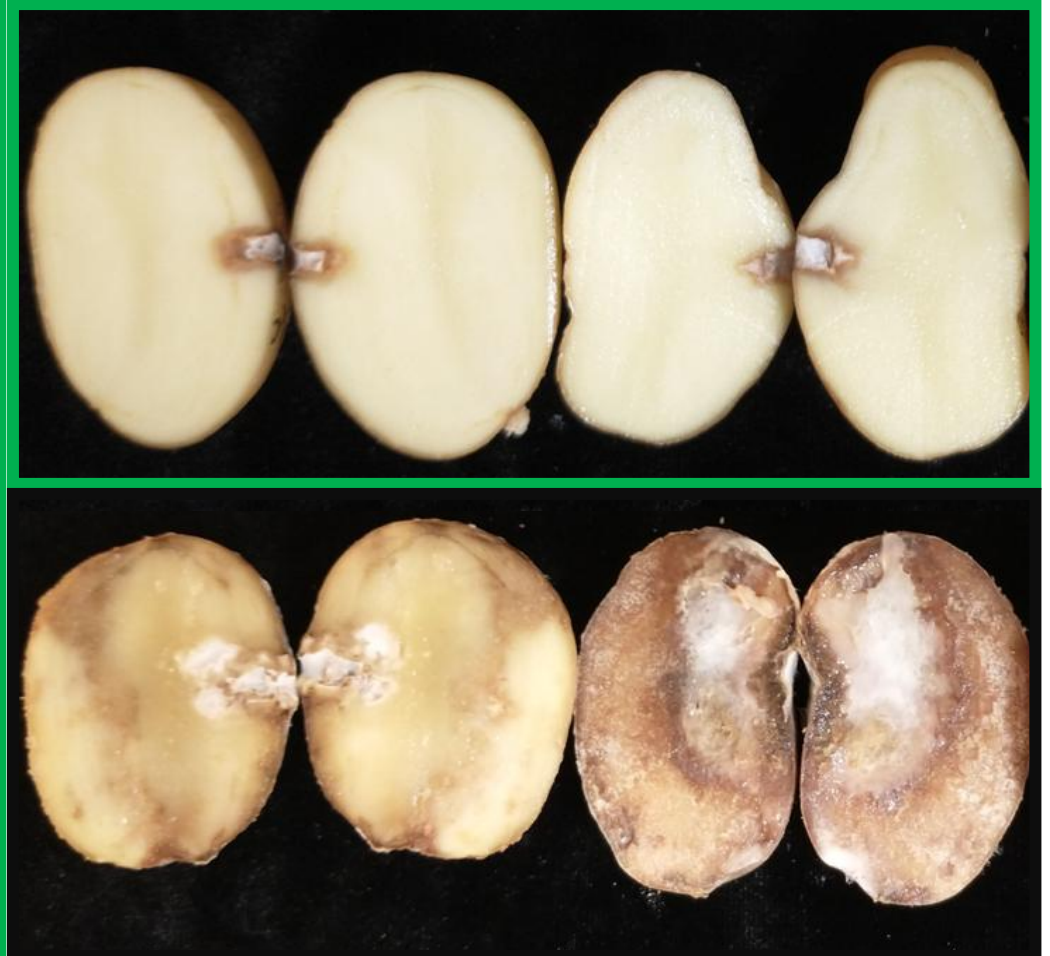
PiperPlus

THRIVING IN THE SAME FIELD



PiperPlus and Maris Piper

INOCULATED PIPERPLUS TUBERS SURVIVE



Genetic Technology (Precision Breeding) Act 2023

Government Bill

Gene Editing

deleting or making small changes using nucleases (e.g. CRISPR)



selected genes edited for **desired** trait

Cisgenesis

inserting selected genes that could have been bred in



selected gene inserted for **desired** trait

PiperPlus

Precision Bred Organism (PBO)

Created using methods of modern biotechnology,

but could have resulted from traditional processes

Proportionate rules to regulate traits, not methods



ACRE

provides scientific
advice on precision
bred status

DEFRA

Release notice
for field trials

Marketing
notice for
Precision Bred
status and path
to market

Beyond the discovery: PBO's path to market



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PRECISION BRED VARIETY

can be grown,
processed and
used for food
and feed

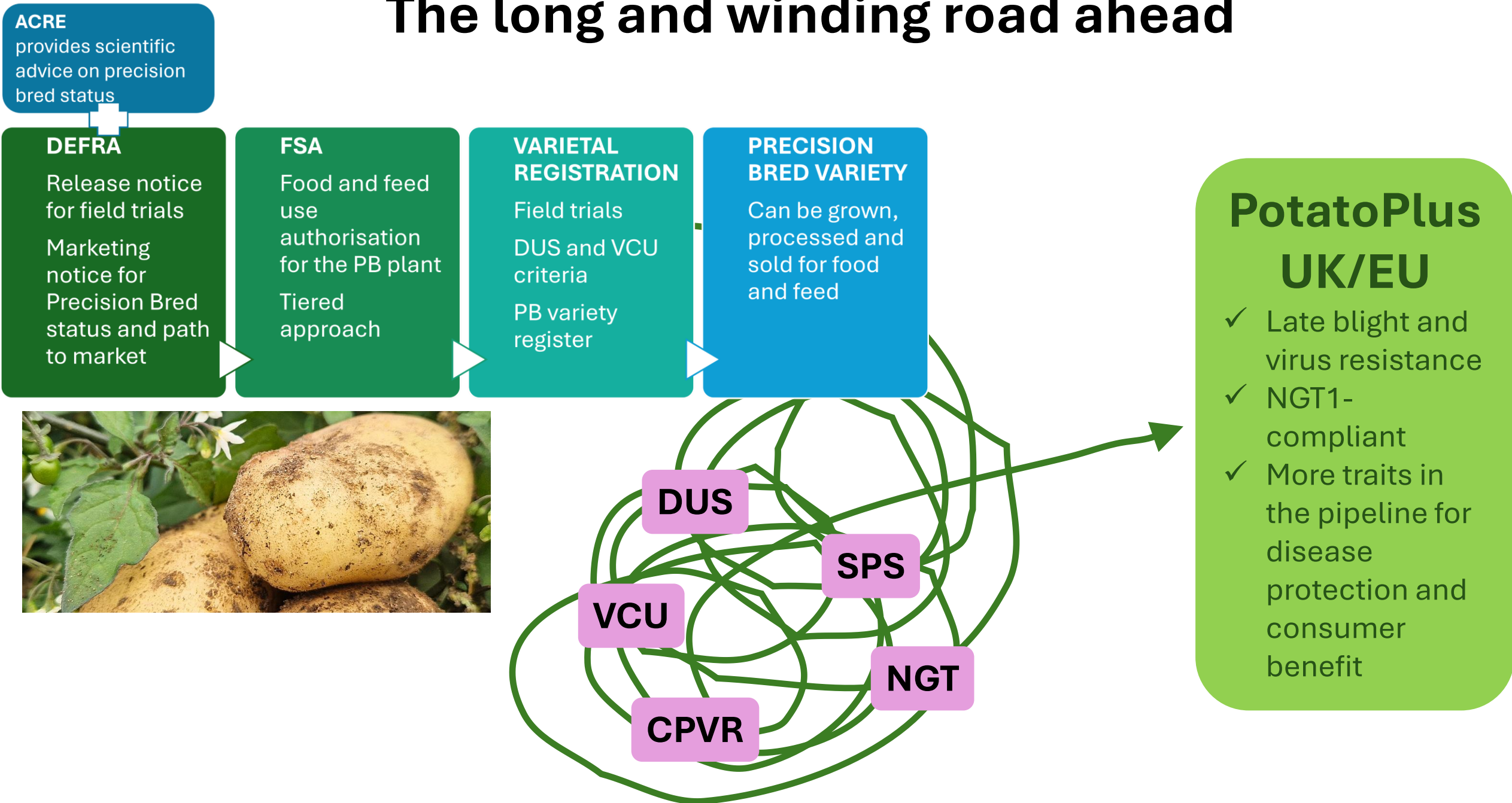
Our ref: PBM/25/SOTU/002

Monday 8th June 2026

THE GENETIC TECHNOLOGY (PRECISION BREEDING) ACT 2023, SECTION 8:

CONFIRMATION OF PRECISION BRED STATUS REFERENCE PBM/25/SOTU/002

The long and winding road ahead



PotatoPlus for the UK and EU: challenges

- ✓ We have rebuilt our gene stacks to fit NGT rules

But we won't know the fine details of the rules till 2028

- ✓ Could we use herbicide resistance just for selection, not for cultivation?

NGT regulations say 'Yes, but actually no.'

- ✓ Is *Solanum americanum* within potato gene pool?

DEFRA said yes, but what about the EU?

- ✓ What about varietal registration for NGT plants?

The law is yet to be written but distinctness won't be a trivial matter

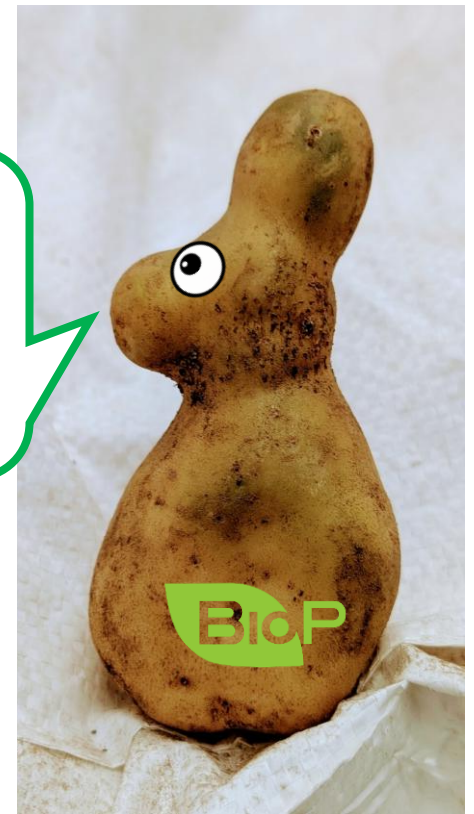


PotatoPlus: resistance and other traits in the pipeline

- ✓ Nematodes
- ✓ Blackleg (*Dickeya* and *Pectobacterium*)
- ✓ Early blight
- ✓ Wireworms
- ✓ Tuber quality traits (bruising, reducing sugars)



ACKNOWLEDGEMENTS



'New features could have resulted from traditional processes'

Sexual fertilisation, spontaneous mutation, in vitro fertilisation, polyploidy induction, embryo rescue, grafting, induced mutagenesis, somatic hybridisation or cell fusion*.

Sex Plant Reprod (1994) 7:29–40

ORIGINAL PAPER

Ronald Eijlander · Willem J. Stiekema

Biological containment of potato (*Solanum tuberosum*): outcrossing to the related wild species black nightshade (*Solanum nigrum*) and bittersweet (*Solanum dulcamara*)

Euphytica 66: 55–64, 1993.

© 1993 Kluwer Academic Publishers. Printed in the Netherlands.

Resistance to potato late blight (*Phytophthora infestans* (Mont.) de Bary) in *Solanum nigrum*, *S. villosum* and their sexual hybrids with *S. tuberosum* and *S. demissum*

L.T. Colon, R. Eijlander, D.J. Budding, M.T. Van Ijzendoorn, M.M.J. Pieters & J. Hoogendoorn
DLO-Centre for Plant Breeding and Reproduction Research (CPRO-DLO), P.O. Box 16,
6700 AA Wageningen, the Netherlands

Precision breeding: *S. americanum* traits

Somatic hybridization between *Solanum tuberosum* and species of the *S. nigrum* complex: Selection of vigorously growing and flowering plants

August 1997 · *Euphytica* 96(3)

DOI: [10.1023/A:1003038419126](https://doi.org/10.1023/A:1003038419126)

Source · [QAI](#)

 Karin Horsman ·  Marjan Bergervoet ·  Evert Jacobsen

Successful first and second backcrosses of *S. nigrum* (+) *S. tuberosum* somatic hybrids with both *Solanum* parents

September 1999 · *Sexual Plant Reproduction* 12(3):144–151

DOI: [10.1007/s004970050185](https://doi.org/10.1007/s004970050185)

 Karin Horsman ·  Richard Fratini ·  Dirkjan Huigen ·  Evert Jacobsen

Alteration of the genomic composition of *Solanum nigrum* (+) potato backcross derivatives by somatic hybridization: Selection of fusion hybrids by DNA measurements and GISH

June 2001 · *Plant Breeding* 120(3):201 – 207

DOI: [10.1046/j.1439-0523.2001.00591.x](https://doi.org/10.1046/j.1439-0523.2001.00591.x)

 Karin Horsman ·  Tatjana Gavrilenko ·  Marjan Bergervoet · [Show all 6 authors](#) ·  Evert Jacobsen



PRECISION-BRED ORGANISM

1. Created by application of modern biotechnology
2. New features are stable
3. New features could have resulted from traditional processes



NGT ORGANISM

SPS agreement

1. Created by targeted mutagenesis or cisgenesis
2. Number of genetic modification strictly prescribed
3. No herbicide resistance or insecticidal properties



PRECISION-BRED ORGANISM

1. Created by application of modern biotechnology
2. New features are stable
3. New features could have resulted from traditional processes

Ad. 1. Recombinant nucleic acid techniques; micro- and macro-injection, micro-encapsulation [Genetically Modified Organisms (Deliberate Release) Regulations 2002].

Ad. 2. Capable of being propagated by sexual or asexual reproduction.

Ad. 3. Sexual fertilisation, spontaneous mutation, in vitro fertilisation, polyploidy induction, embryo rescue, grafting, induced mutagenesis, somatic hybridisation or cell fusion*.

Copy number, epigenetic status, genome location, and border presence discounted.

NGT



1. Created by targeted mutagenesis or cisgenesis
2. Number of genetic modification strictly prescribed
3. No herbicides or insecticides

Ad. 1. One genetic modification = one substitution or insertion of up to 20 nt, or deletion of any number of nt. Up to three such modifications permitted per a single CDS. Changes in non-coding sequences don't count towards this limit.

Ad. 2. One genetic modification = one insertion or substitution of continuous DNA sequence from a conventional breeding pool, or inversion of translocation of an endogenous sequence.

Ad. 3. Up to 20 of the above genetic modification combined per monoploid genome*.