Enhanced Disease Resistance in Plants

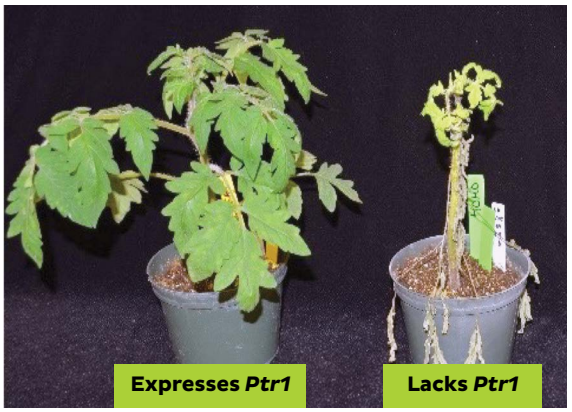
The *Ptr1* Technology Confers Resistance To Bacterial Pathogens

GENETIC ENGINEERING | AGRICULTURE | PEST CONTROL

TECHNOLOGY HIGHLIGHTS

- BTI and Cornell scientists have identified the *Ptr1* gene in *Solanum lycopersicoides*, a wild relative of tomato
- Domesticated tomato varieties do not have a functional copy of the *Ptr1* gene
- The *S. lycopersicoides Ptr1* gene confers resistance to at least two major plant bacterial pathogens
- Tomato lines expressing the *S. lycopersicoides Ptr1* gene remained free of bacterial speck disease in the field during a natural outbreak
- Traditional plant breeding or genetic engineering approaches can be used to transfer or restore *Ptr1* functionality in tomatoes and possibly other plants

EFFECTIVENESS OF THE *PTR1* TECHNOLOGY



Ptr1 confers resistance to bacterial speck disease.

Plants were inoculated with 1 x 10^4 cfu/mL NYS-T1 race 1 *P. syringae* pv. tomato strain, which expresses the AvrRpt2 protein.
Photographs were taken 7 days after inoculation.

LICENSING OPPORTUNITIES

Genetic engineering
Exclusive licenses are available on a species per species basis

Masker-assisted plant breeding
Non-exclusive licenses available

COLLABORATION/R&D OPPORTUNITIES

BTI and the Martin lab will consider proposals for company-sponsored research or participation in SBIR or STTR grants. An area of particular interest is the application of the *Ptr1* technology to species other than tomatoes.

INTELLECTUAL PROPERTY

ENHANCED DISEASE RESISTANCE IN PLANTS
U.S. Application 16/916,757
Status: pending
Inventors: Greg Martin, Ari Feder, Sarah Hind, Samantha Mainiero, and Diana Carolina Mazo-Molina
Assignees: Boyce Thompson Institute and Cornell University

Key Facts About The Technology

BACKGROUND INFORMATION

Bacterial speck causes severe necrotic lesions on different parts of the plant, affecting fruit yield and quality, requiring chemical treatment to avoid significant economic losses.

The Pto/Prf genes confer genetic resistance to race 0 strains of *P. syringae* by coding for a serine/threonine cytoplasmic kinase and a nucleotide-binding leucine-rich repeat (NLR) protein. These proteins form a complex that recognizes the bacterial type III effectors AvrPto or AvrPtoB

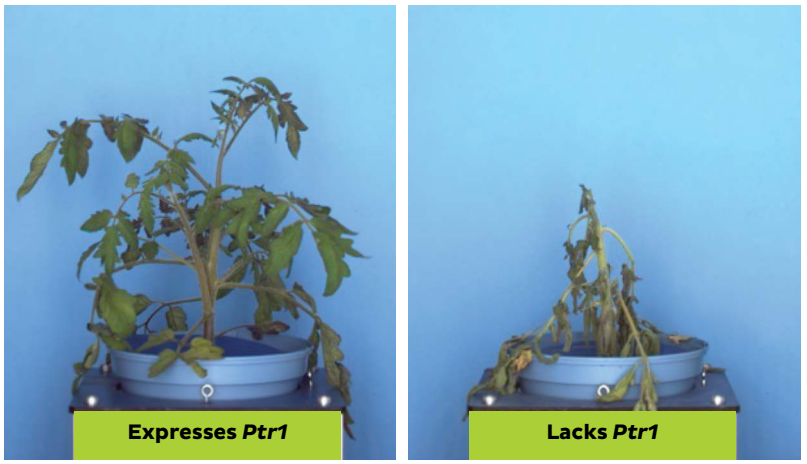
However, the widespread use of the Pto/Prf genes in the 1980s has led to the emergence of race 1 strains of *P. syringae* lacking AvrPto and AvrPtoB

Ptr1, by detecting the presence of the bacterial protease AvrRpt2 present in race 1 strains, confers strong resistance against bacterial speck.

Ptr1 also confers resistance to the pathogen *Ralstonia pseudosolanacearum,* one of the most damaging plant pathogens causing bacterial wilt in over 200 species.

It is possible that Ptr1 will also confer resistance to bacterial spot disease caused by *Xanthomonas campestris.*

BROAD RESISTANCE TO BACTERIAL PATHOGENS



Ptr1 also confers resistance to bacterial wilt disease.

Plants were soil drench-inoculated with 50 mL of 10^8 cfu/mL of *R. pseudosolanaceraum* CMR15. which expresses AvrRpt2 homolog RipBN. Photographs were taken 13 days after inoculation.

HOW TO USE *PTR1* IN TOMATO

Genetic engineering:
a *Ptr1* insertion or the correction of the pseudogene present in cultivated tomato are possible.

Marker-assisted plant breeding:
Introgression of the *Ptr1* gene into tomato varieties is possible.

HOW TO USE *PTR1* IN OTHER PLANTS

Species closely related to tomato:
Pepper and potato have retained a functional copy of *Ptr1* [Ref.2]. Some cultivated varieties/lines however may have lost *Ptr1* during domestication, and Ptr1 could be re-introduced to restore resistance to bacterial pathogens that express AvrRpt2 or homologs of this effector.

Distant plant species (e.g. rice):
More research is needed to determine whether the introduction of *Ptr1* could confer resistance in plants outside of the Solanaceae family.

References

[1] The *Ptr1* Locus of *Solanum lycopersicoides* Confers Resistance to Race 1 Strains of *Pseudomonas syringae* pv. *tomato* and to *Ralstonia pseudosolanacearum* by Recognizing the Type III Effectors AvrRpt2 and RipBN. Mazo-Molina *et al.*, Mol Plant Microbe Interact. 2019 32(8):949-960.
[2] *Ptr1* evolved convergently with *RPS2* and *Mr5* to mediate recognition of AvrRpt2 in diverse solanaceous species. Mazo-Molina *et al.*, Plant J. 2020 103(4):1433-1445

MEET OUR FACULTY/INVENTOR

Greg Martin is Professor in the School of Integrative Plant Science, Plant Pathology and Plant-Microbe Biology Section at Cornell University. The Martin lab at BTI studies the molecular basis of bacterial infection processes, plant disease susceptibility, and plant immunity using biochemistry, bioinformatics, cell biology, forward and reverse genetics, genomics, molecular biology, plant breeding, plant pathology and structural biology.

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