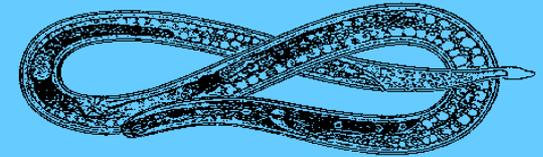
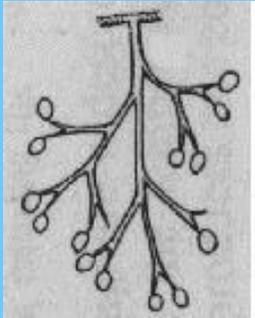




Santa Barbara County Agricultural Commissioner



Plant Pest and Disease Diagnostic Services

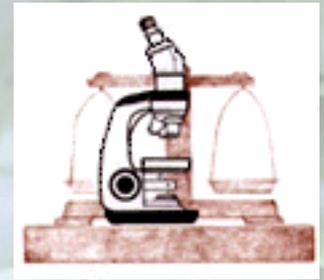


Plant Pathology
Heather Scheck

Entomology
Brian Cabrera

Santa Barbara:
Santa Maria:

681-5600
934-6200



Plant Pest and Disease Diagnostic Services

Plant Pests Only *

Arthropods and Mollusks

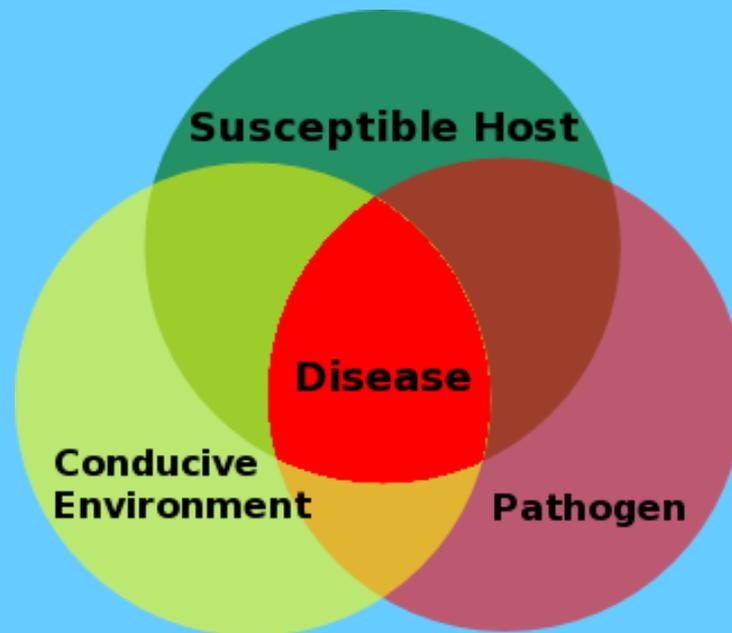
Pathogens and Nematodes

Weeds

**spiders, structural pests OK*

Plant Disease Epidemiology

- is the study of disease in plant populations
- understanding of the cause and effects of disease and develop strategies to intervene in situations where crop losses may occur



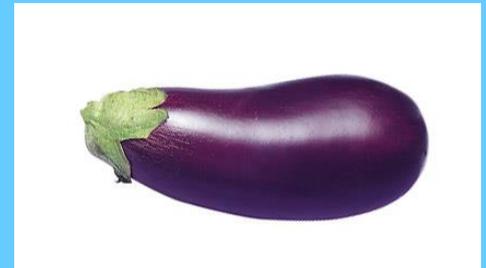
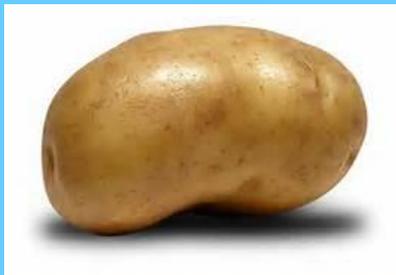
Ralstonia solanacearum

Bacterial Wilt

Southern Wilt

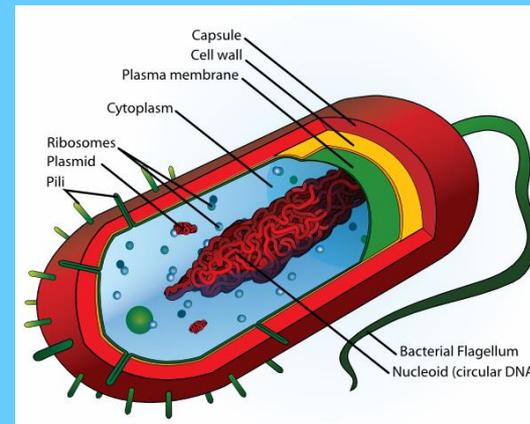
Brown Rot

- *Ralstonia* is one of the world's most destructive plant pathogenic bacteria
- It has affected at least 3.7 million acres of potatoes in more than 80 countries, and it can cause 100% crop loss
- Most hosts of *R. solanacearum* are in the family *Solanaceae*, and include food crops, ornamentals and weeds



Ralstonia solanacearum

- Big losses in tropical agriculture because the pathogen is very widely distributed and has an unusually broad host range
- Because *R. solanacearum* is a soil borne pathogen and host resistance is limited, the diseases are very difficult to control
- R. solanacearum* generally occurs in lowlands in tropical or subtropical areas, but one subgroup of called Race 3 biovar 2 (R3bv2) attacks plants at cooler, higher altitudes or in temperate zones



Pathogenesis

- *R. solanacearum* enters the plant via a wound. The bacteria get access to the wounds partially by flagellar-mediated swimming motility and chemotactic attraction toward root exudates
- After invading a host, *R. solanacearum* multiplies and moves systematically within the plant before bacterial wilt symptoms occur (latent infections worsen epidemics)
- Wilting occurs with high levels of bacteria in the xylem and is partially due to vascular dysfunction in which water cannot reach the leaves sufficiently.
- *Ralstonia's* systemic toxin also causes loss of stomatal control.
- High bacterial densities, byproducts of plant cell wall degradation; tyloses and gums produced by the plant itself are other contributing factors to wilting.

Ralstonia Symptoms



Wilting of new tomato growth



Wilting and stunting of mature tomato plants

Bacterial Wilt of Tomato

Ralstonia Signs



Bacteria streaming from
cut tomato stems



Bacteria exuded from tomato

Ralstonia - Symptoms



Wilting of potato plants



Internal browning of potato stem

Bacterial Wilt of Potato

Ralstonia - Signs



Bacteria exuded from potato stem



Brown rot of tubers with exuded bacteria

Brown Rot of Potato

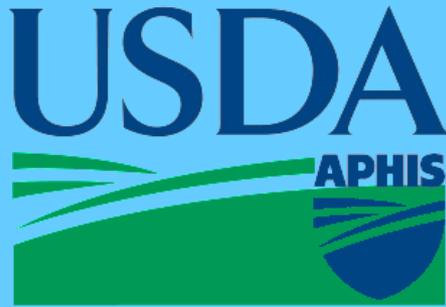
Ralstonia solanacearum

R3bv2

- R3bv2 probably originated in the Andes, this group now occurs in tropical highlands and in subtropical and warm-temperate areas throughout the world, *except in North America*. It is responsible for an estimated \$1B US in losses each year
- R3bv2 has recently appeared in Europe where it disrupted seed potato production and caused serious quarantine-related losses
- R3bv2 was listed in 2002 as a *Select Agent Plant Pathogen*, and is now subject to the strictest biosecurity regulations

-This zero tolerance includes enforcement of quarantine regulations, sanitation protocols, and inspections designed to prevent introduction





7 plant pathogens on the Select Agent List:

Secretary determines have the potential to pose a *severe* threat to animal or plant health; not in the US now

Downy Mildew of Sorghum and Maize:

Peronosclerospora philippinensis (*Peronosclerospora sacchari*)

Red Leaf blotch of Soybean:

Phoma glycinicola

Brown Rot of Potato:

Ralstonia solanacearum R3bv2

Brown Stripe Downy Mildew of Maize:

Sclerophthora rayssiae

Potato Wart

Synchytrium endobioticum

Bacterial blight of Rice

Xanthomonas oryzae

Rathayibacter toxicus – infects ryegrass but kills cattle and sheep

If introduced, *Ralstonia solanacearum* R3bv2 could affect a potato crop in the U.S. valued at \$3.9 billion in 2012 - with an export value of \$1.8 billion for a variety of potato products.



Epidemiology:

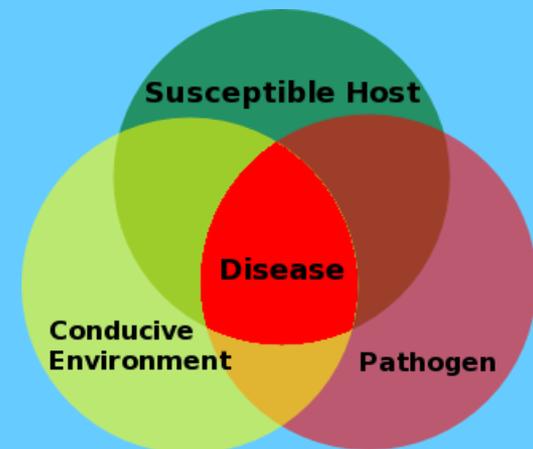
Ralstonia solanacearum can be transmitted through contaminated soil, irrigation water, equipment, or personnel.

The bacteria may be spread by the following means:

- Shared water irrigation systems
- Transplanting and propagating infected plants
- Taking cuttings without disinfecting tools between plants
- Pinching buds of plants without sanitizing
- Transfer of contaminated soil (on equipment or shoes) to disease-free areas

Not spread by:

- Splashing of water
- Leaf to leaf contact
- Aerial transfer



Why worry so much about R3bv2? Why put it on the Select Agent List?

- Attacks under more temperate conditions, doesn't require tropical conditions Doesn't occur in North America and we already have lots of restrictions on bringing in propagative parts of *Solanaceous* plants.....
- *What else* do we import from offshore that could bring R3bv2 and Bacterial Wilt / Brown Rot of Potato??



Geraniums



(Yes it's better to call them Pelargoniums but everyone knows them as Geraniums)

Southern Wilt of Geranium caused by *R. solanacearum* R3bv2



Southern Wilt of Geranium

Lethal disease with no curative chemical treatments
-must prevent infection with phytosanitary methods



Geraniums

#1 in terms of units sold and #3 in wholesale value in the U.S. for ornamentals



Annuals in hard freeze areas

Three countries now account for the majority of Geranium Stock Plant production:



The Netherlands



Kenya



Guatemala

.....and all 3 have had recent outbreaks
of *Ralstonia solanacearum* R3bv2

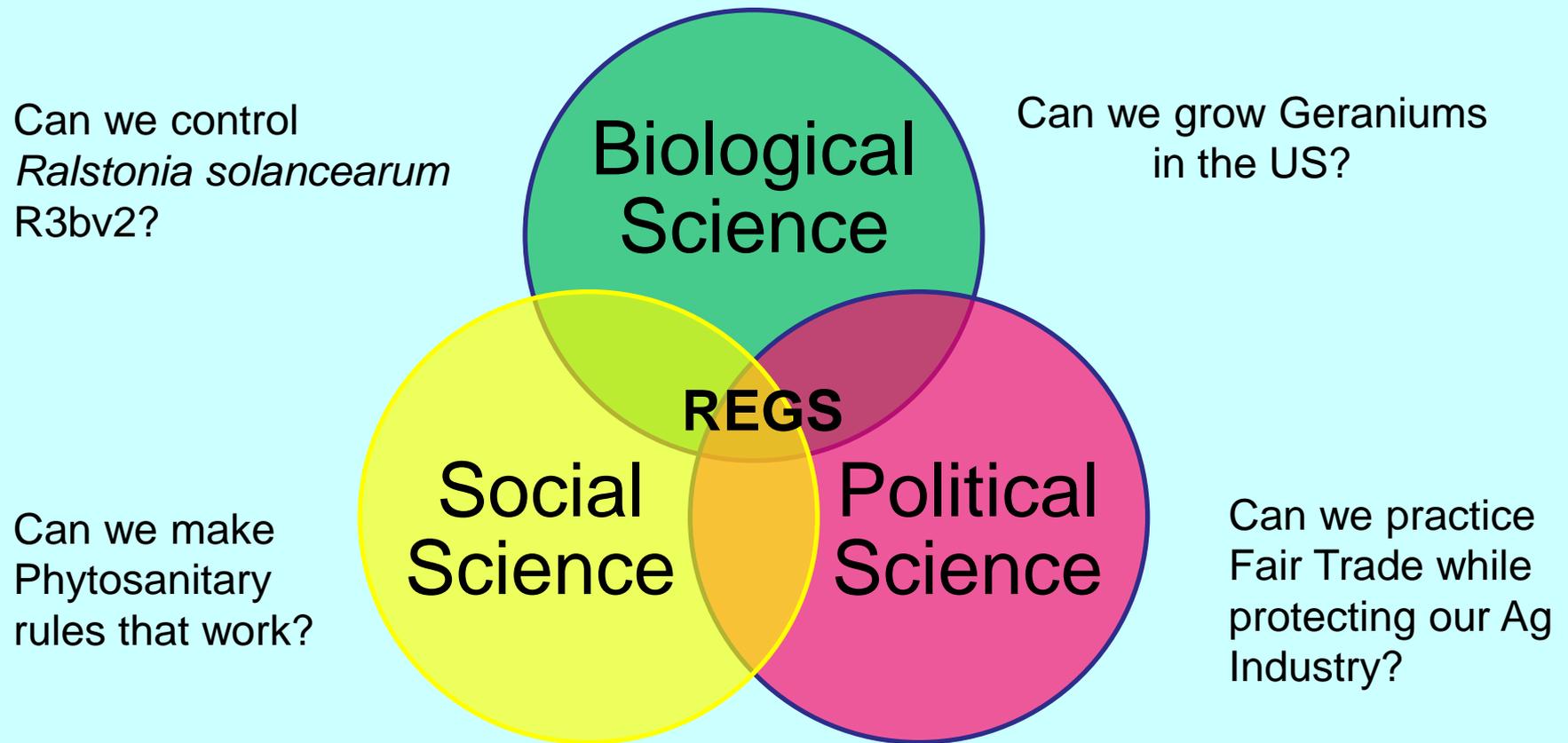
Introductions of R3bv2 with greenhouse production of geraniums occurred in 2003 and 2004, introduced from Kenya and from Guatemala, which were eradicated.

.....Based on the findings in Guatemala, USDA APHIS-PPQ instated a destruction order for the three suspect varieties and other potentially exposed plants that were shipped to the U.S. between July 27, 2003 and January 3, 2004.

By January 26, 2004, APHIS had identified 459 facilities in 41 states that had received suspect geraniums; 362 facilities were on hold; 79 control actions had been initiated; and 529,367 plants had been destroyed. By the end, between 1.5 and 2 million cuttings/plants were destroyed.....



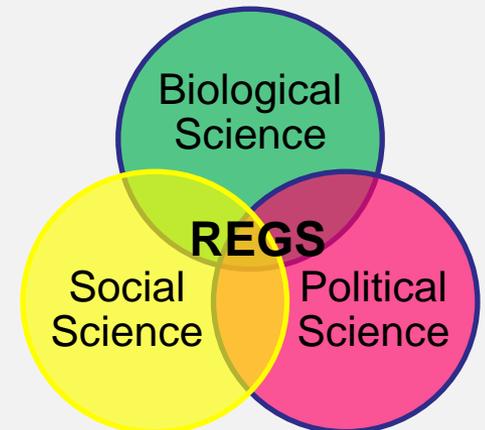
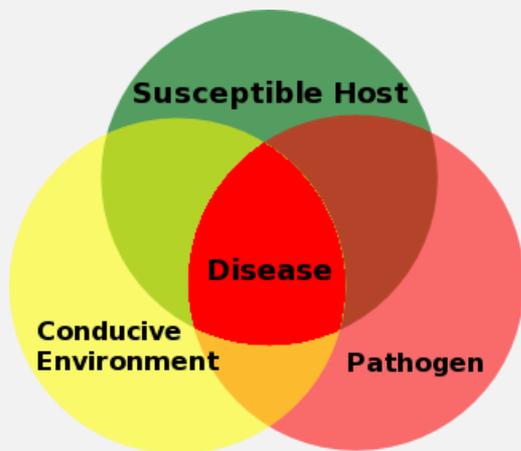
Regulatory Plant Disease Epidemiology



Since 2004 - huge business expansions into areas where R3bv2 is endemic in the soil and water:

“.....industry concentration necessitates the need for larger, fully-integrated offshore facilities in Central America capable of servicing the needs of large growers. Smaller, non-integrated onshore producers may have a tough time competing in the future as the bar is constantly being raised by the supply chain.”

-Greenhouse Grower Magazine, 2011





New Pest Response Guidelines *Ralstonia solanacearum* Race 3 biovar 2 (2008)

Overview of Regulatory Program After a United States Detection

If *Ralstonia solanacearum* race 3 biovar 2 is detected on geraniums or potatoes in the United States, follow this procedure:

1. Determine the origin of the infection.
2. Survey the extent of distribution of potentially infected geranium plants or potatoes.

Quarantine Actions Required – On and Off Shore

Geraniums: After investigations are performed—the unit of held suspect geraniums and potentially infected plants associated with them must be destroyed or disposed of. In addition, the area must be disinfected.

Potato Cropping Systems

- If a property has positive-testing or positive-associated fields, all plant material that can be reasonably removed from the field must be destroyed or disposed of. This includes cull piles and other plant debris.
- Leave the field fallow for two years, and irrigate to promote volunteer sprouting. During the two years, the volunteer crop must be sampled, tested, and disked under during the growing season every four weeks to eliminate host material. Weed hosts in the field and along the edges must be sprayed with efficacious labeled herbicides to eliminate them from the area.
- In the following two years, plant fields with non-host crops; irrigate to promote volunteer potato sprouting, disking any volunteer potatoes as sprouting occurs. Fields must be tested semi-annually for four years after an initial positive find. Furthermore, no seed production can occur in the field for at least five years after detection of *Ralstonia solanacearum* race 3 biovar 2.

Potato Cropping Systems (cont.)

- Fields with susceptible hosts (potatoes or tomatoes) must be sampled for two seasons prior to any new seed production on the property. Fields adjacent to positive testing or associated fields, or those on a shared water supply, may **not** grow host crops for two years, **nor** seed potatoes for two years, and must test and control any volunteer potato or weed hosts.
- Maintain strict sanitation of all vehicles entering and leaving the infested fields.
- Storage facilities on properties with positive testing tubers must be held in quarantine until all potentially infested tubers are tested and either found to be negative or destroyed. The storage facilities must then be properly cleaned and disinfected with approved disinfectants in strict accordance with labeling.

Geraniums offshore:

(3) Any article of *Pelargonium* spp. or *Solanum* spp. that is from a country or area where *Ralstonia solanacearum* race 3 biovar 2 is known to occur must meet the following requirements:

(i) The national plant protection organization of the country in which the articles are produced (the NPPO) must have entered into a **bilateral workplan with APHIS**. This bilateral workplan must set out conditions for monitoring the production of articles of *Pelargonium* spp. and *Solanum* spp., for enforcement of the requirements of this paragraph (r)(3), and for the establishment of a trust fund as provided for in paragraph (r)(3)(xv) of this section.

(ii) The **production site** where the articles of *Pelargonium* spp. and *Solanum* spp. intended for export to the United States are produced must be **registered with and certified** by both APHIS and the NPPO. As part of the certification process, production sites must be initially approved and thereafter visited at least once a year by APHIS and the NPPO to verify compliance with the requirements of this paragraph (r)(3).

(iii) The **production site** must conduct **ongoing testing** for *R. solanacearum* race 3 biovar 2. Only articles of *Pelargonium* spp. and *Solanum* spp. from a group of articles that has been tested according to an APHIS-approved testing protocol with negative results for the presence of *R. solanacearum* race 3 biovar 2 may be used in production and export. **Records** of the testing must be kept for two growing seasons and made available to representatives of APHIS and of the NPPO. All testing procedures must be approved by APHIS.

(iv) Each greenhouse on the production site must be constructed in a manner that ensures that runoff water from areas surrounding the greenhouses cannot enter the greenhouses. The greenhouses must be surrounded by a **1-meter buffer that is sloped so that water drains away** from the greenhouses.

(v) Dicotyledonous **weeds must be controlled** both within each greenhouse on the production site and around it. The greenhouses on the production site and the 1-meter buffer surrounding them must be free of dicotyledonous weeds.

(vi) All **equipment** that comes in contact with articles of *Pelargonium* spp. or *Solanum* spp. within the production site must be adequately **sanitized** so that *R. solanacearum* race 3 biovar 2 cannot be transmitted between plants or enter from outside the production site via the equipment.

(vii) Production site personnel must adequately **sanitize their clothing and shoes and wash their hands** before entering the production site to prevent the entry of *R. solanacearum* race 3 biovar 2 into the production site.

(viii) **Growing media** for articles of *Pelargonium* spp. and *Solanum* spp. must be free of *R. solanacearum* race 3 biovar 2. Growing media and containers for articles of *Pelargonium* spp. and *Solanum* spp. must not come in contact with growing media that could transmit *R. solanacearum* race 3 biovar 2 and must be grown in an APHIS-approved growing medium.

(ix) **Water** used in maintenance of the plants at the production site must be free of *R. solanacearum* race 3 biovar 2. The production site must either derive the water from an APHIS-approved source or treat the water with an APHIS-approved treatment before use.

(xv) The government of the country in which the articles are produced must enter into a trust fund agreement with APHIS before each growing season. The government of the country in which the articles are produced or its designated representative is required to **pay in advance all estimated costs** that APHIS expects to incur through its involvement in overseeing the execution of paragraph (r)(3) of this section.



Product Overview

Test Label: NA
Test Format: ImmunoStrip
Capture Reagent: Monoclonal
Detection Reagent: Monoclonal



Intended Use:

This ImmunoStrip is a reliable tool for detection of *Ralstonia solanacearum* (*Rs*), the causal agent of Southern wilt, Moko disease of banana, and brown rot of potato. The test can be used to test bacterial cultures and plant tissue. The pathogen is frequently found in root, tuber, stem, and petiole tissue. Leaf tissue may also be tested.

This test is not recommended for testing the plant genus *Helleborus*, a member of the *Ranunculaceae* family. Internal data demonstrates that the *Ralstonia solanacearum* (*Rs*) ImmunoStrip Test may produce non-specific reactions (false positives) when testing root and crown material of *Helleborus*.

This test is an accepted method by the USDA-APHIS for detection of *Rs*, race 3 biovar 2, which is listed as a potential bio-terrorist pathogen.

This test does not require any special equipment or expertise to run. Results are obtained in as little as a few minutes.

Technical Information

Related Products

Ralstonia solanacearum

ImmunoStrip®
ISK 33900/0025

Includes:

- ImmunoStrips
- Sample bags containing BEB1 buffer
- [User Guide](#)

Size

ImmunoStrips

Quantity: x \$120.00 USD

Prices listed are US domestic prices.

[Update Cart](#)

The product you are ordering may not include all items necessary to run an assay. Please check out the related products section for a listing of items recommended for performing this assay.

??Questions??

