

# Virulence and epidemiology of *Puccinia graminis* f.sp. *tritici* in Ecuador in 2016

Charles Barnes

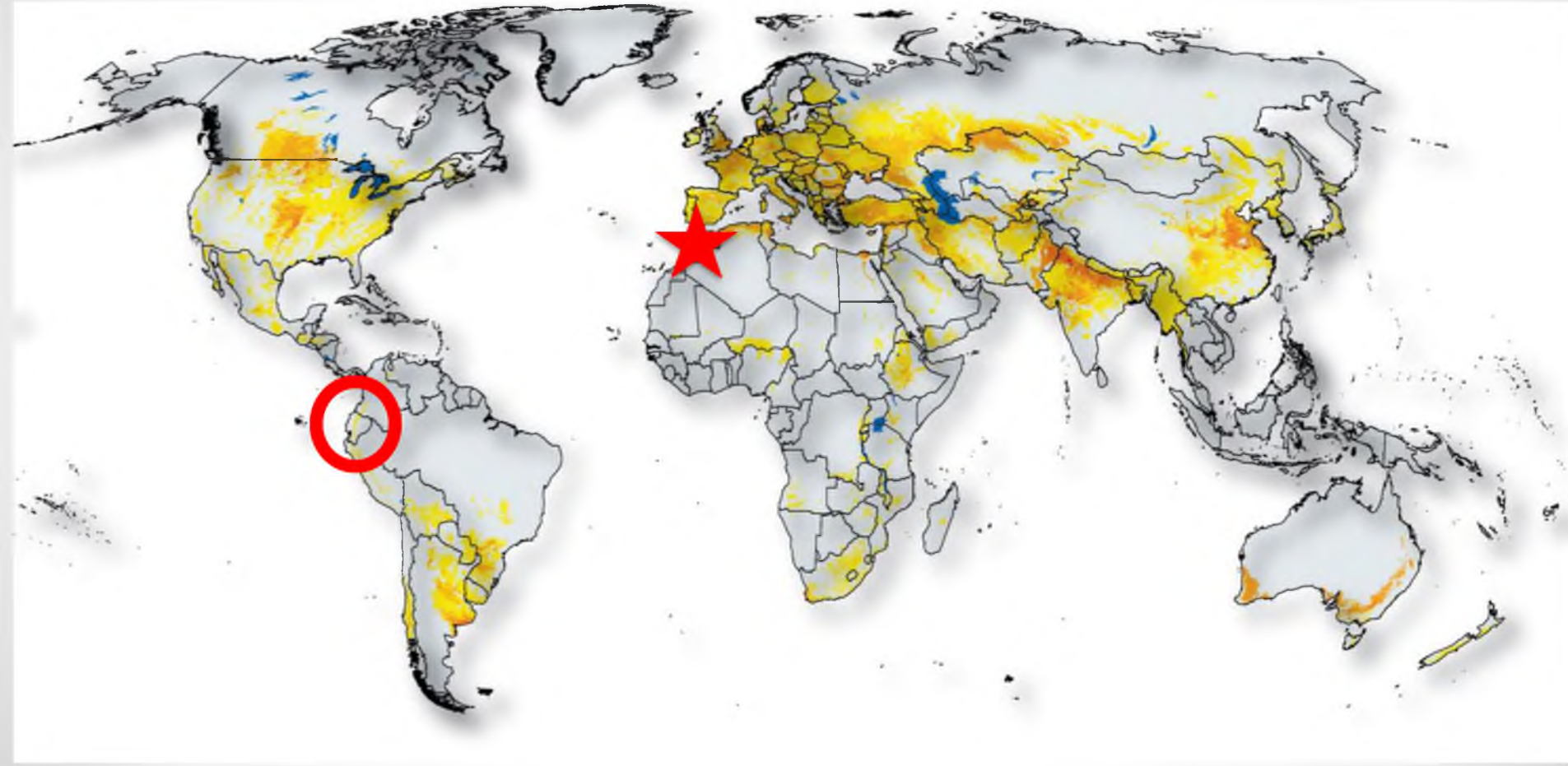


- Instituto Nacional de Investigaciones Agropecuarias
- National Agriculture Research Institute

# The Pgt Group

- **Ecuador**
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  - **Maria E. Ordóñez-PUCE**
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  - **Tom Fetch**
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  - **Kasia Dadej**
- **United States-USDA-ARS**
  - **Les Szabo**

# Wheat Growing Regions



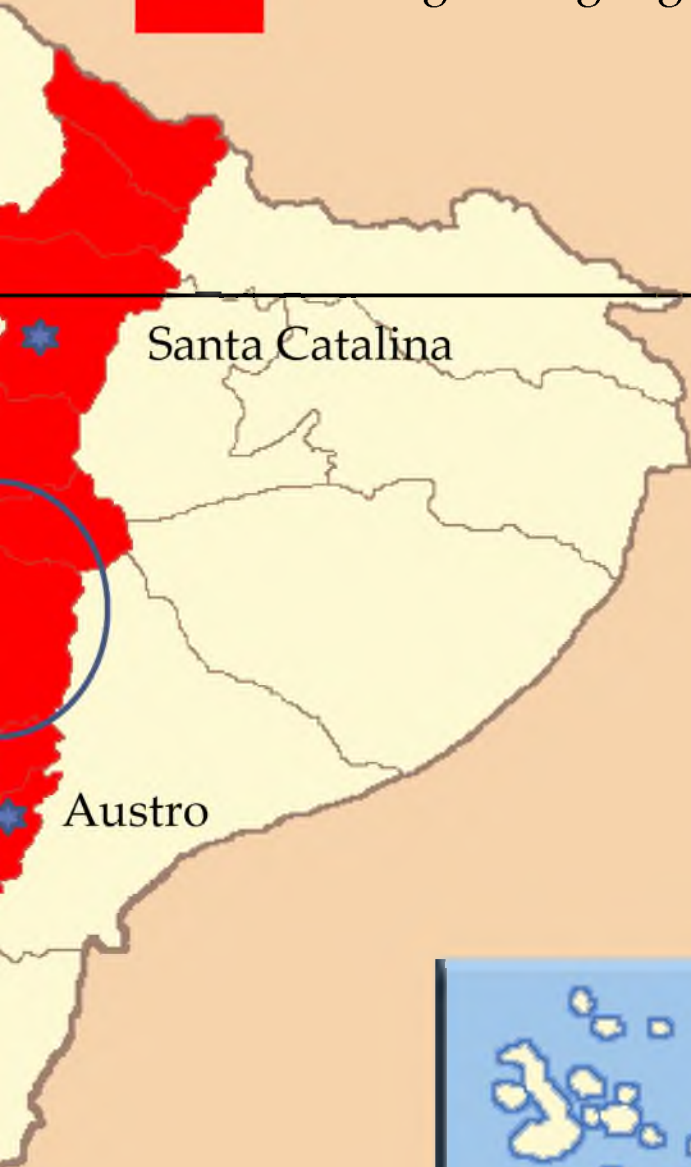
<http://wheat.org/wheat-in-the-world>

Equator

IAP - Estación Experimental Santa Catali



Cereal growing regions



Ecuador

Santa Catalina

Austro





3,060 masl  
10,045 ft

A photograph of a two-story building with a brick section on the left and a white section with a green roofline on the right. The brick section has the text 'SANTA CATALINA' and 'I.N.I.A.P.' in white. The white section has two rows of windows. In front of the building is a green lawn with two flagpoles. The background shows rolling hills under a blue sky with white clouds. The foreground is a dirt path.

SANTA CATALINA  
I.N.I.A.P.

INIAP - Estación Experimental Santa Catalina



# History of INIAP

- **1961.** INIAP was founded on a public farm of the National Wheat Commission- Now Santa Catalina
- **1966.** International wheat meeting, INIAP was designated Headquarters of High Altitude Wheat Research.



En la Reunión Internacional del Trigo, Ecuador fué designado Sede de Investigaciones de Trigos de Altura. Aquí, los especialistas asistentes visitan "Santa Catalina"



INIAP. - Estación Experimental Santa Catalina



Discusión  
Exposición  
Asesoría  
Retorno

1. Monte de los Técnicos
1. Vuelcos
  2. Fertilizantes
  3. Irrigación
  4. Paquete de Producción
  5. Extensión
  6. Rapido avance de producción

Son 64 / 1963  
60000 2 días  
21 días

9. Fullon  
2.1  
2.1 Step - 3.0 Step



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# Why Ecuador

## A lot of rust at Santa Catalina

- Oats
  - Grown all year long for cattle
  - Dominated by stem rust, some crown rust

# Why Ecuador

## A lot of rust at Santa Catalina

- Sentinel plot during off season
  - Leaf rust on wheat, barley, and rye in January-February
  - Stripe rust appears on wheat and barley mid February





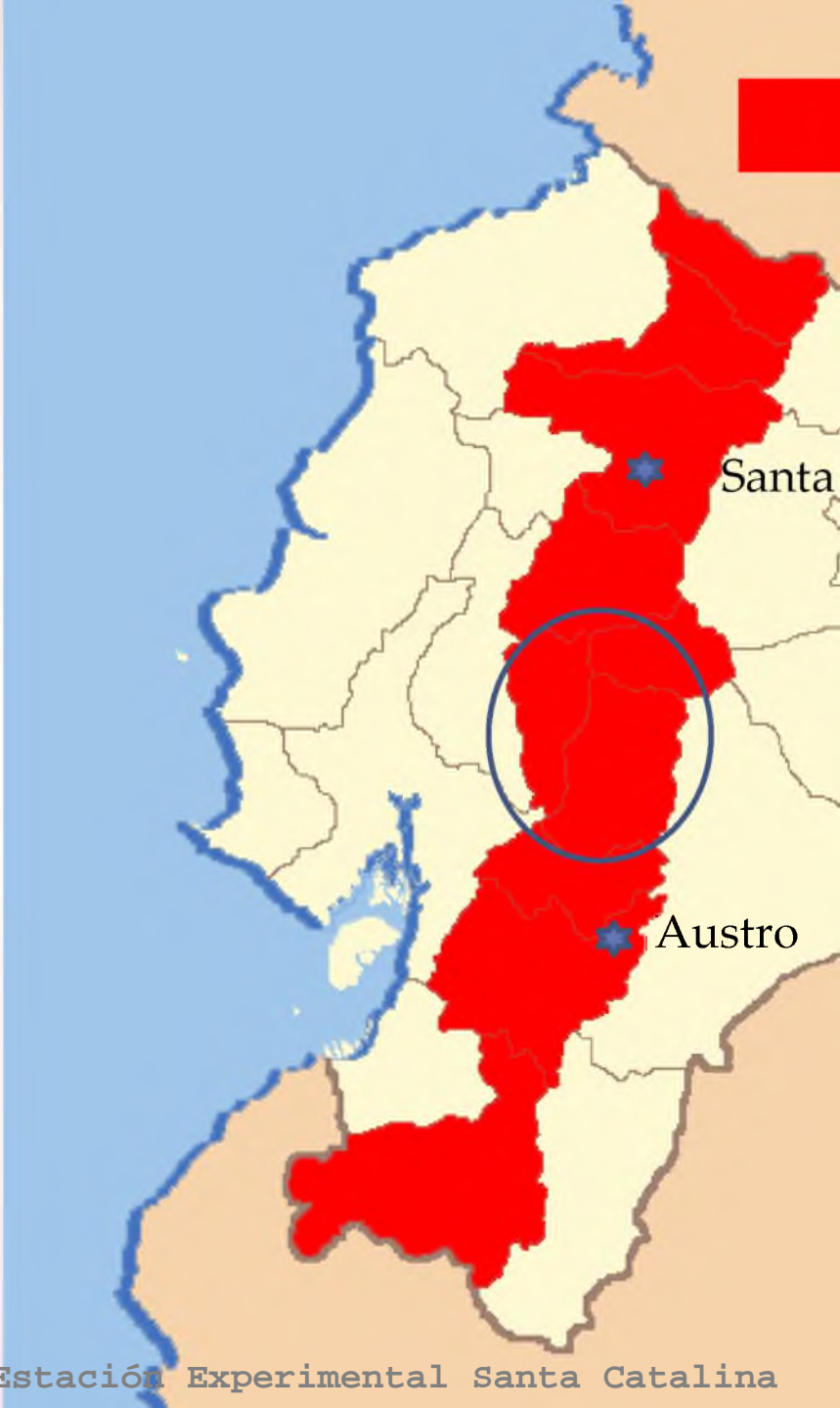
# Why Ecuador

## A lot of rust at Santa Catalina

- Cereals sown late Feb -harvested late July
  - Stripe rust predominates
    - 2015-2016, 96 samples of Psh, Pst, 53 races (X. Chen)
  - Stem rust on wheat and rye by the end of July
    - Races largely unknown, except for the RRTTF

# The 2 stations

- Santa Catalina
  - Evaluate > 2,000 lines per year
  - Wheat-CIMMYT-Mexico
  - Barley-U of Alberta, ICARDA-Morocco, PBI-Australia
- Austro
  - Small-mix of everything
  - Just a few lines, but more area



INIAP - Estación Experimental Santa Catalina

# Cereal growing regions



# The wheat in Austro

- UC-Davis line containing *Sr38*. UC11075
- Originally sent to the Austro Station in 2012
- Field size of 200 m<sup>2</sup> – but just one line
  - vs Santa Catalina 2,000+ lines
- February 2016 Pgt RRTTF outbreak.

A close-up photograph of a wheat spike. The spike is green and appears to be in the early stages of grain development. The surrounding wheat leaves and stems are heavily affected by a rust disease, showing prominent reddish-brown lesions and some necrotic damage. The background is a dense field of similar wheat plants.

RRTTF

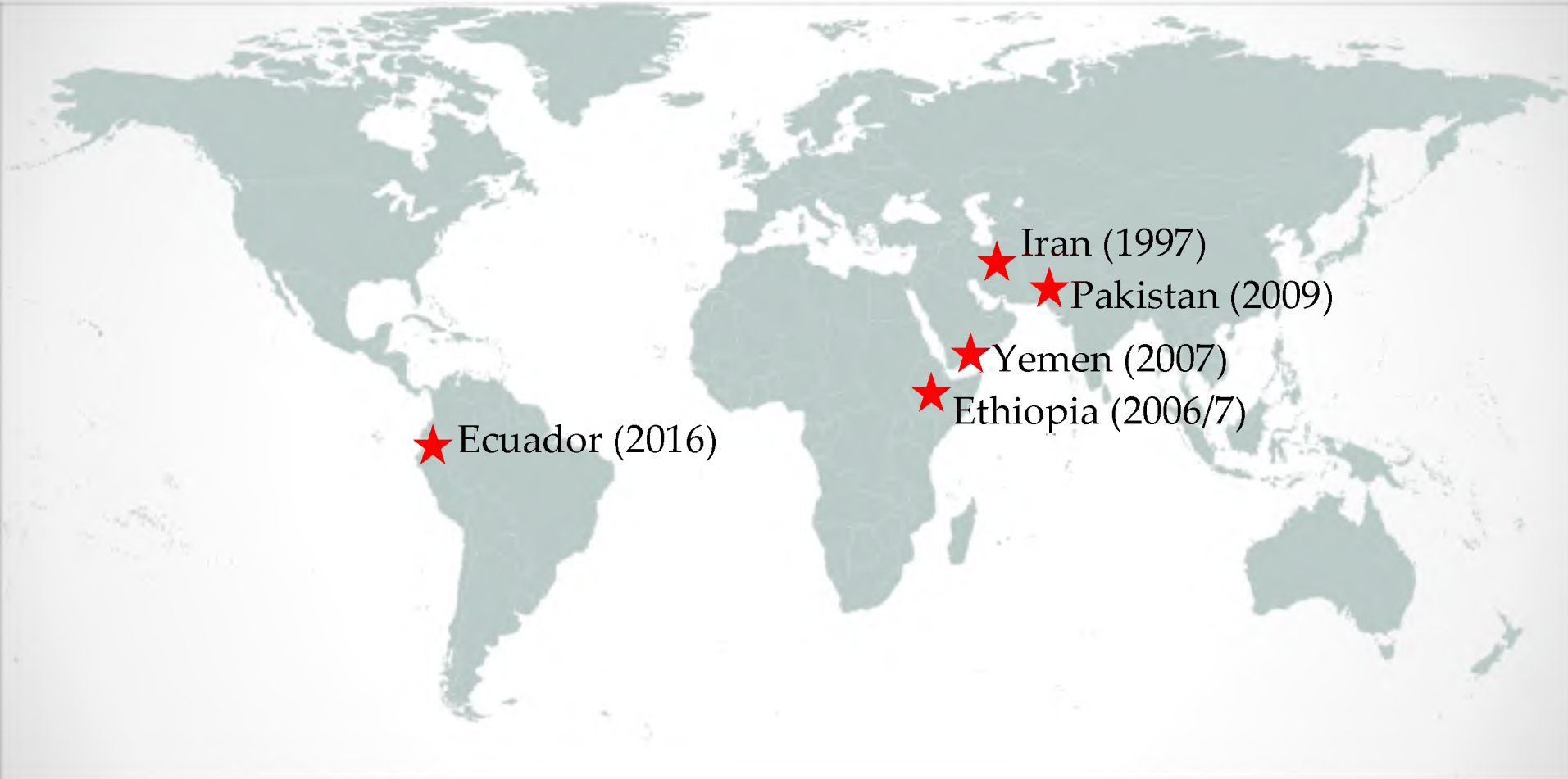


# Identification

- Pathotyped
  - RRTTF: Agriculture-Agri Food Canada-Morden
- Genotyped
  - SSR markers: Agriculture-Agri Food Canada-Ottawa
  - SNP markers: Cereal Disease Laboratory-MN USA/ Race Group III (RRTTF/TRTTF)
    - Matched samples from Ethiopia, Pakistan and Yemen



# Distribution of RRTTF



# Santa Catalina

- The RRTTF infections were not as severe
- Other races
  - Virulence on *Sr13*
  - Virulence on *Sr27*



# Severity

February 2016

Austro station (southern)



July 2016

Santa Catalina (northern)



Prevailing winds



# Spore movement



CAP - Estación Experimental Santa Catalina



Cereal growing regions





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# How prevalent is RRTTF?

- Was found in the north and south in Ecuador
- Little wheat grown in Ecuador, variable locations, variable sowing dates

Year	Production (FAOSTAT)	Year	Wheat Consumption (INIAP)
1969	94,100 tonnes	1964	9 kg/year
2016	6,746 tonnes	2015	43 kg/year

# Alternative hosts

- Lots of rusts on lots of grasses

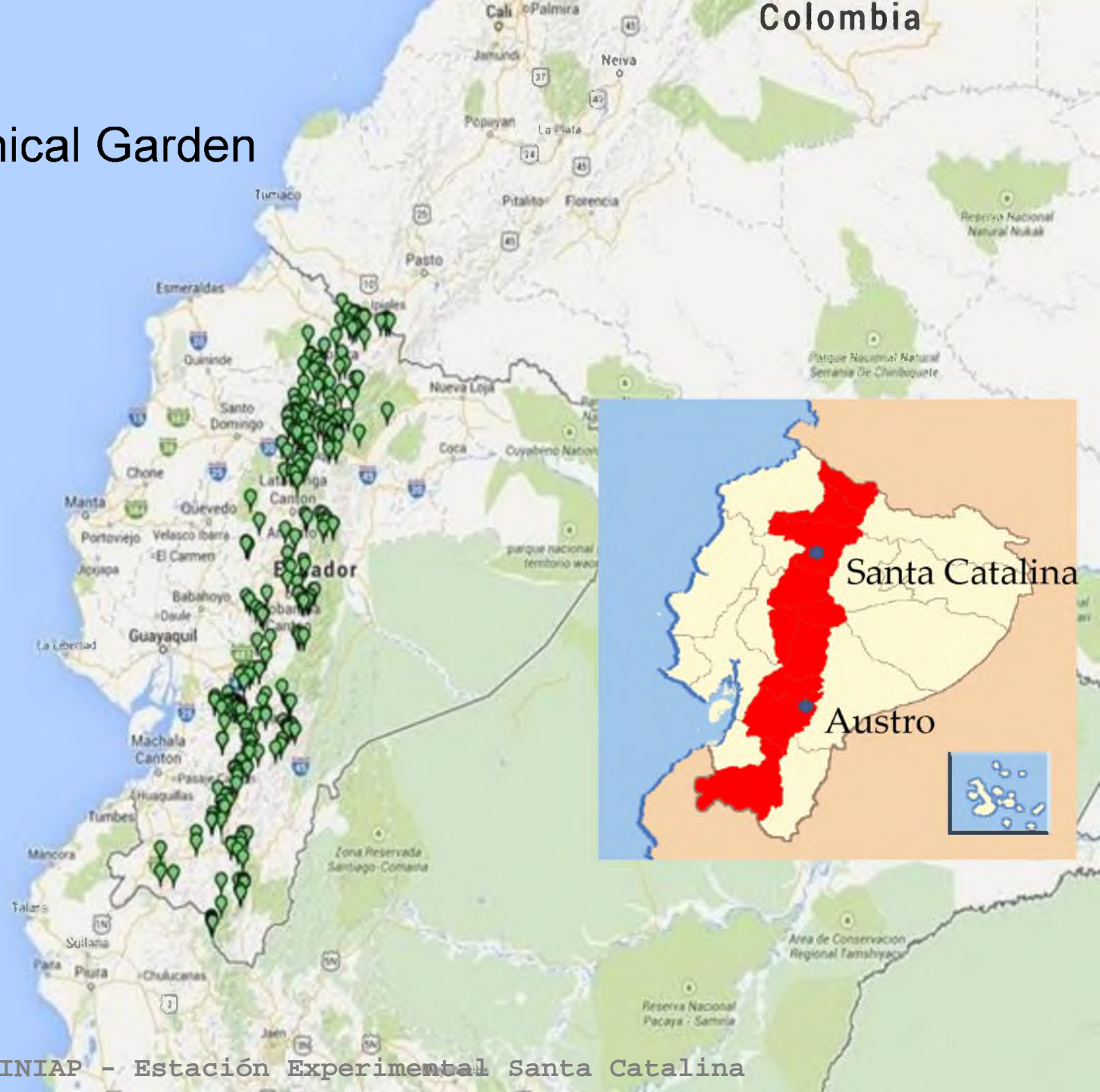
Host species	Rust species				ITS sequence			
	<i>Puccinia holcina</i>	<i>Puccinia coronata</i>	<i>Puccinia striiformis</i>	<i>Puccinia graminis</i>	<i>Puccinia</i> sp.	<i>Edythea</i> sp.	<i>Uromyces transversalis</i>	<i>Uromyces pencanus</i>
<i>Agrostis</i> sp.	-	-	-	-	3	-	-	-
<i>Anthoxanthum</i> sp.	-	-	2	3	2	-	-	-
<i>Bromus</i> sp.	-	-	-	-	2	-	-	-
<i>B. chatharticus</i>	-	-	1	-	-	-	-	-
<i>Dactylis glomerata</i>	-	-	1	-	-	-	-	-
<i>Holcus lanatus</i>	10	10	1	-	2	-	-	-
<i>Nasella</i> sp.	-	-	-	-	-	-	-	1
<i>Sporobulus</i> sp.	-	-	-	-	1	-	-	-
<i>Paspalum</i> sp.	-	-	-	-	-	1	-	-
Not identified	1	2	-	-	1	-	-	-
<i>Berberis</i> sp.	-	-	-	-	-	1	-	-
<i>B. grandiflora</i>	-	-	-	-	-	1	-	-
<i>B. hallii</i>	-	-	-	-	-	1	-	-
<i>Gladiolus</i> sp.	-	-	-	-	-	-	1	-
<i>Luzula</i> sp.	-	-	-	-	-	1	-	-
<b>Total</b>	<b>11</b>	<b>12</b>	<b>5</b>	<b>3</b>	<b>11</b>	<b>5</b>	<b>1</b>	<b>1</b>
<i>Lolium</i> sp.				1	1	<b>Visually</b>		
<i>Elymus</i> sp.				1				

# *Berberis* species

- Maybe 30 or more *Berberis* species in Ecuador
  - Tropicos website. Records 200+ years.
- 6 *Berberis* species from DNA sequence
- 7 rust species from DNA sequence
  - 6 *Edythea* species
  - 1 Pucciniales
  - No *Puccinia* to date
  - Every *Berberis* has a rust
- Hybridization? New Susceptibility?
  - Radhika Bartaula et al 2018



# From Tropicos Missouri Botanical Garden



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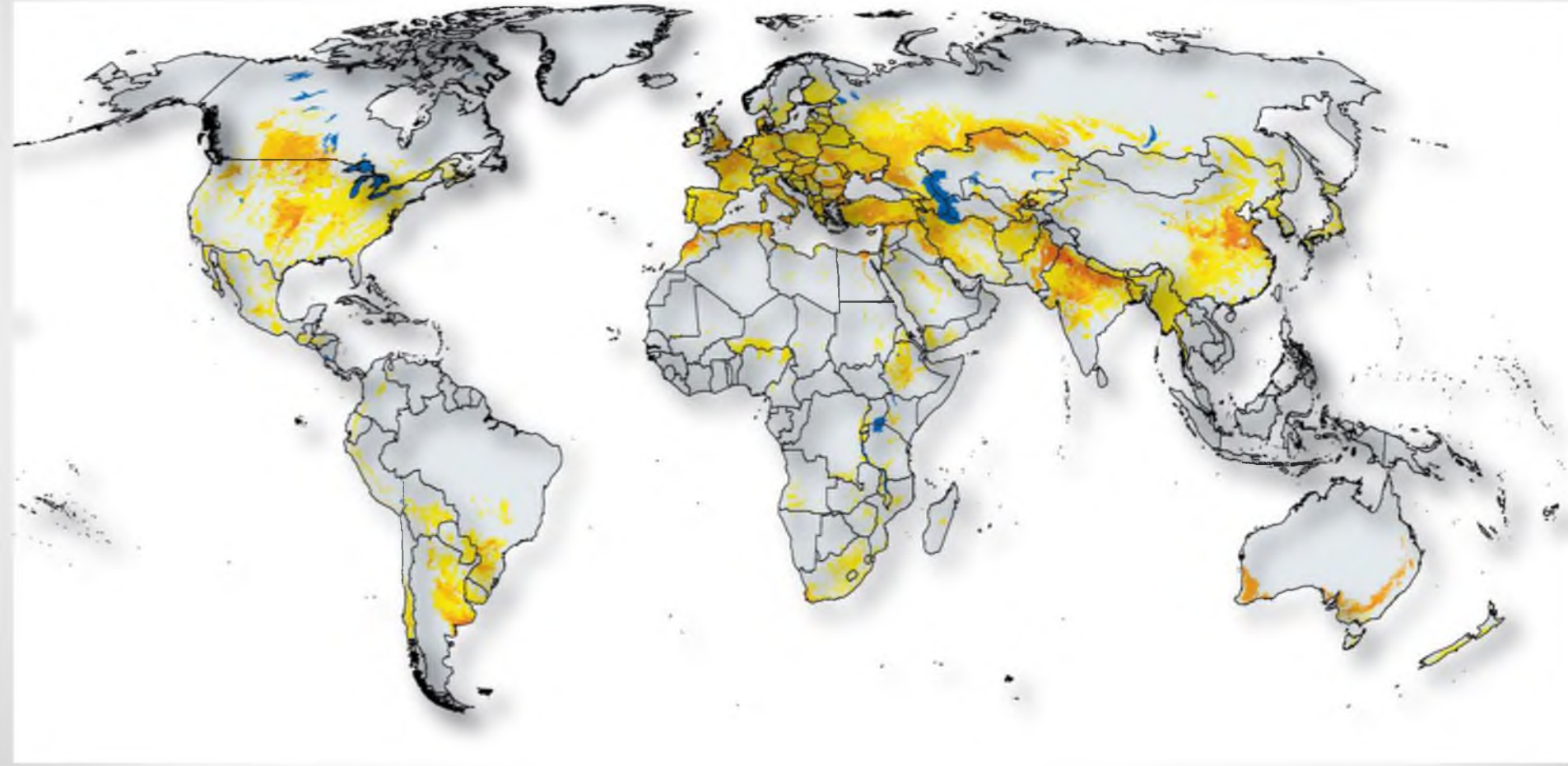




There is always rust



# Conclusion



<http://wheat.org/wheat-in-the-world>



A map of South America is shown, with several regions highlighted in yellow and orange, indicating areas of interest or surveillance. The highlights are concentrated in the northern and central parts of the continent, including Colombia, Venezuela, Ecuador, Peru, and Bolivia. The rest of the continent is shown in a light gray color.

# Global surveillance is important



Thank you

# Special Thank you to

- BGRI
- Delivering Genetic Gain in Wheat  
Project-Cornell University