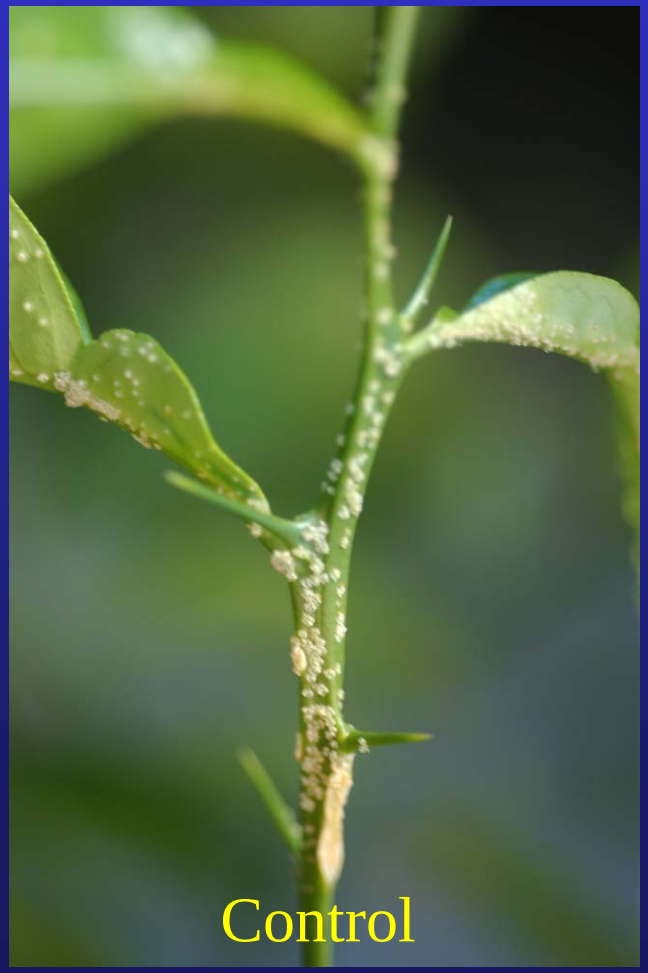
Integrated Plant Genetics, Inc.

- *Gram negative bacterial resistance*
- *Enabling technologies for molecular breeding*

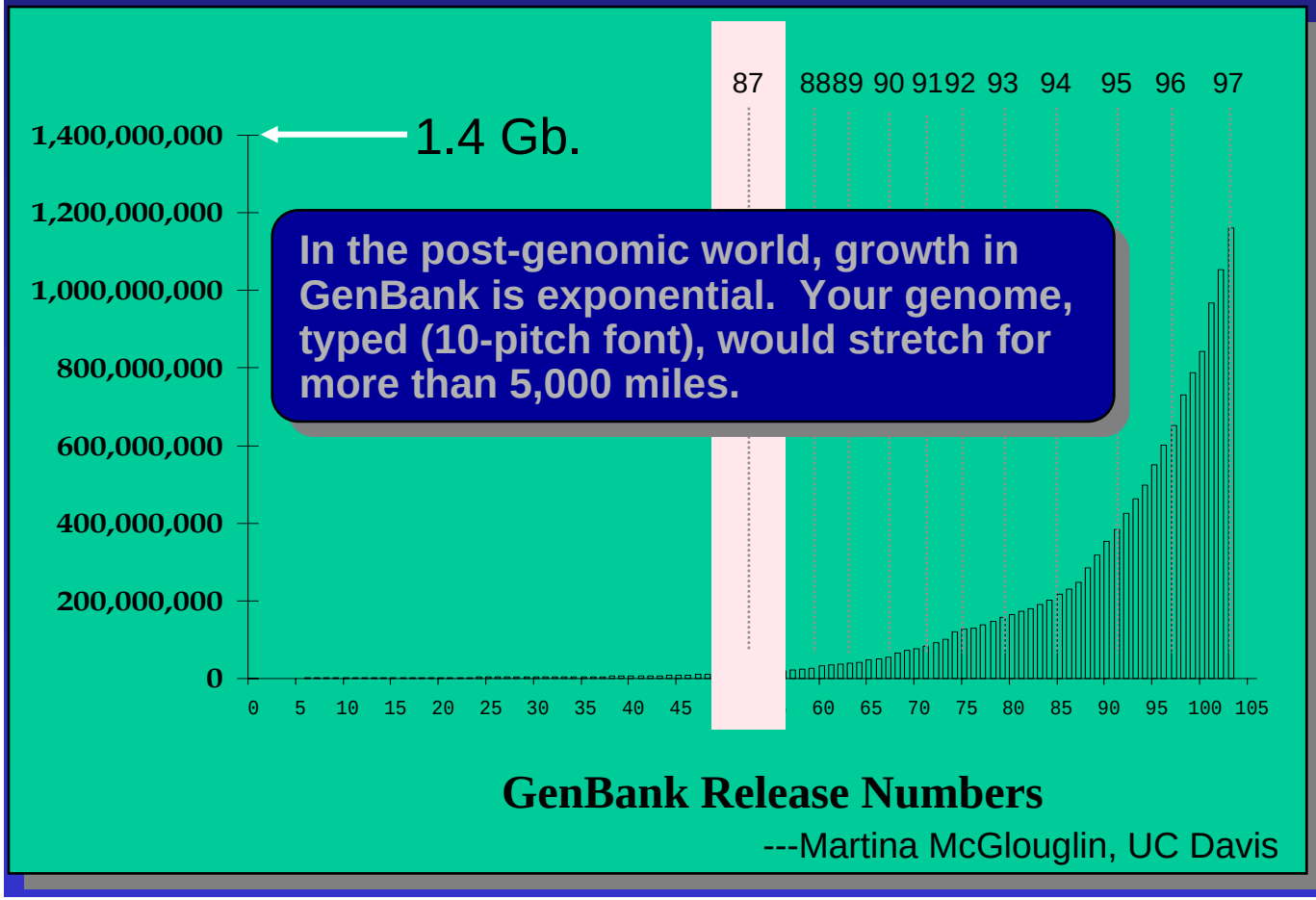


Control

DiseaseBlock® 1.0

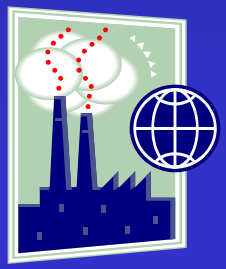
IPG

Genes are digital code.
Genes are *ownable*.
Gene discovery is logarithmic.



Discovery engines:

academia



industry

But, IP controls gene deployment

Tissue targeting
(flowers, xylem, etc.)

plant transformation methods

Inventive Discovery

industrial gene discovery

Selectable marker genes

promoters

academic gene discovery

Freedom-to-Operate (FTO)
IP Barriers

IP as Market Barrier

- **Most public or private plant DNA technologies cannot be independently commercialized due to FTO restrictions on *enabling* technologies.**

-Example: 70 patents needed to produce Golden rice.

–Example: Monsanto's key enabling (use of *Agrobacterium*) US 6,051,757, application date: 1983, issued date: 2000.

–Monsanto owns use of *any antibiotic* in plants;

–Novartis owns use of *any* positive selection.

- **IPG's patent pending methods provide FTO.**

IPG

☑ Transformation process achieved for elite geranium cultivars

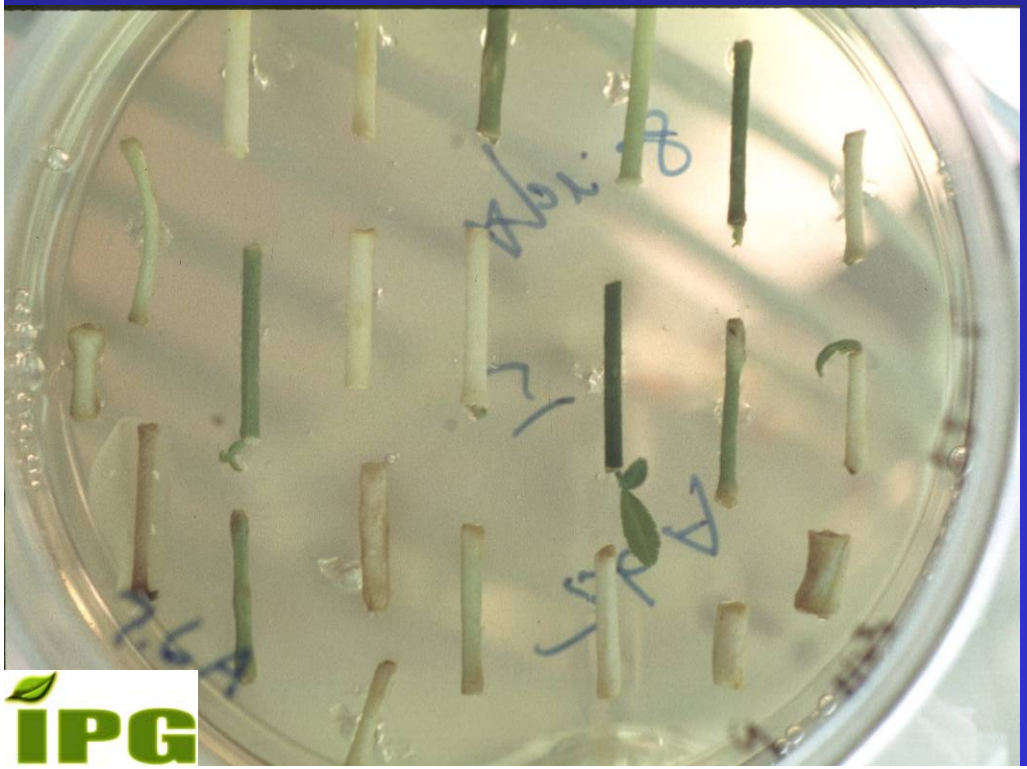
Gene on DNA cloning vector (IPG Gram negative bacterial Growth inhibitor)

- DNA delivery method
- Selection method

☑ Transformation process achieved for elite citrus cultivars.

DNA clone on DNA vector
(IPG Gram negative bacterial Growth inhibitor)

- DNA delivery method
- Selection method



Greenhouse testing

Grafting onto Swingle rootstock (30% survival)

☑DiseaseBlock® 3.0 proteins (Patents #1&5) are ☑ expressed in *Pelargonium* leaves and roots (Patent #2), and ☑ localized to veins using ☑ transformation method (Patent #3) and ☑ selection method (Patent #4).

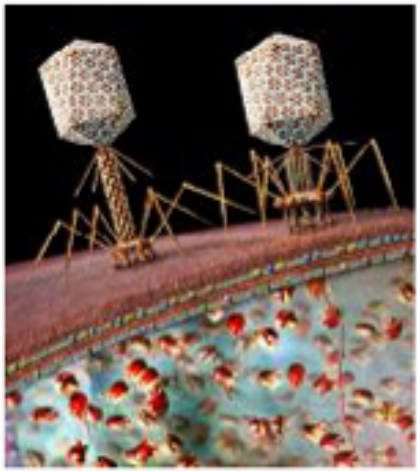
Root Xylem

Leaf xylem

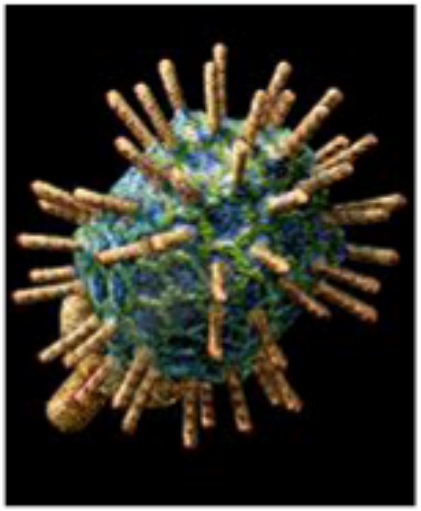
IPG

IPG DiseaseBlock® 2.0

- Bacteriophages are bacterial viruses that can kill bacteria.
- Bacteriophages are safe for plants and animals.
- Specific bacteriophage genes produce proteins lethal to bacteria.



Bacteriophage T4 virions attacking a bacterial cell

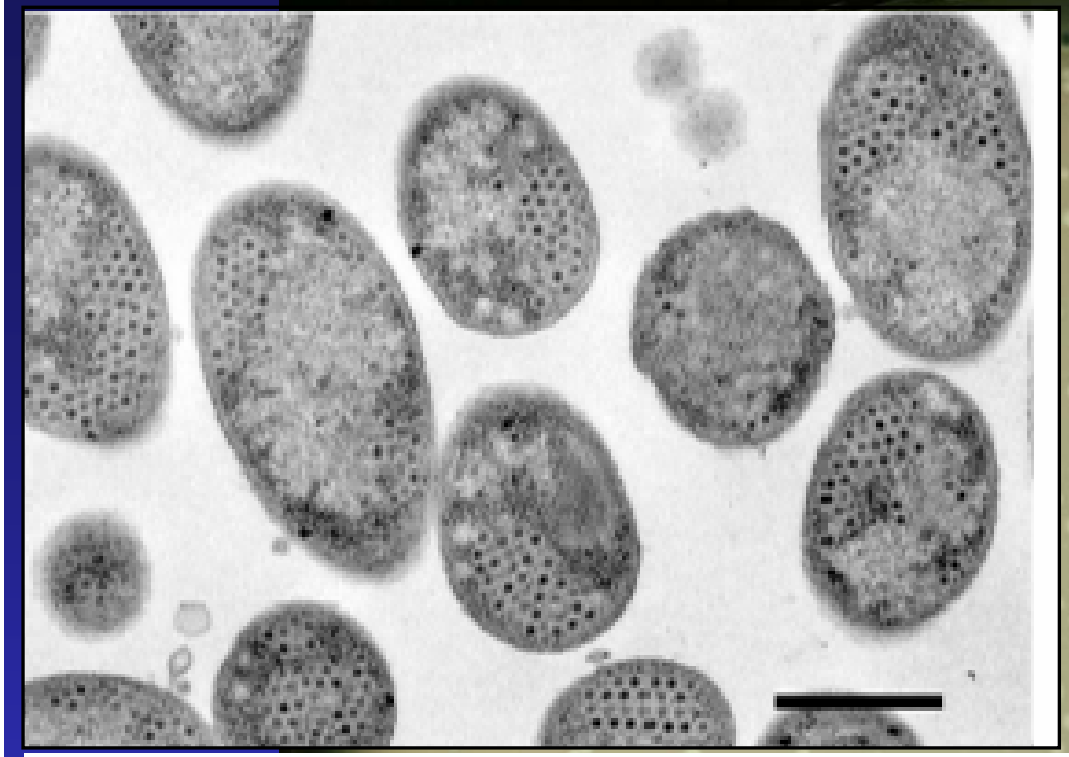


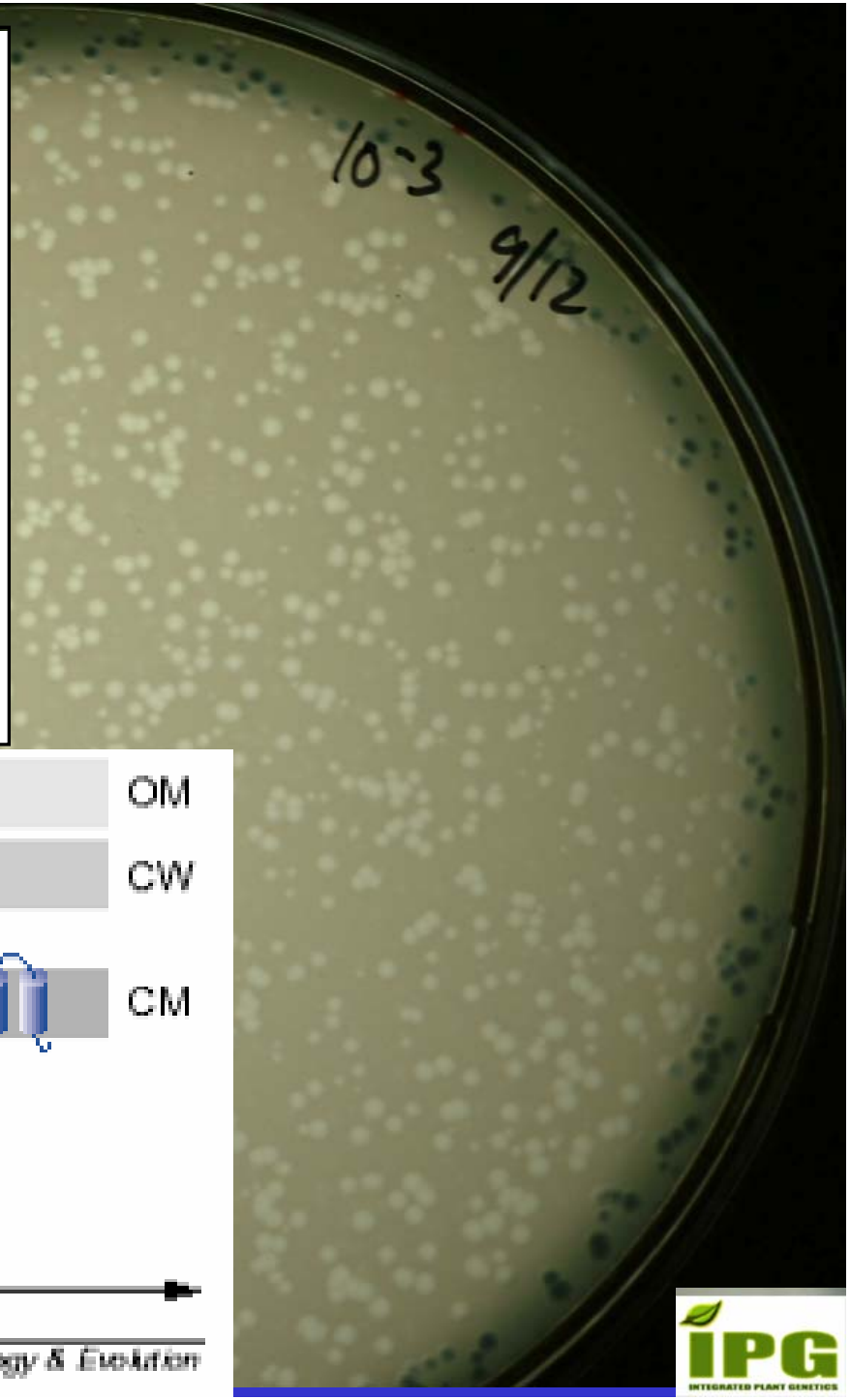
Bacteriophage phi 29

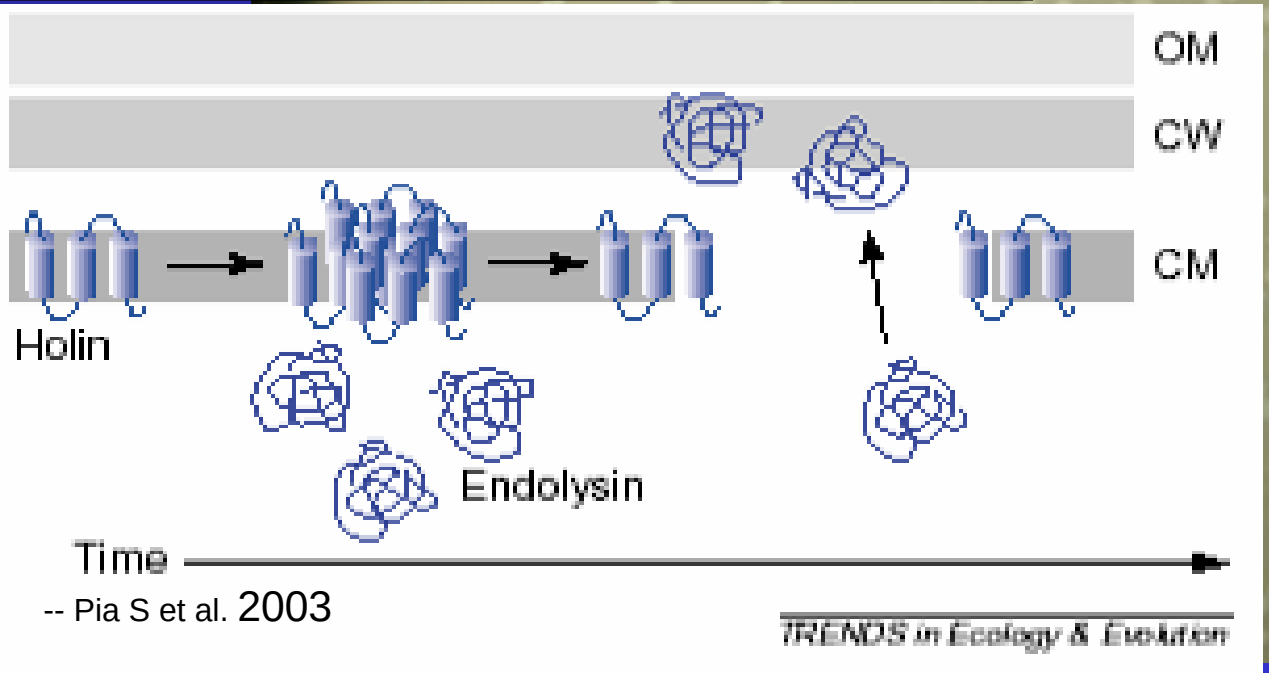
Bacteriophage p 22

Filamentous Phages

Russell Kightley Media: Scientific Illustration
GPO Box 3021, Canberra, ACT 2601, Australia. Tel/Fax: 02-62811293







-- Pia S et al. 2003

TRENDS in Ecology & Evolution

Discovery process: functional genomics

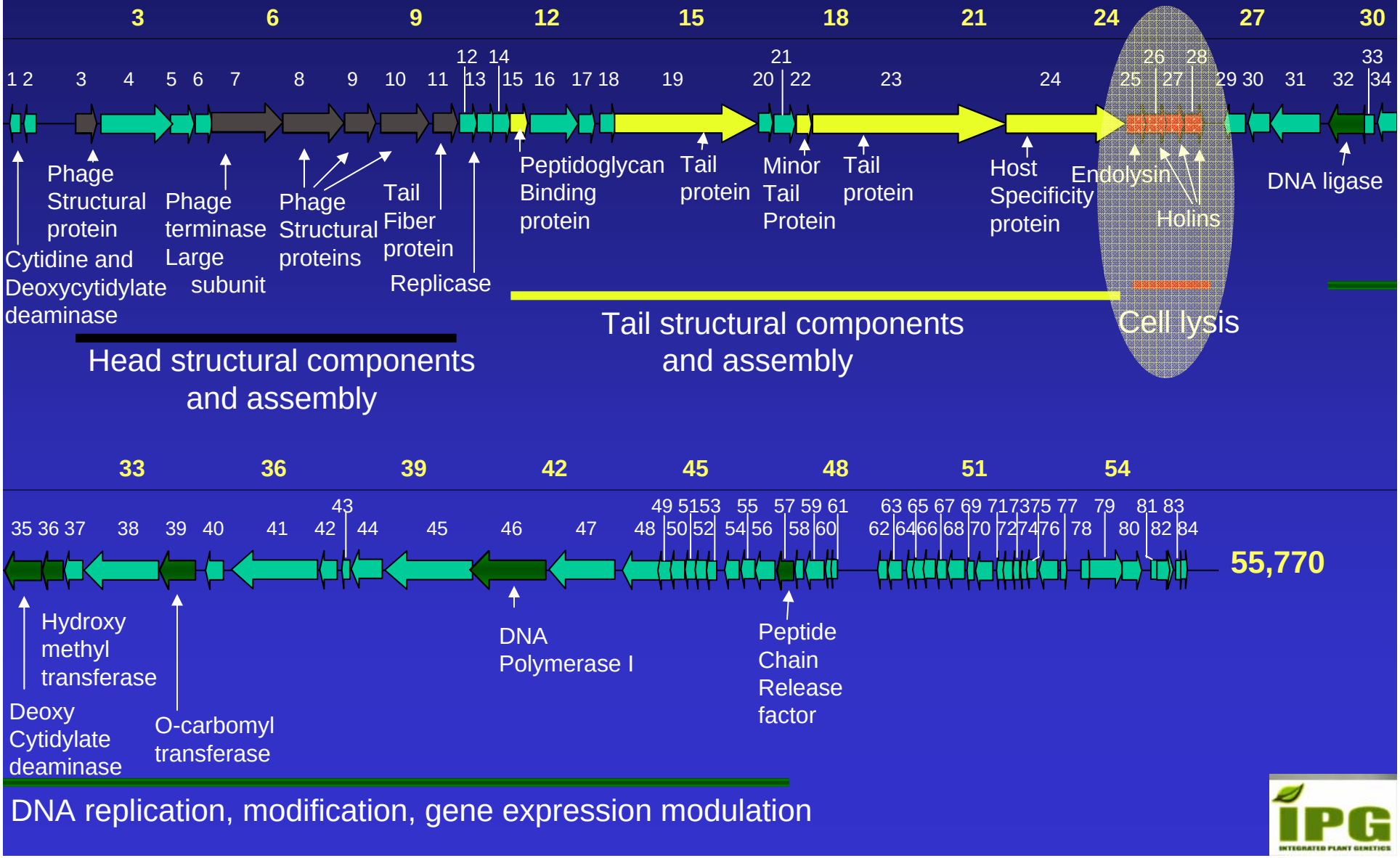
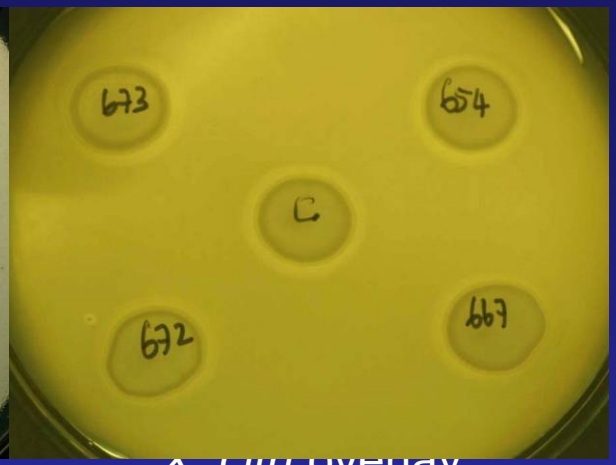


Plate overlay assay to identify lethal phage clones

Uninduced: *E. coli* only

Ralstonia overlay



X. citri overlay

Induced: *E. coli* only

Ralstonia overlay

X. citri overlay

BL21/DE3/pLysS grown overnight, uninduced until spotted onto plate.
654, HZ; 667, MTP; 670, HZB; 672, EL; 673, HZL. Photo 16 hrs.

IPG DiseaseBlock® 3.1 Platform: using phage and other genes to kill bacterial plant pathogens

Phage have limited infections, but some phage genes encode more general bacterial killers.

Organism Tested	Diseases Caused
Xanthomonas pelargonii	Geranium blight
Xanthomonas campestris	Black rot of crucifers
Xanthomonas citri	Citrus canker
*Xanthomonas oryzae**	Rice blight
*Ralstonia solanacearum**	Wilt and blight of many plants
Pseudomonas syringae	Bean halo blight
*Xylella fastidiosa**	Pierce's Disease & CVC

Liberibacter spp.* (not tested, but likely) Citrus Greening

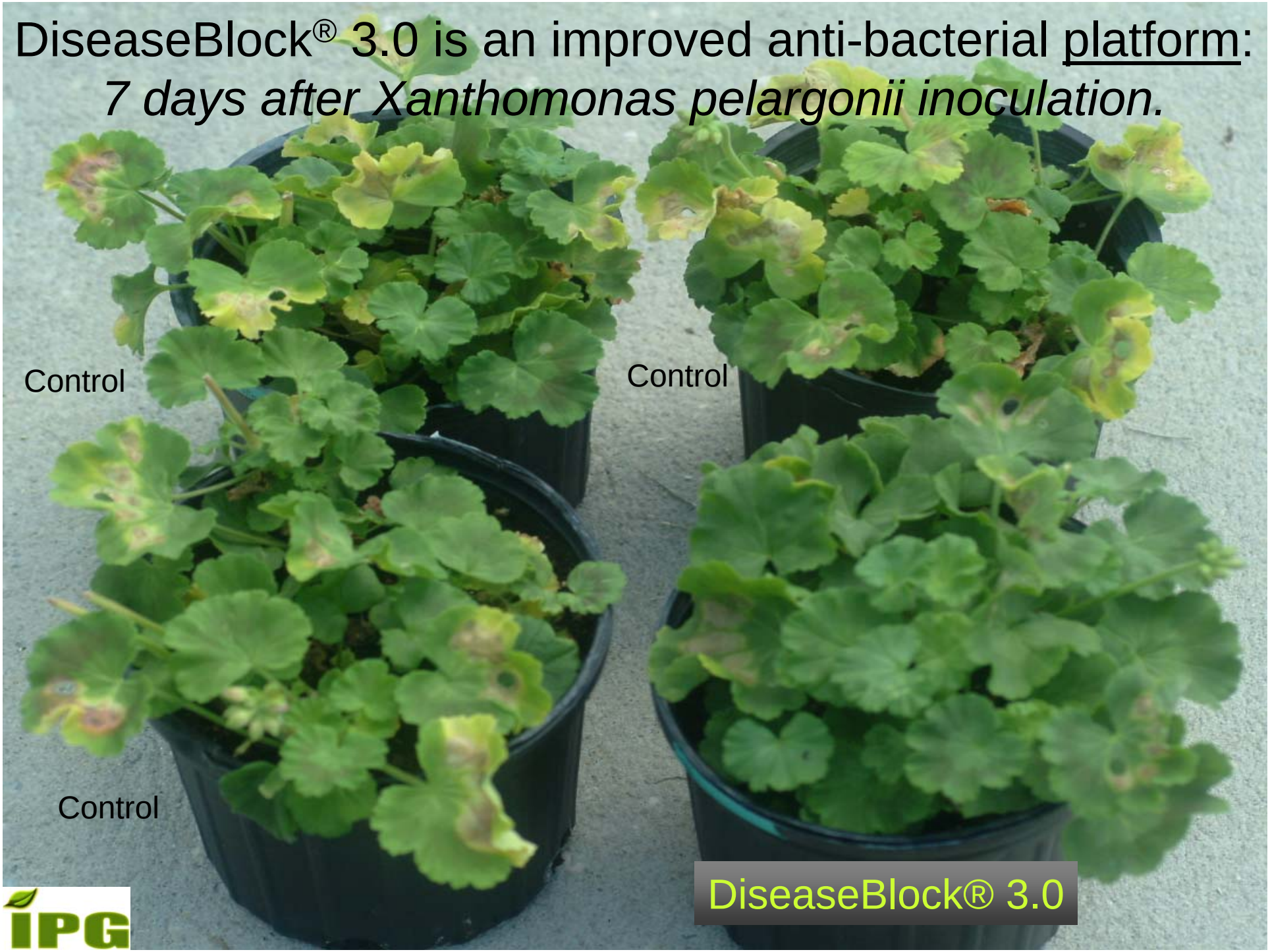
**USDA Select Agents*

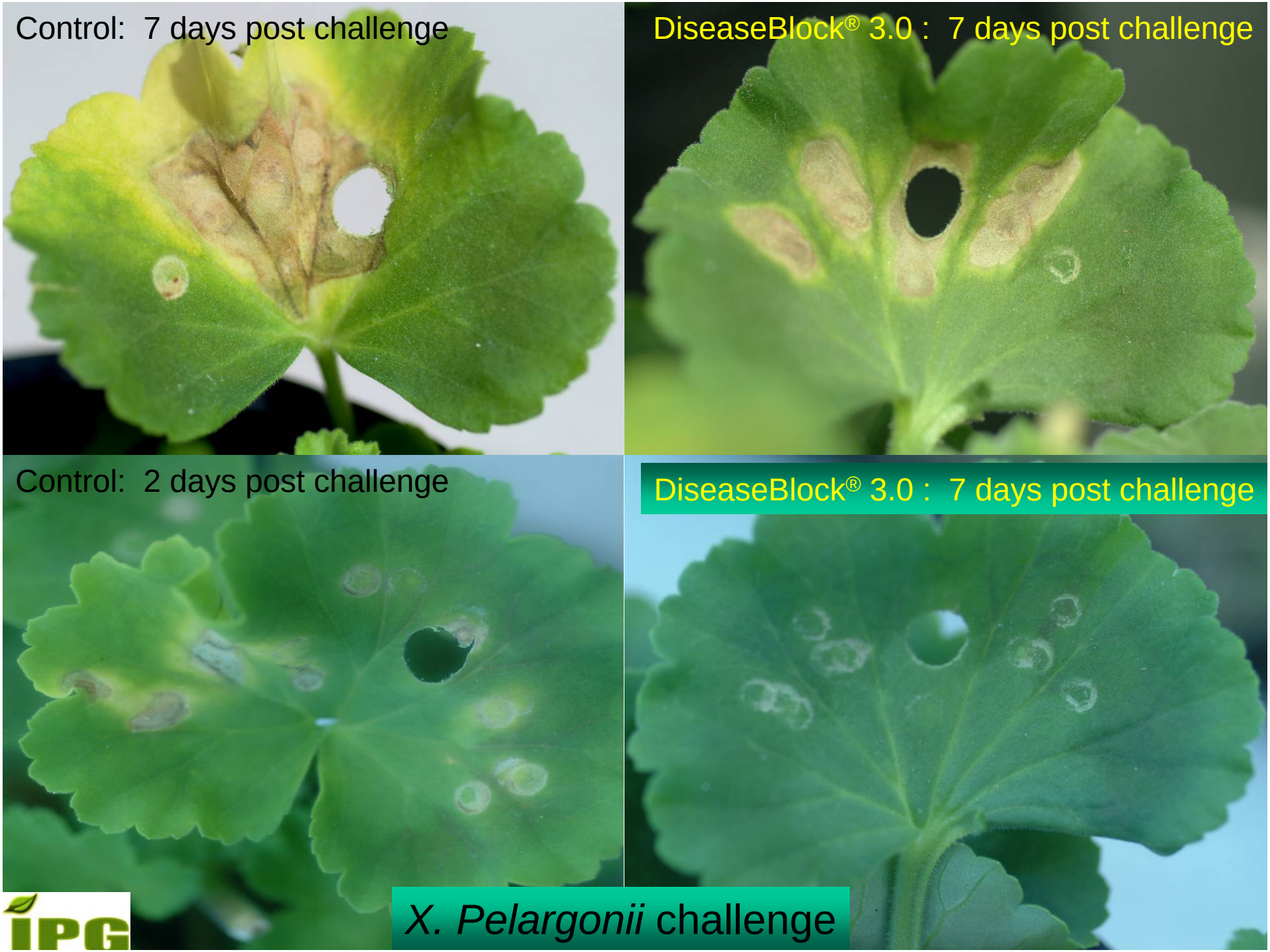
IPG

Select Agent Resistance: Challenge inoculations of transgenic DiseaseBlock® 2.0 geranium with *Ralstonia solanacearum*

DiseaseBlock® 3.0 is an improved anti-bacterial platform:

7 days after Xanthomonas pelargonii inoculation.




Control: 7 days post challenge
DiseaseBlock® 3.0 : 7 days post challenge
Control: 2 days post challenge
DiseaseBlock® 3.0 : 7 days post challenge
IPG
X. Pelargonii challenge

DiseaseBlock® may also provide immunity to two untreatable citrus bacterial diseases.

Citrus Greening (Huanglongbin) discovered 2005

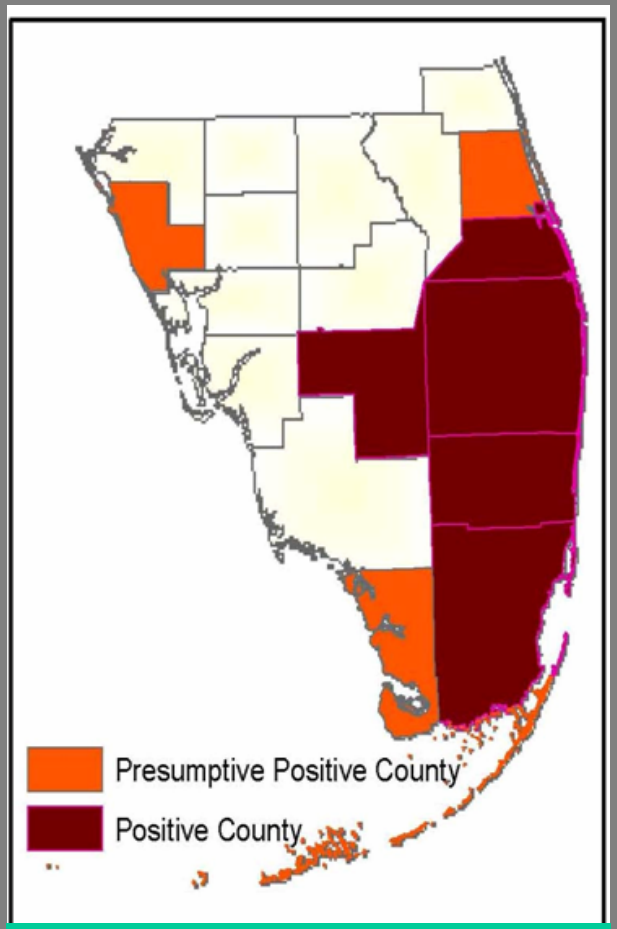
Canker eradication program now ended after 10 years

IPG

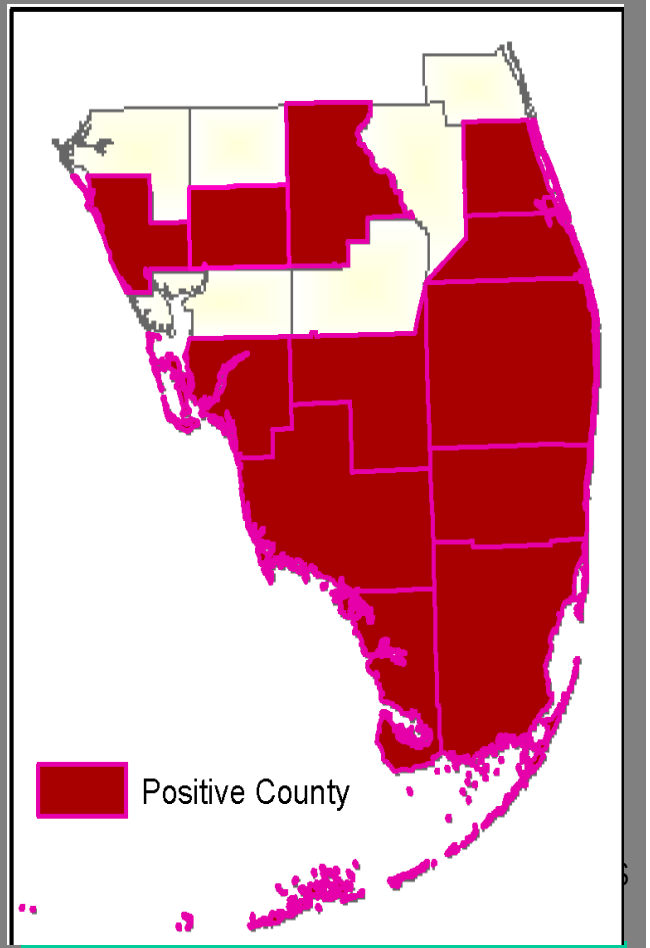
From Psyllid establishment to greening establishment: 6 years

From greening infection to citrus host death: 5 years

APHIS/PPQ intercepted the vector 40 times in US ports between 1985-98.



as of 11/02/05, 414 confirmed positive trees from 271 locations



as of 9/10/06, 558 confirmed positive trees from 414 locations, including 9 commercial groves

GMO fruit trees *are* accepted in the U.S.

Transgenic (right) and nontransgenic papaya in Hawaii.

Work by: D. Gonsalves, Cornell U.; S. Ferreira and R. Manshardt, U.Hawaii; M. Fitch, USDA; J. Slightom, Pharmacia

Transgenic 'UH Rainbow' to be graded in a commercial packinghouse.

Integrated Plant Genetics, Inc.

- ***Gram negative bacterial resistance***
- ***Enabling technologies for molecular breeding***

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