

Phytophthora infestans and *andina* populations of Peru



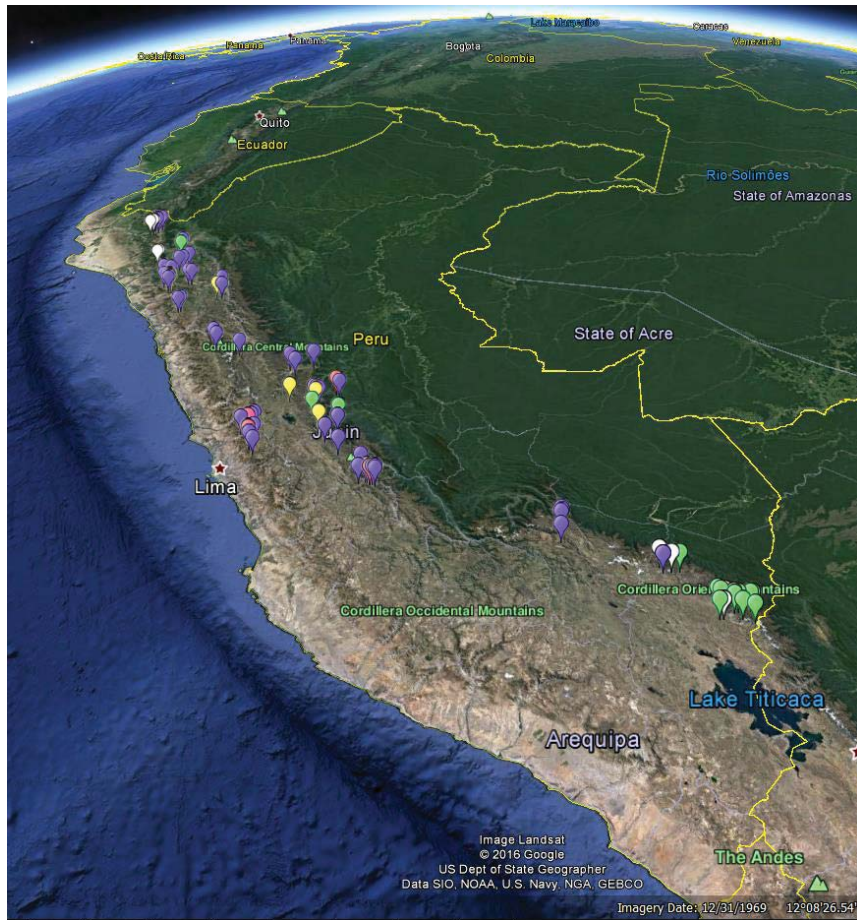
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Mirian Correa, Almendra Astete







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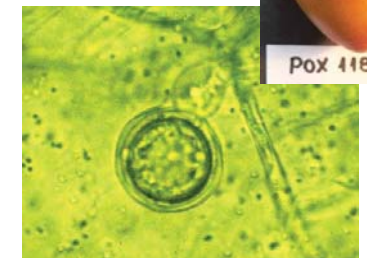
Blight in the Peruvian Andes



	Clonal lineage	Mt-haplotype	Mating type	
	PE-3	la	A1	<i>P. infestans</i>
	PE-7	la		
	US-1	lb		
	EC-1	lla		
	new	?		
	PE-8	lc	A2	<i>P. andina</i>

P. andina in Peru

Host	Country	Isolation year	No. of isolates	mtDNA haplotype	RFLP	Mating type
<i>S. betaceum</i>	Peru	2003–2008	18	lc	PE-8	A2
<i>S. betaceum</i>	Ecuador	1998–2005	8	la	EC-3	A1
<i>S. betaceum</i>	Colombia	2009	15	n.a.	CO-1	n.a.
<i>S. brevifolium</i>	Ecuador	1997–1998	2	lc	EC-2.1	A2
<i>S. tetrapetalum</i>	Ecuador	1997–1998	2	lc	EC-2	A2



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Doi: 10.1111/ppa.12531

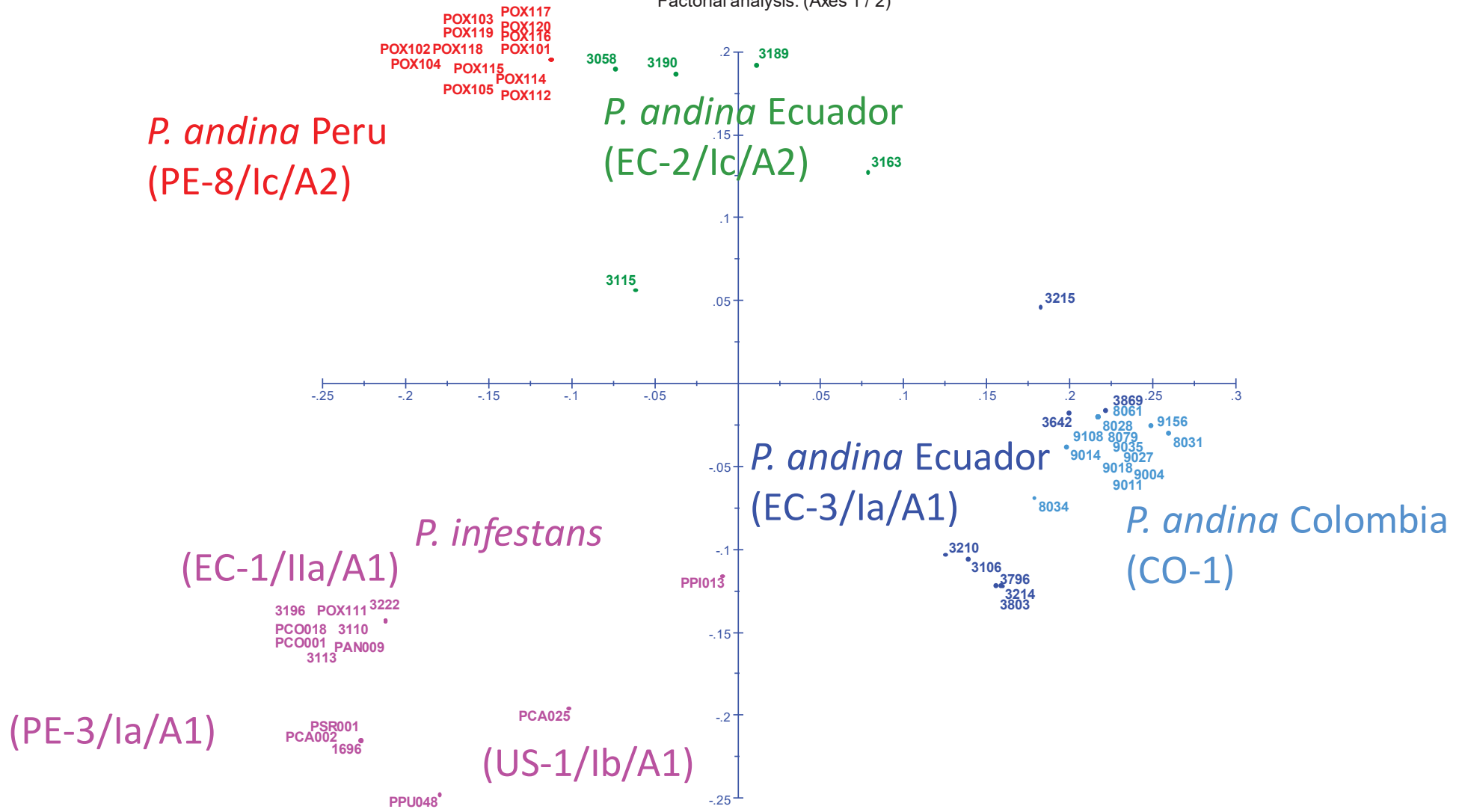


Identification of an A2 population of *Phytophthora andina* attacking tree tomato in Peru indicates a risk of sexual reproduction in this pathosystem

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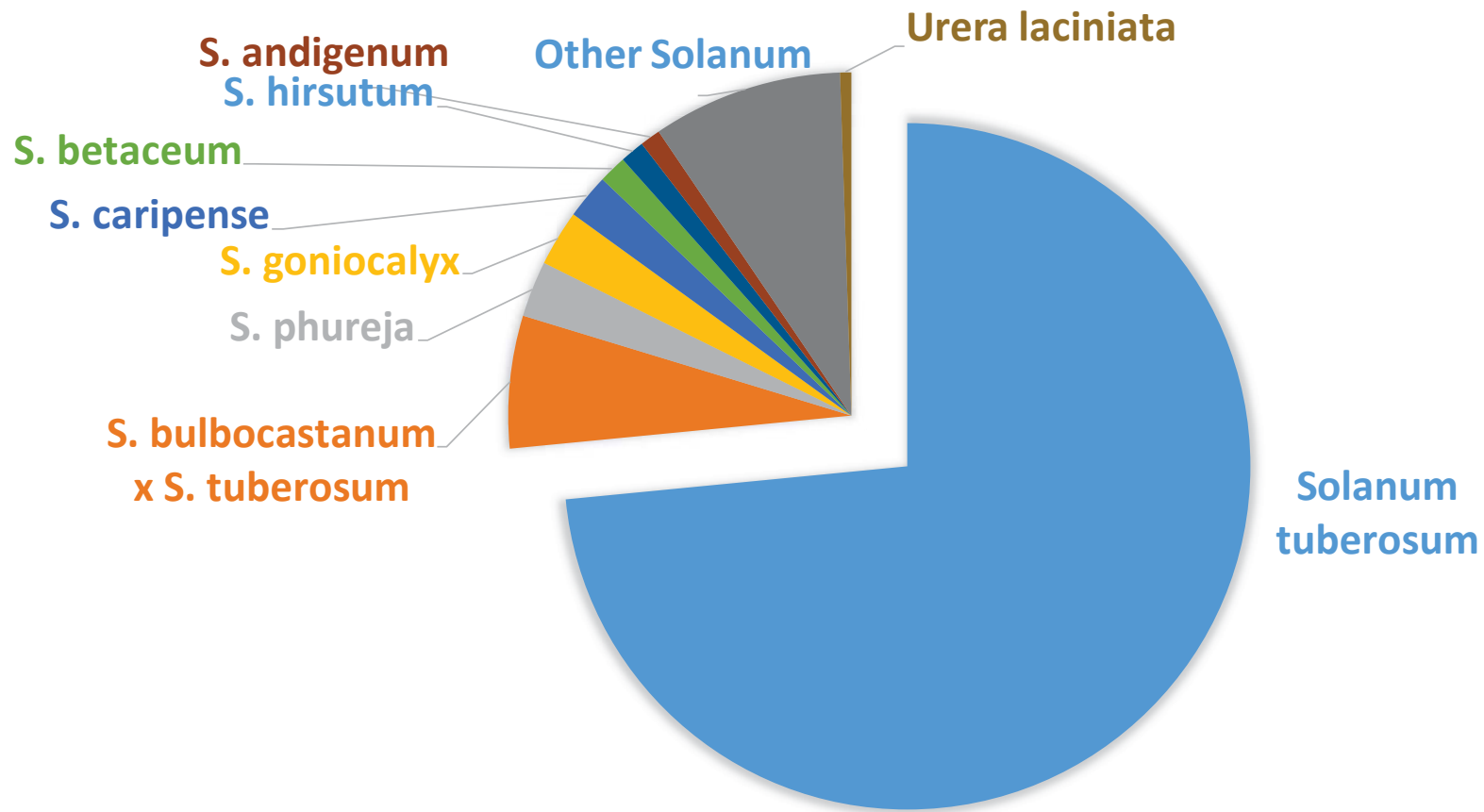
Factorial analysis: (Axes 1 / 2)



Role of wild hosts as source of inoculum

- *P. andina* infecting tree tomato in Peru is likely a result of gene flow from wild relatives
- To what extent is this happening in *P. infestans* infecting potato?

Host species of *Phytophthora* isolates in CIP collection (until 2013)

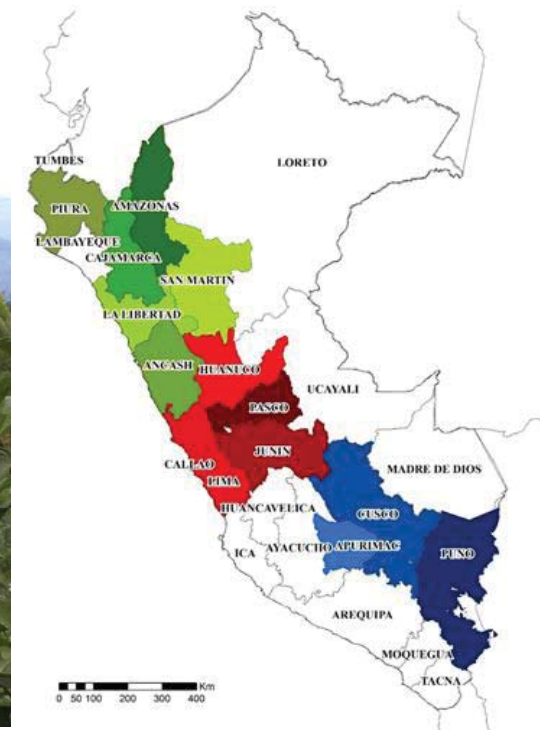


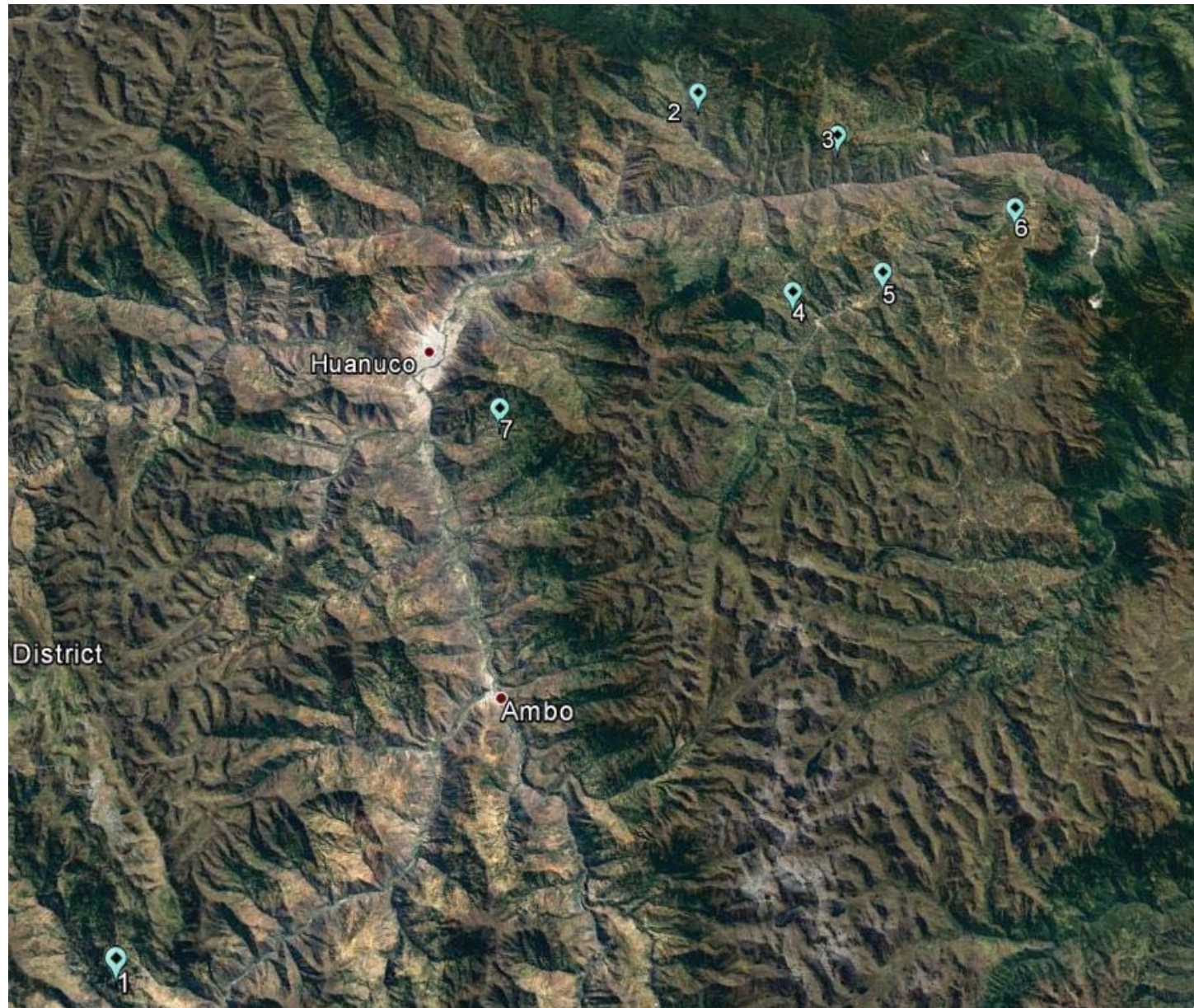
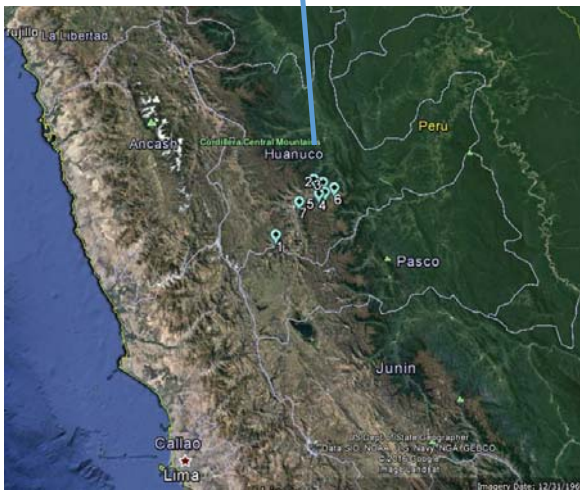
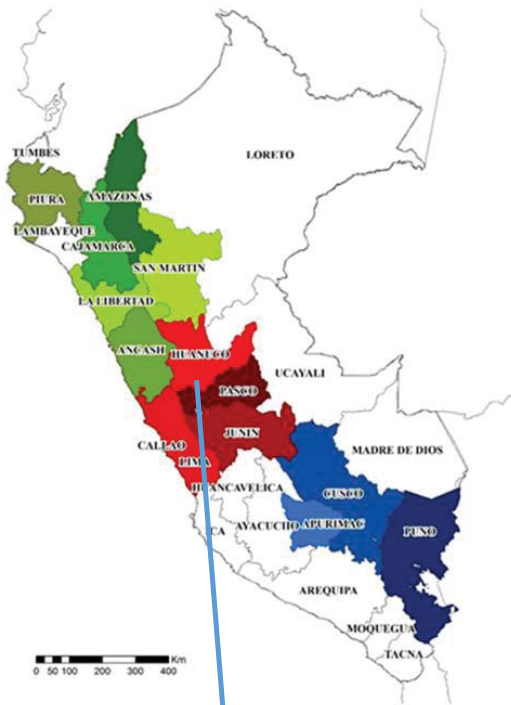
Phytophthora isolates from Solanaceous hosts in Peru characterized



Host	Isolation year	mtDNA haplotype
<i>Solanum tuberosum</i>	1996-2009, 2013	Ila/EC-1, Ia/PE-3, Ib/US-1, NEW
<i>S. andigena</i>	1999-2003	Ila/EC-1
<i>S. billhookerii</i>	1999	Ila/EC-1
<i>S. caripense</i>	1999-2000	Ila/EC-1, Ib/US-1
<i>S. goniocalyx</i>	1999-2013	Ila/EC-1, Ia/PE-3, Ia/PE-7
<i>S. grasilifrons</i>	1999	Ila/EC-1
<i>S. hypocrathrum</i>	1999-2000	Ila/EC-1
<i>S. mochiquense</i>	1999	Ila/EC-1
<i>S. sogarandinum</i>	1999	Ila/EC-1
<i>S. urophyllum</i>	1999	Ila/EC-1
<i>S. wittmackii</i>	1999-2000	Ila/EC-1
<i>S. huancabambense</i>	2000	Ila/EC-1
<i>S. piurae</i>	2000	Ila/EC-1, Ib/US-1
<i>S. medians</i>	2000	Ila/EC-1, Ia/PE-7
<i>S. raquialatum</i>	2000	Ia/PE-3, Ib/US-1
<i>S. paucisectum</i>	2000-2003	Ila/EC-1
<i>S. phureja</i>	2000-2008	Ila/EC-1
<i>S. chaucha</i>	2000-2009	Ila/EC-1, Ia/PE-3
<i>S. bulbocastanum</i>	2000-2009	Ila/EC-1
<i>S. chiquidenum</i>	2008	Ila/EC-1
<i>S. cajamarquense</i>	2008	Ib/US-1
<i>S. lycopersicum</i>	2008	Ila/EC-1
<i>Lycopersicon sp.</i>	1999-2000	Ila/EC-1, Ib/US-1
<i>L. peruvianum</i>	1996-1999	Ila/EC-1
<i>L. hirsutum</i>	1999-2000	Ila/EC-1, Ia/PE-7, Ib/US-1
<i>Physalis sp.</i>	2000	Ila/EC-1
<i>S. betaceum</i>	2003-2008	Ic/PE-8

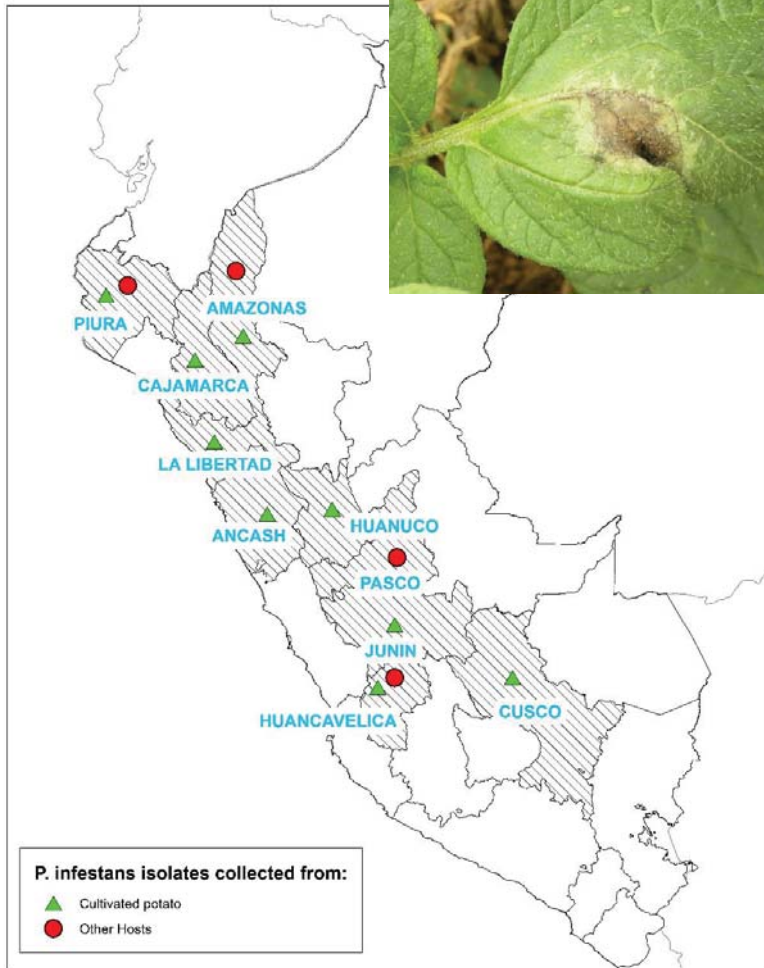
2016-2017 new country-wide sampling extending to cultivated potato and alternative Solanaceous hosts



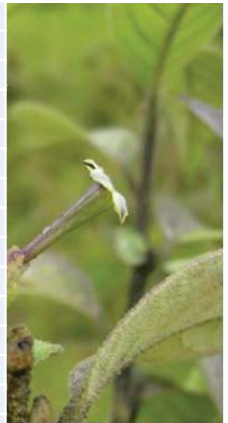




Sampling: cultivated potato



Departament	Living isolates	FTA cards
Cajamarca	11	50
Ancash	19	66
Huancavelica	55	78
Piura	17	45
Amazonas	20	48
Huanuco	13	60
La Libertad	7	25
Junin	47	74
Cusco	17	37
TOTAL	142	483



Nicandra physalodes (L.) Gaertn.

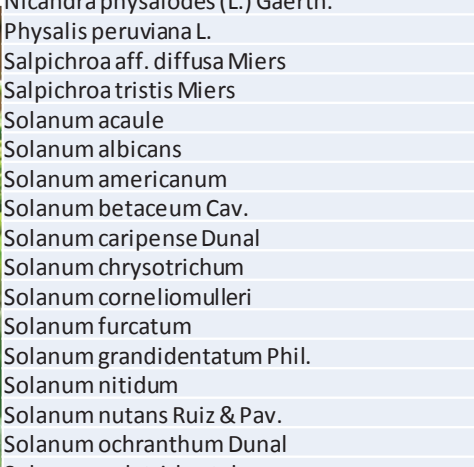
Salpichroa tristis Miers

Salpichroa aff. diffusa Miers

Physalis peruviana

Iochroma grandiflorum Benth.

Iochroma umbellatum L. f.



Cestrum sp.

Acnistus arborescens (L.) Schlttdl

Browallia americana L.

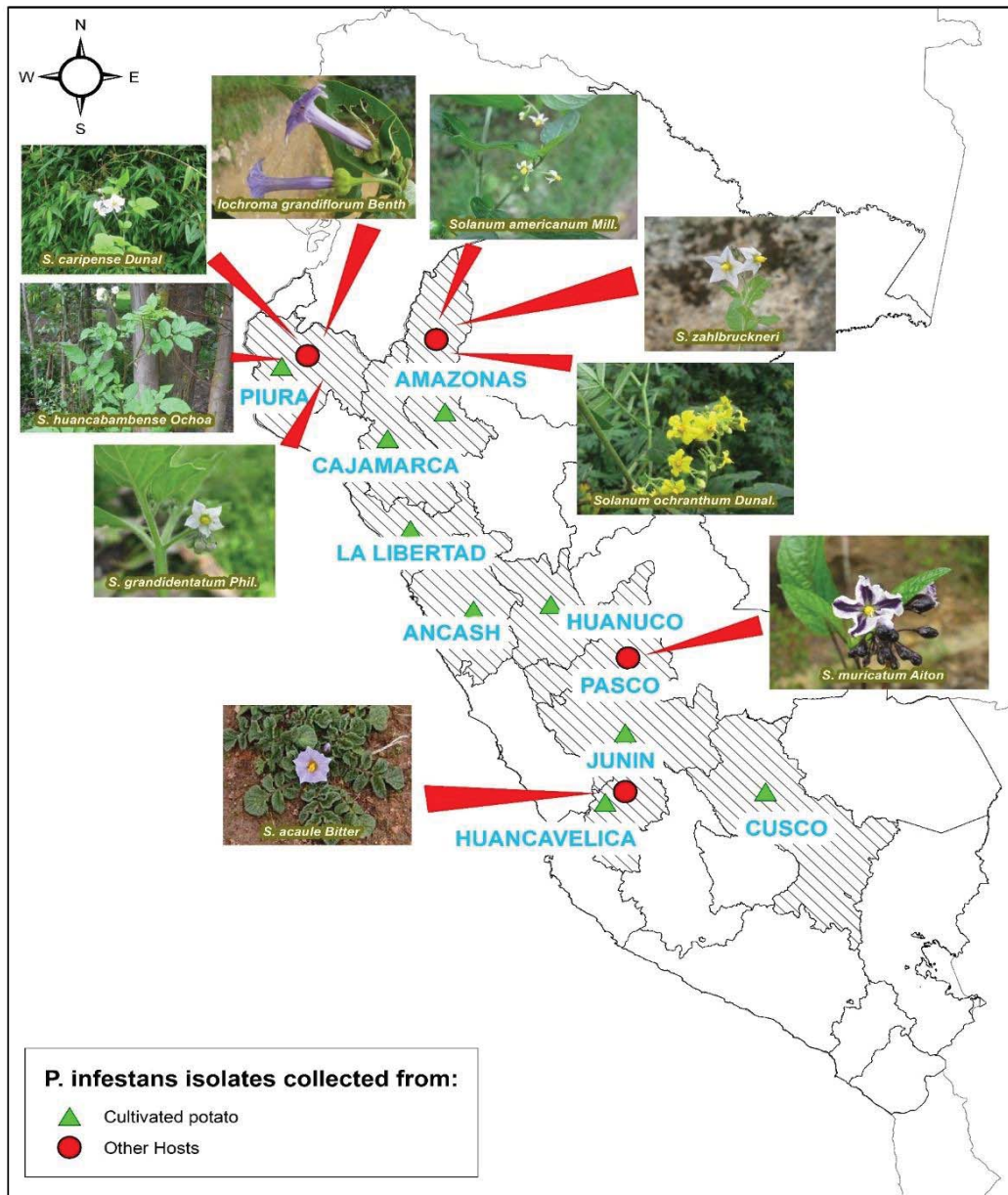
Iochroma umbellatum

Iochroma grandiflorum Benth.

Iochroma grandiflorum Benth.

LISTA DE ESPECIES

- Acnistus arborescens (L.) Schlttdl.
- Browallia americana
- Brugmansia sanguinea (Ruiz & Pav.) D. Don
- Capsicum pubescens Ruiz & Pav.
- Cestrum auriculatum
- Cestrum falcatum
- Cestrum sp.
- Cestrum tomentosum L. f.
- Iochroma grandiflorum Benth.
- Iochroma umbellatum
- Jaltomata dentata
- Jaltomata hererae
- Jaltomata incahuasina Mione & Leiva, S.
- Jaltomata propinqua
- Jaltomata sinuosa (Miers) Mione
- Lycianthes acutifolia Ruiz & Pav.
- Lycianthes lycioides
- Lycianthes sp.
- Nicandra physalodes (L.) Gaertn.
- Physalis peruviana L.
- Salpichroa aff. diffusa Miers
- Salpichroa tristis Miers
- Solanum acaule
- Solanum albicans
- Solanum americanum
- Solanum betaceum Cav.
- Solanum caripense Dunal
- Solanum chrysostrichum
- Solanum corneliomulleri
- Solanum furcatum
- Solanum grandidentatum Phil.
- Solanum nitidum
- Solanum nutans Ruiz & Pav.
- Solanum ochranthum Dunal
- Solanum polytrichostylum
- Solanum rubicaule S.R. Stern
- Solanum trachycarpum Bitter & Sodiro
- Solanum zahlbruckneri



Wild solanaceas found infected with *P. infestans*

- S. americanum*
- S. zahlbruckneri*
- S. ochranthum*
- S. candolleanum*
- S. acaule*
- S. muricatum*
- lochroma grandiflorum*
- S. grandidentatum*
- S. caripense*
- S. huancabambense*

Isolates from alternate hosts

Host	Nr	Department	virulence	Metaxyl	Mt haplotype
<i>S. americanum</i>	2	Amazonas	1,3,4,7,10,11	R	Ila
<i>S. zambukneri</i>	3		4	S	Ib
<i>S. ochrantum</i>	5		*	S	*
<i>S. candolleanum</i>	1		*	*	*
<i>S. acaule</i>	1	Huancavelica	1,3,4,7,10,11	R	Ila
<i>S. muricatum</i>	3	Pasco	*	*	*
<i>Lochroma grandiflorum</i>	2	Piura	1,3,4,7,10,11	R	Ila
<i>S. grandidentatum</i>	2		1,3,4,7,10,11	R	Ila
<i>S. caripense</i>	5		*	*	*
<i>S. huancabambense</i>	3		*	*	*

Pathogenicity Tests



Ipomoea grandiflorum: mt DNA IIa

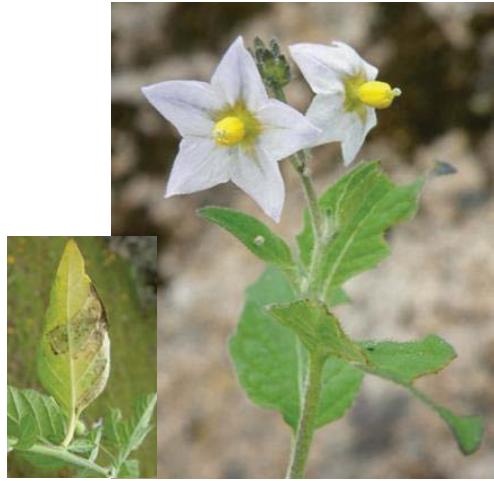
Inoculated on



S. lycopersicum



S. tuberosum var. Yungay



Solanum zahlbruckneri
Mt DNA Ib

Inoculated on



S. lycopersicum



S. tuberosum var. Yungay



Solanum ochrantum

Inoculated on



S. lycopersicum



S. tuberosum var. Yungay

Next steps

- 12 plex SSR in collaboration with Ristaino lab, NCSU:
 - ~ 600 new isolates (living & FTA)
 - ~ 200 old isolates from CIP collection
- database
- NGS in collaboration with Meulia lab, OSU (CGIAR-Borlaug Fellowship to Myriam Izarra):
 - GBS of 48 diverse isolates
 - RNAseq of 4 diverse isolates (3 time points, 3 biological replicates)

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- Soledad Gamboa
- Willmer Perez
- Myriam Izarra
- Mirian Yanina Correa
- Almendra Astete

PNIA

Programa Nacional de Innovación Agraria

Taller en técnicas de colección, aislamiento,
análisis fenotípico y caracterización molecular:
Phytophthora infestans y *Ralstonia solanacearum*

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2016

