Enhanced Disease Resistance in Plants

The *Ptr1* Technology Confers Resistance To Multiple Bacterial Pathogens

**TECHNOLOGY HIGHLIGHTS**

- BTI and Cornell scientists have identified the *Ptr1* gene in *Solanum lycopersicoides*, a wild relative of tomato.
- Domesticated tomato varieties lack a functional copy of the *Ptr1* gene.
- The *S. lycopersicoides* *Ptr1* gene confers resistance to major bacterial pathogens causing wilt, speck and spot disease in plants.
- 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 $1 \times 10^4$ 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

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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.[1]

Ptr1 also recognizes the *P. syringa* effectors HopZ5, AvrRpm1 and AvrB. [2]

Ptr1 has been proposed as a key component of a stacking strategy for durable resistance to a broad range of bacterial diseases in tomato.[4]

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**BROAD RESISTANCE TO BACTERIAL PATHOGENS**

Ptr1 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.

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

By recognizing the effector AvrBst, Ptr1 also confers resistance to bacterial spot disease caused by *Xanthomonas perforans*. [3]

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**HOW TO USE PTR1 IN TOMATO**

**Genetic engineering:**
A Ptr1 gene 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 also possible.

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**HOW TO USE PTR1 IN OTHER PLANTS**

**Use in Solanacea:**
Genomic data indicates that Ptr1 may have been lost across tomato and eggplant cultivars. Analyzed accessions of tobacco, pepper and potato presented a functional copy of Ptr1 [2]. Some cultivated varieties/lines however may have lost Ptr1 during domestication.

**Use in other crops:**
Research is needed to determine whether the introduction of Ptr1 could confer resistance in plants outside of the Solanaceae family.

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**References**


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**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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