



FEDERAL UNIVERSITY OF SANTA CATARINA
PROGRAM IN PLANT GENÉTIC RESOURCES
LABORATORY OF PLANT PATHOLOGY
COURSE SYLLABUS 2018-2



I. IDENTIFICATION:

- 1.1. Postgraduate program: Plant Genetic Resources
- 1.2. Course name: **PLANT-PATHOGEN INTERACTION (RGV 4100-25)**
- 1.3. Credits: 03
- 1.4. Location: Room 204 - Fitotecnia building.
- 1.5. Every second semester: offered in a concentrated way from November 31th to 10th, 2018.
- 1.5. Workload:

In-class hours: 08:00 - 12:00h - Afternoon: Reading time outside-of-class hours
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- 1.6 Lab website: <http://labfitop.paginas.ufsc.br>
- 1.7 Office Hours: by appointment (room 217) - Phone: 3721-5338

II. OBJECTIVE:

Provide to master's or doctoral student a basic knowledge of the main molecular interactions between plants and their pathogens.

III. CONTENT:

Mechanisms of attack and defense in the interactions between plants and pathogens. Genetic analysis of interactions. Use of model systems. Interaction gene to gene, structure and function of gene R. Hypersensitive response and oxidative burst. Signaling pathways in plants and signal translation. Role and function of molecules of interest (salicylic ac., fatty acids, ethylene, active oxygen species, phytoalexins, jasmonates, nitric oxide) in plant resistance to pathogens. "Cross talk" and pathways of signaling against viruses, bacteria, oomycetes and fungi. Induction of resistance. Mechanisms of RNAi involved in plant-pathogen interaction.

IV. INSTRUCTORS:

Coordinator:

Prof. Marciel J. Stadnik (MJS), agronomist (UFSC), M.Sc. (UFV, Viçosa-MG) and Ph.D. (University of Hohenheim/ Germany) in Plant Pathology. Pos-doc at Embrapa (Jaguariúna-SP) and sabbatical leave at University of Kentucky (Lexington-KY, EUA). E-mail: marciel.stadnik@ufsc.br

Collaborators:

Prof. Maryline Magnin-Robert (MMR), biologist (University of Strassbourg), Ph.D. in Biology of Organisms (University Reims Champagne-Ardenne, France), *Prof^a. Franceli R. Kulcheski (FRK)*, biologist, M.Sc. in Plant Breeding (UFRGS) and Ph.D. in Celular and Molecular Biology (UFRGS/ Max-Planck), Pos-doc at UFRGS (Porto Alegre-RS).

Dr. Mateus B. de Freitas (MBF), biologist, M.Sc. and Ph.D in Plant Genetic Resources (UFSC), Technician of the Laboratory of Plant Pathology (Labfitop - UFSC).

V. DIDACTIC PROCEDURE AND ASSESSMENT:

The course will be composed of lectures as well as discussions and presentations of students.

The assessment of learning in Molecular Plant Pathogen Interactions will be based on a set of mandatory activities to be developed during the course, comprising individual presentations (20%), participation in discussions about scientific papers (10%), and final exam (70%).

VI. RECOMMENDED TEXT READING

- Mechanisms of attack and defense in host pathogen interaction

-Agrios - Chapters 4, 5, 6

-El Chartouni, L., Randoux, B., Duyme, F., Renard-Merlier, D., Tisserant, B., Bourdon, N., Pillon, V., Sanssené, J., Durand, R., Reignault, Ph. and Halama, P. 2012. Cytological and biochemical parameters correlate with resistance and tolerance to *Mycosphaerella graminicola* in wheat cultivars. *Plant Biology* 14 :11-21.

- Arabidopsis and other model plants

-Spannagl M, Mayer K, Durner J, Haberer G, Fröhlich A. (2011) Exploring the genomes: from Arabidopsis to crops. *J Plant Physiol.* 168: 3-8.

-Somerville C, Koornneef M. (2002) A fortunate choice: the history of Arabidopsis as a model plant. *Nature Reviews*, 3: 883-889.

- Interaction gene to gene, structure and function of gene R

-McDowell JM and Woffenden BJ. (2003). Plant disease resistance genes: recent insights and potential applications. *TRENDS in Biotechnology*, 21 No.4 178-183.

-Dodds, P. and Thrall, P. (2009). Recognition events and host-pathogen co-evolution in gene-for gene resistance to flax rust. *Functional Plant Biology* 36(5): 395-408.

-Gururani, M. A. et al. (2012). Plant disease resistance genes: Current status and future directions. *Physiological and Molecular Plant Pathology* (78) 51e65.

- Non-host resistance

-Uma, B., Rani, T. S., & Podile, A. R. (2011). Warriors at the gate that never sleep: non- host resistance in plants. *Journal of plant physiology*, 168(18), 2141-2152.

- Signaling and hormones - Nitric oxide (NO), salicylic acid (SA), Jasmonate (JA), fatty acids, etc.

-Aalbi V, Devoto A (2007) Jasmonate signalling network in *Arabidopsis thaliana*: crucial regulatory nodes and new physiological scenarios. *New Phytologist*, 177: 301-318.

-Denancé et al. (2013) Disease resistance or growth: the role of plant hormones in balancing immune responses and fitness costs. *Front Plant Sci.* 24;4:155.

-Klessig DF, Durner J, Noad R, Navarre DA, Wendehenne D, Kumar D, Zhou JM, Shah J, Zhang S, Kachroo P, Trifa Y, Pontier D, Lam E, Silva H. (2000). Nitric oxide and salicylic acid signaling in plant defense. *PNAS* 97(16): 8849-8855.

- Kachroo, K.; Kachroo, P. (2009) Fatty Acid-Derived Signals in Plant Defense. *Ann. Review of Phytopathol*, 153-176.
- Koorneef, A and Pieterse, C.M.J. (2008) Cross Talk in Defense Signaling. *Plant Physiology*, 146, pp. 839-844.
- Moreau, M., Lindermayr, C., Durner, J., Klessig, D.F. (2010) NO synthesis and signaling in plants - where do we stand? *Physiologia Plantarum* 138, 372-383.
- Vlot AC, Dempsey DA, Klessig DF (2009) Salicylic acid, a multifaceted hormone to combat disease. *Annu Rev Phytopathol* 47: 177-206.

- Oxidative burst and reactive oxygen species

- Mittler, R et al. (2011) ROS signaling: the new wave? *Trends Plant Sci.* 16:300-309.
- O'Brien, JA et al. (2012) Reactive oxygen species and their role in plant defense and cell wall metabolism. *Planta* 236:765-779.
- De Freitas, MB and Stadnik, MJ (2015) Ulvan-induced resistance in *Arabidopsis thaliana* against *Alternaria brassicicola* requires reactive oxygen species derived from NADPH oxidase. *Physiol Mol. Plant. Pathol.* 90:49-56.

- Genetic analysis of plant-pathogen interaction

- Lodha TD, Basak J. Plant-Pathogen Interactions: What Microarray Tells About It? (2012). *Mol Biotechnol* 50:87-97.

- Induction of resistance

- Tayeh, Ch., Randoux, B., Bourdon, N. and Reignault, Ph. 2013. Lipid metabolism is differentially modulated by salicylic acid and heptanoyl salicylic acid during the induction of resistance in wheat against powdery mildew. *Journal of Plant Physiology* 170 :1620-1629
- Reignault, Ph., Cogan, A., Muchembled, J., Lounes-Hadj Sahraoui, A., Durand, R. and Sancholle. 2001. M. Trehalose induces resistance to powdery mildew caused by *Blumeria graminis* f. sp. *tritici* in wheat. *New Phytologist* 149 : 519-529
- Durrant WE, Dong X (2004) Systemic Acquired Resistance. *Annu. Rev. Phytopathology*, 42 185-209.

- Mechanisms of RNAi involvement in plant-pathogen interactions

- Pumplin, N. and Voinnet, O. (2013). RNA silencing suppression by plant pathogens: defence, counter-defence and counter-counter-defence. *Nature Reviews Microbiology*, 11 (745:760).
- Wang, H. et al. (2016). A Signaling Cascade from miR444 to RDR1 in Rice Antiviral RNA Silencing Pathway. *Plant Physiology* 170, pp. 2365-2377.

VII. TENTATIVE SCHEDULE

Date of classes	Topics
<p>1: 30/11/2018 Friday</p>	<ul style="list-style-type: none"> - The course at a glance - Review on the main mechanisms of attack and defense in the plant microbe interaction
<p>2: 03/12/2018 Monday</p>	<ul style="list-style-type: none"> - <i>Arabidopsis</i> as plant model - Interaction gene-to-gene, structure and function of R-gene - Non-host resistance
<p>3: 04/12/2018 (08:30h) Tuesday</p>	<ul style="list-style-type: none"> - Genetic analysis of plant-pathogen interactions - Role of nitric oxide (NO) and salicylic acid (SA) in the resistance - Transduction of signals and signaling pathways (SA-jasmonates, ethylene, cross-talk, etc).
<p>4: 05/12/2018 (08:30 h) Wednesday</p>	<ul style="list-style-type: none"> - Hypersensitive response - Oxidative burst and reactive oxygen species
<p>5: 06/12/2018 (08:30 h) Thursday</p>	<ul style="list-style-type: none"> - Mechanisms of RNAi in the plant-pathogen interaction - Induction of resistance using a PAMP and a phytohormone: the wheat-powdery mildew interaction
<p>6: 07/12/2018 Friday</p>	<ul style="list-style-type: none"> -Importance of the species and the genotype in the induction of resistance: the wheat-<i>Septoria tritici</i> Bloch interaction - Student presentations
<p>7: 10/12/2018 Monday</p>	<ul style="list-style-type: none"> - Final exam

Note: The schedule may be modified. If so, you will be notified in class and/or by email of any substantial changes to the schedule above.