Status of the genera *Phytophthora* and *Pythium* in Argentina

H.E. Palmucci, S.M. Wolcan, P.E. Grijalba

Phytopathology Chair Faculty of Agronomy. University Buenos Aires
CIC, Research Center of Phytopathology, UNLP Argentina
In order to have a more comprehensive vision of these fungi, a review and updating of recent progress in this matter in Argentina was carried out.
Materials and Methods

Information was taken from printed sources

- **primary:** proceedings of national and international Scientific Meetings; Bulletins from National Institutions and Universities, Journals and books.

- **secondary:** data bases and on-line sources.
Data bases

- AGRIS 1991-2001
- CABPESTCD 1973-1988
  CABPESTCD 1989-1999/05
- CABPESTCD 2000/01-2001/02
On line sources

• EBSCO Journal Service (2008)  
  http://web.ebscohost.com/
• Cab, Biological Abstracts, Food Science & Tech. Abstracts (2008)  
  http://web5.silverplatter.com/webspirs
• Crossref - ScienceDirect (2008)  
  http://www.sciencedirect.com/
• Scopus (2008)  
  http://www.sciencedirect.com/
Results of records of Plant Pathology Laboratories from 1920 to 1950 taken from Phytopathological Atlas of Argentina (Atlas Fitopatológico de Argentina = www.fitopatoatlas.org.ar)
Results

- Information was analyzed and categorized.
- An inventory was brought up to date about:

  * number of species of both genera
  * geographical distribution
  * hosts affected
  * races, sp. nov. described
  * economic damages
  * research topics
More than 150 species in the world

The first species reported in Argentina was *Pythium ultimum* in 1937 infecting *Beta vulgaris* and *Brassica oleraceae*

To date: 17 *Pythium* species have been reported on 235 hosts
Genus *Pythium*

1. *P. acanthicum* Drechsler
2. *P. aphanidermatum* (Edson) Fitzp
3. *P. catenulatum* V.D. Matthews
4. *P. debaryanum* R. Hesse
5. *P. dissotocum* Drechsler
6. *P. graminicola* Subraman
7. *P. intermedium* de Bary
8. *P. irregulare* Buisman
9. *P. mastophorum* Drechsler
10. *P. oligandrum* Drechsler
11. *P. periplocum* Drechsler
12. *P. polymorphon* Sideris
13. *P. rostratum* E.J. Butler
14. *P. spinosum* Sawada
15. *P. torulosum* Coker & P. Patt.
16. *P. ultimum* Trow
17. *P. vexans* de Bary
The results were presented using tables, maps and graphics.

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>HOST</th>
<th>SYMPTOMS</th>
<th>PROVINCE</th>
<th>REFERENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>P. aphanidermatum</em></td>
<td><em>Pisum sativum</em></td>
<td>Root rot</td>
<td>Cba.</td>
<td>Frezzi, 1956</td>
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<tr>
<td>(Edson) Fitzp.</td>
<td><em>Fragaria vesca</em></td>
<td>Root rot</td>
<td>Cba.</td>
<td>Frezzi, 1956</td>
</tr>
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<td><em>Beta vulgaris</em></td>
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<td>Cba.</td>
<td>Frezzi, 1956</td>
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<td>Frezzi, 1956</td>
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<td><em>Cereus aethiops</em></td>
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<td>Frezzi, 1956</td>
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<td>Cba.</td>
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<td>B A.</td>
<td>Frezzi, 1977</td>
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<td>Cba.</td>
<td>Frezzi, 1956</td>
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<td>Cba.</td>
<td>Frezzi, 1956</td>
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<td><em>Phaseolus vulgaris</em></td>
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<td>Cba.</td>
<td>Frezzi, 1956</td>
<td></td>
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<td><em>Euphorbia pulcherrima</em></td>
<td>Stem and root rot</td>
<td>Bs As.</td>
<td>Palmucci and Grijalba, 2007</td>
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</table>
Geographical distribution

|                | Jul | Sal | Tuc | Cat | SE | Mls | Cha | Ctc | ER | Sp | Fst | Cba | Mza | LR | SL | Sj | BA | LP | RN | Chu | SC | Neu | TF | IM | Prov/sp |
|----------------|-----|-----|-----|-----|----|-----|-----|-----|----|----|-----|-----|-----|-----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|
| P. acanthicum  |     |     | X   |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |     |     |     |     |     | 1   |
| P. aphanidermatum| X  |     |     |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 3   |
| P. catenulatum  |     | X  |     |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 2   |
| P. debaryanum   | X   | X  |     |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 14  |
| P. dissotocum   | X   | X  |     |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 3   |
| P. graminicola  |     | X  |     |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 1   |
| P. intermedium  |     | X  |     |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 3   |
| P. irregularre  |     | X  |     |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 4   |
| P. mustophorum  |     | X  |     |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 1   |
| P. oligandrum   |     | X  |     |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 2   |
| P. periplocom   |     | X  |     |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 2   |
| P. polymorphon  |     | X  |     |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 2   |
| P. roristatum   |     | X  |     |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 1   |
| P. spinosum     |     | X  |     |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 2   |
| P. turolosoum   |     | X  |     |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 1   |
| P. ultimum      | X   | X  | X   |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 14  |
| P. vexans       |     | X  |     |     |    |     |     |     |    |    |     |     |     |     |    |    |    |    |    |    |    |     |     |     |     | 3   |
| sp/provinces    | 3   | 3  | 6   | -   | -  | 5   | -   | 3   | 2  | 1  | 2   | 16  | 2   | 2   | 3   | -  | 4  | 2  | 2  | 1  | 1  | 1   | -   | 1   |
### Groups of crops affected by the different *Pythium* spp

<table>
<thead>
<tr>
<th><em>Pythium</em> spp</th>
<th>HOSTS</th>
<th>HORTICULTURAL CROPS</th>
<th>ORNAMENTAL CROPS</th>
<th>FOREST CROPS</th>
<th>FRUIT CROPS</th>
<th>FODDER CROPS</th>
<th>OLEAGINOUS/INDUSTRIAL CROPS</th>
<th>CEREALS</th>
<th>PALMS</th>
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<td><em>P. acanthicum</em></td>
<td>2</td>
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<td><em>P. irregulare</em></td>
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<td>2</td>
<td>2</td>
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<td><em>P. mastophorum</em></td>
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<td><em>P. oligandrum</em></td>
<td>8</td>
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<td>3</td>
<td>1</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td><em>P. periplocum</em></td>
<td>2</td>
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</tr>
<tr>
<td><em>P. polymorphon</em></td>
<td>3</td>
<td>1</td>
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<td>1</td>
<td>1</td>
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</tr>
<tr>
<td><em>P. spinosum</em></td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><em>P. torulosum</em></td>
<td>1</td>
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<tr>
<td><em>P. ultimum</em></td>
<td>91</td>
<td>20</td>
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<td>33</td>
<td>2</td>
<td>3</td>
<td>7</td>
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<tr>
<td><em>P. vexans</em></td>
<td>8</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td></td>
<td></td>
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</tbody>
</table>
Percentage of *Pythium* species found in Argentina

- P.acant: 6.4%
- P.aphanid: 38.7%
- P.catenul: 23.4%
- P.debary: 12.3%
- P.dissot: 6.4%
- P.graminic: 23.4%
- P.intermed: 12.3%
- P.irregul: 38.7%
- P.mastoph: 12.3%
- P.ologand: 6.4%
- P.periploc: 23.4%
- P.polim: 12.3%
- P.rostrat: 38.7%
- P.spinos: 12.3%
- P.torulos: 6.4%
- P.ultimun: 23.4%
- P.vexans: 12.3%
### Species most affecting the hosts

<table>
<thead>
<tr>
<th>Species</th>
<th>Hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>P. ultimun</strong></td>
<td>- Horticultural crops&lt;br&gt;- Ornamental crops&lt;br&gt;- Industrial crops&lt;br&gt;- Forest crops</td>
</tr>
<tr>
<td><strong>P. debaryanum</strong></td>
<td>- Horticultural crops&lt;br&gt;- Forest crops (Fruit rot in <em>Cucurbitaceous</em> in post harvest <em>Ipomea batata, Arachis hypogea</em>)</td>
</tr>
<tr>
<td><strong>P. irregulare</strong></td>
<td>- Ornamental crops&lt;br&gt;- Horticultural crops <em>Arachis hypogea, Nicotiana tabacum</em></td>
</tr>
<tr>
<td><strong>P. aphanidermatum</strong></td>
<td>- Horticultural crops (Fruit rot in <em>Cucurbitaceas</em>)</td>
</tr>
</tbody>
</table>
Regional maps show the distribution of *Pythium* spp.
This genus includes more than 100 species in the world.

The first plant disease caused by *Phytophthora* in Argentina was reported at the end of 1800’s.

Up to date 18 species have been determined on 180 hosts.
Genus *Phytophthora*

1. *P. austrocedrae* Gresl. & E.M. Hansen
2. *P. boehmeriae* Sawada
3. *P. cactorum* (Lebert & Cohn) J. Schröt
4. *P. cambivora* (Petri) Buisman
5. *P. capsici* Leonian
6. *P. cinnamomi* R.D. Rands
7. *P. citricola* Sawada
8. *P. citrophthora* (R.E.Sm .& E.H. Sm.) Leonian
9. *P. cryptogea* Pethybr. & Laff
10. *P. drechsleri* Tucker
11. *P. gonapodyides* (H:E. Petersen) Buisman
12. *P. infestans* (Mont.) de Bary
13. *P. medicaginis* E.M. Hansen & D.P. Maxwel
14. *P. megasperma* Drechsler
15. *P. nicotianae* Breda de Hann
16. *P. nivea* Thaxter
17. *P. palmivora* (E.J. Butler) E.J. Butler
18. *P. sojae* Kufm. & Gerd.
## Results for *Phytophthora cinnamomomi*

<table>
<thead>
<tr>
<th>HOST</th>
<th>CROP</th>
<th>SYMPTOMS</th>
<th>PROVINCE</th>
<th>REFERENCES</th>
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<td><em>P. cinnamomi</em></td>
<td>Azalea sp</td>
<td>Root rot</td>
<td>BA</td>
<td>Frezzi, 1977</td>
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<tr>
<td>R.D. Rands</td>
<td><em>Calycanthus</em></td>
<td>Root and stem rot</td>
<td>CbA</td>
<td>Frezzi, 1977</td>
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<td></td>
<td><em>floridus</em></td>
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<td><em>Casuarina</em></td>
<td>Stem and collar canker</td>
<td>BA</td>
<td>Frezzi, 1977</td>
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<td></td>
<td><em>cunningamiana</em></td>
<td>Root and basal stem rot,</td>
<td>ER</td>
<td>Palmucci et al, 2008</td>
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<td><em>Cupressus</em></td>
<td>Root rot</td>
<td>Cba</td>
<td>Frezzi, 1977</td>
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<td><em>Echeveria</em></td>
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<td>Cba</td>
<td>Frezzi, 1977</td>
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<tr>
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<td><em>Eucalypts</em></td>
<td>Root rot and died</td>
<td>Cba</td>
<td>Frezzi, 1977</td>
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<td><em>Iresine</em></td>
<td>Root rot</td>
<td>Cba</td>
<td>Frezzi, 1977</td>
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<tr>
<td></td>
<td><em>Juglans</em></td>
<td>crown rot</td>
<td>Juj</td>
<td>Alcoba et al, 2005</td>
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<td><em>Ligustrum</em></td>
<td>Root rot</td>
<td>Cba</td>
<td>Frezzi, 1950, 1977</td>
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<td><em>Persea</em></td>
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<td>Cba, Sta, Juj, Tuc</td>
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<td>Cba</td>
<td>Frezzi, 1950; 1977</td>
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<td>Cba</td>
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<td>Frezzi, 1950; 1977</td>
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<td><em>Prunus</em></td>
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<td>BA</td>
<td>Frezzi, 1977</td>
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<td><em>Rhododendron</em></td>
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<td>BA</td>
<td>Frezzi, 1977</td>
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<td>Cba</td>
<td>Frezzi, 1950; 1977</td>
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<tr>
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<td>Cba</td>
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<td><em>Rubus</em></td>
<td>Root and crown rot</td>
<td>BA</td>
<td>Paganini, 2004</td>
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<td><em>Vaccinium</em></td>
<td>Root and crown rot</td>
<td>Sta, Tuc.</td>
<td>Hongn et al, 2003; Hongn, 2005; Wright et al, 2005</td>
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</table>
# Groups of crops affected by the different Phytophthora spp

<table>
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<tr>
<th>Phytophthora spp</th>
<th>HOSTS</th>
<th>VEGETABLE CROPS</th>
<th>ORNAMENTAL CROPS</th>
<th>FOREST CROPS</th>
<th>FRUIT CROPS</th>
<th>FODDER CROPS</th>
<th>OLEAGINOUS/INDUSTRIAL CROPS</th>
<th>CEREAL CROPS</th>
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Percentage of *Phytophthora* species found in Argentina
# Geographical distribution of *Phytophthora* spp

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Regional maps showing the distribution of *Phytophthora* spp
Most of the work done on *Pythium* and *Phytophthora* correspond to work of morphological identification and pathogenicity.

In the crops with a greater economic importance in the country, like soybean and potato, the investigations included work on resistance, races and different control techniques.
First cited in 1970’s by Hartwig

1989 to 1992 ➔ Race 1

1993 to 1997 ➔ race 1 (prevalent), race 4 reported (Santa Fe province), but 24% of the isolates presented virulence formulas that could not be classified as previously described

During 1997-1998 ➔ 53 % isolates race 1, but an increasing variability in pathogenicity was observed

*P. sojae* is a highly variable pathogen in Argentina and so far many new races have been detected that will be reported for the first time in Argentina (Barreto et al., unpublished).
**Phytophthora infestans**

**Resistance**

Lorenzo Lamattina et al. (IIB). Universidad Nacional del Mar del Plata. Biochemical and molecular studies related with host defence.

Micheletto-S; Andreoni-M; Huarte-MA

Vertical resistance to late blight in wild potato species. Argentinian wild diploid *Solanum* species as sources of quantitative late blight resistance

**Races and Mating type**

Calderoni, 1966 \( \Rightarrow \) race 1,4

Bazán y Segura (1968) \( \Rightarrow \) races 3 and 4.

Van Damme y Ridao (1994) \( \Rightarrow \) Mating type A1 y A2 and 

diferent virulence formulas (e.g.: 1,4 - 1,3,4,7,11 )

**Chemical control**

Mantecon-JD; Escande-AR AD: Exp. Balcarce, INTA, Argentina

Effectiveness of systemic and non-systemic fungicides.
Phytophthora sp. nov. described

- *Phytophthora austrocedrae* sp. nov., a new species associated with *Austrocedrus chilensis* mortality in Patagonia (Argentina) 2007. Greslebin et al.
Molecular Characterization

- Before 2000 taxonomic identification = morphological and physiological characterization.

- Since 2000 some of the diagnoses were complemented with molecular techniques (e.g.):
  - *P. sojae* on soybean
  - *P. infestans* on potato
  - *P. palmivora* on olivo
  - *P. austrocedrae* on *Austrocedrus chilensis*
  - *P. nicotianae* on dieffembachia
  - *P. cinnamomomi* on casuarina
Frezzi, Mariano J.

- Argentine pathologist from Cordoba province.
- Considered a referent by Argentine researchers.


Conclusions

This revision allowed an updating of the situation of these genera. The hosts, location and symptoms. 17 species of *Phythium* and 18 of *Phytophthora* have been cited.

1. A wider variety of pathogens have not even been diagnosed

2. It is necessary for the different teams to join forces and effort to research these pathologies.

3. All this information will be used as the basis for a Survey of *Phytophthora* and *Pythium* in Argentina integrating morphological and molecular methods.
• This complete work (including the tables) will be published next year in the magazine of the Argentine Botanic Society (www.botanicargentina.com.ar)

• Now we have to confirm: 1) the validity or not of the host-pathogen relations cited. 2) The existence of living isolates and we have form a good collection
MUCHAS GRACIAS

H.E. Palmucci, S.M. Wolcan, P.E. Grijalba