



**Cornell University**  
New York State Agricultural Experiment Station



**Wolfram Koeller**

Professor  
Department of Plant Pathology

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**Ph.D.** 1979 Biochemistry  
Philipps University, Marburg, Germany  
Diploma 1976 Chemistry  
Philipps University, Marburg, Germany

**Division of Effort**

Research - 100%, Fungicide resistance, ecology of adaptive population responses

**Complete CV**

Academic Ranks:

Professor 2000 – present Cornell University  
Associate Professor 1992 - 2000 Cornell University  
Assistant Professor 1986 - 1992 Cornell University  
Senior Research Scientist 1982 - 1986 Bayer, Monheim, Germany  
Visiting Research Fellow 1980 – 1982 Washington State University, Pullman

Professional Experience

2000 - present Professor of Plant Pathology, Cornell University  
1992 - 2000 Associate Professor of Plant Pathology, Cornell University  
1986 – 1992 Assistant Professor of Plant Pathology, Cornell University  
1982 - 1986 Senior Research Scientist (Fungicide Biochemistry and Resistance)  
Bayer AG - Pesticide Division, Leverkusen, Germany  
1980 - 1981 Visiting Fellow  
Washington State University, Pullman, WA  
1979 Research Associate  
Philipps-University Marburg, Germany  
1976 - 1979 Research Assistant  
Philipps-University Marburg, Germany  
1974 - 1976 Teaching Assistant  
Philipps-University Marburg, Germany

Major Professional Assignments, Honors, and Awards

2002 Lee M. Hutchins Award of The American Phytopathological Society.

1991 - 1997 Associate Editor, Phytopathology.

1980 - 1982 Postdoctoral Fellow of the German Research Foundation (DFG)

## PROGRAM OVERVIEW AND OBJECTIVES

The future control of plant diseases relies on four general avenues: chemical disease control agents with minimal effects on non-target organisms, breeding of disease-resistant cultivars including transgenics, development of effective biocontrol agents and employment of cultural practices minimizing the severity of epidemics. The effectiveness of these tactics is continuously challenged by adaptive responses of pathogen populations toward their changing environments.

The long-term goal of my research on Resistance to Site-specific Antifungal Agents is to contribute to the sustained effectiveness of plant disease management. Primary focus is on current and future site-specific fungicides. Our program on fungicide resistance pursues a holistic approach: results from population and molecular studies are employed in the development of resistance management strategies. Our primary model pathogen is *Venturia inaequalis*, a typical ascomycete causing apple scab. More recently, we have added *Magnaporthe grisea* and *Colletotrichum graminicola* to our arsenal of pathogen models.

Two major questions govern our applied part of the program: Can older site-specific fungicides with previous histories of resistance still be integrated into effective disease management programs, and how can the relative risk of new site-specific fungicides be predicted in order to slow the process of adaptive population responses down? The fundamental research thrust of the program is to better understand the mechanisms by which populations of the same species adapt to their continuously changing environments. The development of fungicide resistance provides a model to study and better understand the adaptive evolution of population structures.

A second thrust is to explore, whether specific targets of chemical interference with the infection of plants would be less prone to adaptive population responses leading to resistance. My program has been continuously engaged in this question, with fungal cutinases serving as a model. Cutinases as secreted enzymes are involved in the penetration of host surfaces by attacking plant pathogens. Highly specific inhibitors of cutinases are expected to act as 'antipenetrants' protecting plants from fungal attack at the initial stage of host-pathogen interactions. The cutinase target is attractive, because inhibitors would interfere with a highly specialized step in plant infection rather than with fungal growth and reproduction. Our work on cutinases stands as an example for combining conceptual advances in the understanding of host-pathogen interactions with practical applications.

## REPRESENTATIVE ACADEMIC RESPONSIBILITIES

Current Division of Effort

Research 100%

Primary Departmental Program Area:

Resistance to anti-fungal agents

- Mechanisms of resistance to fungicides
- Management and risk assessment of resistance to fungicides
- Modes of action of fungicides
- Characterization of novel target sites for future fungicides

Post-Doctoral Associates

2001 – 2002 Cruz Avila-Adame Ph. D. Plant Pathology  
Cornell University

1998 – 2000 Tie Bang Wang Ph. D. Plant Genetics  
Iwate University, Morioka, Japan

1995 - 1998 Desen Zheng Ph. D. Plant Genetics and Breeding  
Fujian Agricultural University, China

1995 - 1998 Gilberto Olaya Ph. D. Plant Pathology  
Cornell University

1991 - 1993 Chenglin Yao Ph. D. Plant Pathology  
Texas A&M

1990 - 1991 Katherine L. Reynolds Ph. D. Plant Pathology  
Cornell University

1988 - 1989 Franzine D. Smith Ph. D. Microbiology  
University of Massachusetts

Visiting Scientists

1995 - 96 GeHyeong Lee Ph. D. Chemist  
Korea Institute of Chemical Technology

1993 Luigi Toti Ph. D. Botany  
Eidgenössische Technische Hochschule Zürich  
1992 - 93 Maja Bodmer M. S. Plant Pathology  
Eidgenössische Forschungsanstalt Wädenswil,  
Switzerland  
1992 - 93 Urs Hilber Ph. D. Plant Pathology  
Universität Basel, Switzerland  
1991 - 93 Toshihide Saishoji Kureha Chemical Industry Co.,  
Tokyo, Japan

#### Teaching and Advising Responsibilities:

##### Courses

1996 - 2001 PP 709: Phytomycology  
Lecture and Lab "Chemical Control - Resistance Management".  
1993 - 2001 PP 701: Concepts of Plant Pathology: Organismal Aspects  
Lecture "Converting knowledge of pathogenesis into methods of disease  
control: Chemical control of plant diseases."  
1987 - present PP 900: Dissertation Research

##### Graduate Field Membership:

Field of Plant Pathology

##### Graduate Majors

1992 - 2001 Diana M. Parker - Ph. D. - Plant Pathology  
"Cutinase Action in Plant Disease Control."  
1996 - 2001 Cruz-Avila Adame - Ph. D. - Plant Pathology  
"Mechanism of Resistance of Strobilurin Fungicides."  
1995 - 1996 Chao-Yun Fan - M.S. - Molecular Plant Pathology  
"Role of Serine Hydrolases in Plant Infection."  
1987 - 1991 Frances Trail - Ph. D. - Molecular Plant Pathology  
"Diversity of Cutinases from Plant Pathogenic Fungi: Evidence for the Role  
of Cutinase in Tissue Specificity."

##### Graduate Minors

1997 - 2000 Frank Wong - Ph. D. - Plant Pathology, Committee Member  
(Chair: W. F. Wilcox)  
1992 - 1995 Ker-Chung Kou - Ph. D. - Plant Pathology, Committee Member  
(Chair: H. C Hoch)

##### Undergraduate Minors

2001 Andrea Damon - B. S. - Hobart and William Smith College,  
Honor Thesis

1988 Jus Wubben - Agric. Engineer - Wageningen Agricultural University,  
Netherlands  
Honor Thesis

#### REPRESENTATIVE PROFESSIONAL ACTIVITIES

##### Professional Societies:

1987 - present American Phytopathological Society

1992 - present American Chemical Society

##### Editorial Boards:

1991 - 1997 Associate Editor of PHYTOPATHOLOGY

## Committee Assignments:

### International/National

2003 Organizing Committee Chair of the Symposium "Fungicide Resistance in North America".  
2003 CAST Symposium: Management of Pest Resistance: Strategies Using Crop Management, Biotechnology and Pesticides  
Moderator of Session: Have models helped ?  
2003 Steering Committee: CAST Symposium: Management of Pest Resistance: Strategies Using Crop Management, Biotechnology and Pesticides  
2003 8th International Congress of Plant Pathology, Christchurch, NZ  
Organizer of Discussion Session "Chemical Control"  
2000 Organizer and Chair of the APS Symposium: "Pathogen Resistance"  
1999 Co-chair of the symposium "Fungicide Resistance" at the 2nd PanPacific Congress "Pesticide Chemistry" in Hawaii.  
1997 - 2000 Founder and chair of the new APS Subject Committee "Pathogen Resistance"  
1998 Invited expert at a hearing of the National Research Council Working Group "The future of pesticides in the United States"  
1996 Organizer of the APS Forum "Fungicide resistance - Organization of an APS representation"  
1996 Workshop Chair (Pest Resistance Management) at the 3rd IPM Conference, January 7-11, Washington DC.  
1994 Co-chair of the symposium "Fungal Hydrolases and Pathogenicity" at the 5th International Mycological Congress, Vancouver, BC  
1994 Discussion Leader of Session "Fungicide Mode of Action" Eighth International Congress of Pesticide Chemistry, Washington, DC  
1994 - 1995 Program Committee: "ACS Special Conference: Molecular Genetics and Ecology of Pesticide Resistance"  
1994 - 1998 Chair of the Working Group 'Pest Resistance Management', an ESCOP Subcommittee on Pest Management Strategies  
1994 Workshop Chair (IPM and Pesticide Resistance) at the 2nd IPM Conference, April 19-22, 1994, Las Vegas  
1992 - 1994 Secretary of the 'Western Regional Coordinating Committee on Resistance and Resistance Management to Pesticides in Pests and Beneficial Organisms' (WRCC 60)  
1991 - 1994 Invited member of the working group 'Pest Resistance Management', an ESCOP Subcommittee on Pest Management Strategies  
1991 - 1997 Associate Editor of PHYTOPATHOLOGY  
1990 Invited member of the IOPRM Fungicide Resistance Working Group  
1990 Chair of Session "Mechanisms of Tolerance and Resistance" Seventh International IUPAC Congress of Pesticide Chemistry, Hamburg, Germany  
1989 Participant of the 'USDA/States NAPIAP Fungicide Resistance Assessment Panel' (P. L. Sanders, Project Coordinator)  
1987 - 2000 Appointed member of the 'Western Regional Coordinating Committee on Resistance and Resistance Management to Pesticides in Pests and Beneficial Organisms' (WRCC 60)

### University and College

2003 Ad hoc Committee: Promotion to Full Professor with tenure  
2001 - present Member of CALS Senate  
1998 Member of the search committee "Associate University Librarian and Director of Mann Library"  
1993 Ad hoc Committee: Promotion to Associate Professor with tenure  
1992 CALS Strategic Planning -  
Member of the Special Committee on Graduate Education  
1991 - 1995 Member of the Cornell Faculty Council of Representatives  
1990 Long Range Plan for IPM - Leader of Narration Preparation  
"The development of safer pesticides"

## Geneva Experiment Station

2001 - present Member and Chair of the Faculty "Nominations and Election Committee"  
2001 Chair of ad-hoc Committee: "Space Allocation of Genomics at Geneva"  
1999 Member of the search committee "Geneva Librarian"  
1998 - 2001 Member and Chair of the Faculty "Library Committee"  
1998 - 2000 Member of the Geneva Genomics Group  
1998 - 2000 Faculty advisory committee "Cornell Agriculture and Food Technology Park"  
1998 Member of the search committee "Environmental Safety and Health Officer at Geneva"  
1996 - 1998 Member of the Faculty "Graduate Student Committee"  
1993 Member of the search committee "Geneva Librarian"  
1991 Member of the search committee "Assistant Librarian"  
1991 - 1993 Member and Chair of the Faculty "Library Committee"

## Department

2002 Member of the faculty search committee "Virologist" position  
2001 - present Organizing Committee of the Plant Pathology Seminar Series  
1998 - 2000 Member of the faculty search committee "Tree and Small Fruit" position  
1994 Geneva Representative "Task Force Committee on Plant Pathology Teaching"  
1990 - 1993 Geneva Representative Graduate Student Selection Committee  
1990 - 1991 Organizer of the Plant Pathology Seminar Series  
1987 - 1999 OSHA Representative  
1987 - 1999 APS-News Reporter

## REPRESENTATIVE PROFESSIONAL CONTRIBUTIONS

### Invited presentations (past 10 years)

\*Indicates invited Lectures at National and International Scientific Meetings

September 23, 2003 St. Johann BASF Symposium Biosciences: "New Germany Technologies for Efficient Bioproduct Development."  
Key note lecture: "Fungicide Resistance: Challenges and Opportunities".  
\*August 13, 2003 Charlotte, NC APS Annual Meeting. Symposium " Fungicide Mode of Action and Deployment for Resistance Management"  
Key note lecture "Fungicide Mode of Action".  
\*April 10, 2003 Indianapolis, IN CAST Symposium: Management of Pest Resistance: Strategies Using Crop Management, Biotechnology and Pesticides  
Key note lecture "Pathogens"  
February 27, 2003 Lake George, NY Cornell Cooperative Extension, Northeastern NY Area Fruit Program  
"Recent developments in pathogen fungicide resistance: Example of apple scab"  
\*February 5, 2003 Christchurch, NZ 8th International Congress of Plant Pathology  
"Possible mechanisms in strobilurin resistance"  
January 16, 2003 Rochester, NY Cornell Cooperative Extension, Workshop for Apple Consultants. Discussion leader:  
"Status and management of fungicide resistance"  
\*December 10, 2002 Grand Rapids, MI Great Lakes Expo – Fruit, Vegetable & Farm Market  
Ken Kropf Memorial Lecture: "Risk of resistance of apple scab to strobilurins".  
\*October 24, 2002 Orlando, FL Pesticides in the Molecular Age  
A Satellite to the 11 th North American ISSX

Meeting

"Discovery of Targets for New Fungicides"

October 8, 2002 Geneva, NY Plant Pathology Seminars

"Resistance to fungicides: Any light in the tunnel?"

\*October 3, 2002, Bromont Quebec NED-APS Meeting

Symposium: Fungicide Resistance Management

"Evolution, development, and management of fungicide resistance"

Sept. 18-22 2002 Jealott's Hill, GB Syngenta QoI Technical Workshop

Invited Expert Panel

\*July 30, 2002 Milwaukee, WI 2002 Annual APS Meeting

Symposium: Strobilurins and Turfgrass

Diseases "A tricky class of fungicides:

Challenges for in vitro fungicide sensitivity testing."

May 8, 2002 New Brunswick, Syngenta/Rutgers Strobilurin (QoI) Resistance NJ Workshop

"Experience with Fungicide Resistance in Agricultural Crops"

April 10, 2002 Grand Rapids, MI Bayer Workshop for Crop Consultants

"Fungicide resistance in the

Management of Apple Scab"

March 4, 2002 Limburgerhof, BASF Internal Workshop

Germany "Fungicide Resistance - Risk Assessment and Management"

\*February 12 2001 Ventura, CA Gordon Research Conference, Agricultural Science, Diversity Exploration in

Agricultural Science "Prospects for new fungicides"

\*April 5 2001 Sendai, Japan 11th Symposium on Fungicide Resistance

Phytopathological Society of Japan

"Resistance in apple scab to DMI and

strobilurin fungicides"

April 9 2001 Odawara, Japan Nippon Soda Co.

Internal Seminar Series

"Resistance to strobilurin fungicides"

May 7 2001 East Lansing, MI Michigan State University, Center for

Integrated Plant Systems, Workshop

Fungicide and Antibiotic Resistance

" Fungicide resistance: Management strategies".

\*August 14, 2000 New Orleans, LA APS Annual Meeting

"Fungicide resistance: Management Strategies"

\*October 27, 1999 Honolulu 2nd Pan-Pacific Conference on Pesticide

Science "Resistance to Strobilurin

Fungicides"

September 15, 1999 Ithaca, NY Cornell Plant Pathology Seminar Series

"Chemotherapy of Plant Diseases".

July 12-15, 1999 Chile, Argentina Lecture series:

Brazil "Management of Fungicide Resistance".

February 14, 1999 Geneva, NY IPM Fruit School

"Management of resistance to DMI fungicides"

\*November 18, 1998 Las Vegas, NV APS Annual Meeting - Turf Working Group

"Management of fungicide resistance"

\*August 7, 1998 Edingburg, UK 7th International Congress of Plant

Pathology "Mode of action studies with real plant pathogens"

May 25, 1998 Princeton, NY Cyanamid Seminar Series

"Fungicide resistance"

January 20, 1998 Springhouse, PA Rohm and Haas Seminar Series

"Cutinase - Opportunities for plant disease control"

\*January 22, 1998 Miami, FL 5th FRAC Banana Working Group Meeting

"Status quo of DMI resistance"

June 17, 1998 St. Louis, MO Monsanto Internal Symposium

"Management of fungicide resistance - How can the principles be applied to transgenic traits?"

\*November 12, 1997 San José, Annual Meeting APS, Caribbean Division

Costa Rica "Status Quo and Future of Fungicide

Resistance"  
\*August 27, 1997 Orlando, FL ACS National Meeting  
"Modes of action and management of resistance"  
February 7, 1997 Ballston, NY CCE Northeast NY Area Tree Fruit Schools  
"Managing resistance in apple scab disease: Present and potential fungicide strategies"  
February 6, 1997 Plattsburg, NY CCE Northeast NY Area Tree Fruit Schools  
"Managing resistance in apple scab disease: Present and potential fungicide strategies"  
July 22, 1996 Rahway, NJ Merck Research Laboratories Seminars  
"Characteristics of fungicides for the control of cereal diseases."  
\*July 1, 1996 Wädenswil Symposium on Soil, Mycorrhiza, Pathogens, Switzerland Agriculture  
"Nature and management of resistance to DMI fungicides"  
February 6, 1996 ResearchTriangle Rhone-Poulenc Park, NC "Dodine as tool for the management of DMI resistance in apple scab control."  
December 15, 1995 East Lansing, MI MSU Pesticide Research Center  
"Status of DMI resistance in apple scab control."  
November 14, 1995 Ithaca, NY Cornell 1995 Production Agriculture Inservice Education Week  
"Fruit - New fungicide Chemistry."  
\*August 15, 1995 Pittsburg, PA 1995 APS Annual Meeting  
Colloquium: Practical Aspects of Fungicide Resistance Management.  
"General overview and introduction."  
\*June 21, 1995 Big Sky, Montana ACS Special Conference  
Molecular Genetics and Ecology of Pesticide Resistance  
"Relative merits of strategies for the management of fungicide resistance."  
\*May 19, 1995 Reinhardsbrunn 11th International Symposium "Modern Germany Fungicides and Antifungal Compounds"  
"Recent developments in DMI resistance."  
\*May 16, 1995 Reinhardsbrunn 11th International Symposium "Modern Germany Fungicides and Antifungal Compounds"  
"Targets for plant protection - Can cutinase be counted in ?"  
May 8, 1995 Rahway, NJ Merck Research Laboratories Seminars  
"Target site for anti-fungals."  
May 8, 1995 Rahway, NJ Merck Research Laboratories Seminars  
"Cutinase and plant disease control."  
\*August 19, 1994 Vancouver, BC Fifth International Mycological Congress  
"Role of cutinase in the invasion of plants"  
\*July 7, 1994 Washington, DC Eighth IUPAC International Congress of Pesticide Chemistry  
"Managing resistance to sterol demethylation inhibitors"  
June 18, 1994 Chinju, Korea Gyeongsang National University  
"Role of fungal cutinases in plant infection"  
June 16, 1994 Seoul, Korea Korea Research Institute of Chemical Technology  
"Antifungal chemicals in the control of plant diseases"  
June 1, 1994 Limburgerhof, BASF Seminar Series  
Germany "Management of DMI resistance"  
May 30, 1994 Leverkusen, Bayer AG seminar Series  
Germany "Function of cutinase isozymes"  
May 11, 1994 Wädenswil, Swiss Federal Research Station for Switzerland Horticulture - Seminar Series  
Role of cutinase in plant infection"  
  
May 7, 1994 Rahway, NJ Merck-Symposium "Antifungal Discovery for Crop Protection: Molecular and Biochemical Approaches"  
"Chemical control of plant pathogens: past, present, and future"  
April 18, 1994 Las Vegas, NV WRCC-60 Workshop  
"Status of fungicide resistance"

December 13, 1993 Indianapolis, IN DowElanco Apple Scab Resistance Management Workshop

"Resistance management in apple scab control."

October 13, 1993 Ithaca, NY Plant Pathology Seminar Series

"Recent progress of the development of fungicides and future prospects."

October 7, 1993 Geneva, NY Plant Pathology Seminar Series

"Recent progress of the development of fungicides and future prospects."

September 15, 1993 St. Louis, MO ALS-Inhibitor Herbicide Resistance Working Group

"Status and Management of Fungicide Resistance."

August 26, 1993 San Jose, Costa Rica Rohm & Haas Banana Taskforce Meeting

Rica "Fungicide Resistance Management."

\*August 5, 1993 Montreal, Canada 6th International Congress of Plant Pathology "Recent progress of the development of fungicides and future prospects."

\*April 13, 1993 East Lansing, MI MSU Pesticide Research Center Annual Conference "Fungicide resistance - How did it start and where do we stand?"

January 28, 1993 Pultneyville, NY 1993 Lake Ontario Fruit School

"Dodine and sterol inhibitor resistance: Why? Where? When?"

## PUBLICATIONS

### RESEARCH AND EXTENSION PUBLICATIONS

#### Refereed Journal Articles and Invited Reviews

Turechek, W. W., and Köller, W. 2004. Managing resistance of *Venturia inaequalis* to the strobilurin fungicides. Plant Health Progress doi: 10.1094/PHP-2004-0908-01-RS.

Köller, W. 2004. Pathogens. Pages 17-19 in: Management of Pest Resistance: Strategies Using Crop Management, Biotechnology, and Pesticides. CAST Special Publication No. 24, Ames, Iowa.

Köller, W., Parker, D. M., Turechek, W. W., Avila-Adame, C., and Cronshaw, K. 2004. A two-phase resistance response of *Venturia inaequalis* populations to the QoI fungicides kresoxim-methyl and trifloxystrobin. Plant Dis. 88:537-544.

Avila-Adame, C., Olaya, G., and Köller, W. 2003. Characterization of *Colletotrichum graminicola* isolates resistant to strobilurin-related fungicides. Plant Dis. 87:1426-1432.

Avila-Adame, C., and Köller, W. 2003. Insertional mutagenesis of *Magnaporthe grisea* toward decreased responsiveness of alternative respiration to inhibition by azoxystrobin. J. Gen. Plant Pathol. 69: 126-130.

Avila-Adame, C., and Köller, W. 2003. Characterization of spontaneous mutants of *Magnaporthe grisea* expressing stable resistance to the Qo inhibiting fungicide azoxystrobin. Curr. Genet. 42: 332-338.

Avila-Adame, C., and Köller, W. 2003. Impact of alternative respiration and target-site mutations on responses of germinating conidia of *Magnaporthe grisea* to QoI-inhibiting fungicides. Pest Managem. Sci 59:303-309.

Köller, W. 2003. Fungicides, sterol biosynthesis inhibitors. Pages 628-640 in: The Encyclopedia of Agrochemicals. Plimmer, J. R., ed., John Wiley, New York. Avila-Adame, C., and Köller, W. 2002. Interrelation between alternative respiration and target site mutations in resistance to QoI fungicides. Pages 829-834 in: The BCPC Conference Pests & Diseases 2002, Conference Proceedings, Vol. 2, British Crop Protection Council, Farnham, Surrey, UK.

Avila-Adame, C., and Köller, W. 2002. Disruption of the alternative oxidase gene in *Magnaporthe grisea* and its impact on host infection. Mol. Plant-Microbe Interact. 15:493-500.

Köller, W., Avila-Adame, C., Olaya, G., and Zheng, D. 2002. Resistance to strobilurin fungicides. Pages 215-229 in: Pesticide Science: Pesticide Resistance. J. M. Clark and I. Yamaguchi, eds. American Chemical Society, Washington, DC.

Köller, W., and Wilcox, W.F. 2001. Evidence for the predisposition of fungicide-resistant isolates of *Venturia inaequalis* to a preferential selection for resistance to other fungicides. Phytopathology 91: 776-781.

- Köller, W., Avila-Adame, C., Olaya, G., and Zheng, D. 2001. Resistance to strobilurin fungicides. Pages 215-229 in: Pesticide Science: Pesticide Resistance. J. M. Clark and I. Yamaguchi, eds. American Chemical Society, Washington, DC.
- Köller, W. 2001. The plant cuticle. Pages 281-285 in: The Encyclopedia of Plant Pathology. Maloy, O.C., and Murray, T.D., eds., John Wiley, New York.
- Köller, W. 2001. Fungal cutinases. Pages 285-289 in: The Encyclopedia of Plant Pathology. Maloy, O.C., and Murray, T.D., eds., John Wiley, New York.
- Köller, W. 2001. Fungicide resistance. Pages 483 - 488 in: The Encyclopedia of Plant Pathology. Maloy, O.C., and Murray, T.D., eds., John Wiley, New York.
- Zheng, D., Olaya, G., and Köller, W. 2000. Characterization of *Venturia inaequalis* mutants resisting the strobilurin fungicide kresoxim-methyl. *Curr. Genet.*38: 148-155.
- Köller, W., and Wilcox, W.F. 2000. Interactive effects of dodine and the DMI fungicide fenarimol in the control of apple scab. *Plant Dis.* 84: 863-870.
- Olaya, G., and Köller, W. 1999. Diversity of kresoxim-methyl sensitivities in baseline populations of *Venturia inaequalis*. *Pestic. Sci.*: 1083-1088.
- Köller, W., and Wilcox, W.F. 1999. Evaluation of tactics for managing resistance of *Venturia inaequalis* to sterol demethylation inhibitors. *Plant Dis.*83: 857-863.
- Köller, W. 1999. Chemical approaches to managing plant pathogens. Pages 337-376 in: Handbook of Pest Management. J.R. Ruberson, ed., Marcel Dekker, New York.
- Olaya, G., and Köller, W. 1999. Baseline sensitivities of *Venturia inaequalis* populations to the strobilurin fungicide kresoxim-methyl. *Plant Dis.* 83: 274-278.
- Köller, W., Wilcox, W.F., and Jones, A.L. 1999. Quantification, persistence and status of dodine resistance in New York and Michigan orchard populations of *Venturia inaequalis*. *Plant Dis.* 83: 66-70.
- Olaya, G., Zheng, D., and Köller, W. 1998. Differential responses of germinating *Venturia inaequalis* conidia to kresoxim-methyl. *Pestic. Sci.* 54: 230-236.
- Fan, C.-Y., and Köller, W. 1998. Diversity of cutinases from plant pathogenic fungi: Differential and sequential expression of cutinolytic esterases by *Alternaria brassicicola*. *FEMS Microbiol. Lett.* 158: 33-38.
- Parker, D. M., and Köller, W. 1998. Cutinase and other lipolytic esterases protect bean leaves from infection by *Rhizoctonia solani*. *Molec. Plant-Micr. Interac.* 11: 514-522.
- Zheng, D., and Köller, W. 1997. Characterization of the mitochondrial cytochrome *b* gene from *Venturia inaequalis*. *Curr. Genet.*32: 361-366.
- Köller, W., Wilcox, W. F., Barnard, J., Jones, A. L., and Braun, G. 1997. Detection and quantification of population shifts of *Venturia inaequalis* to sterol demethylation inhibitors. *Phytopathology* 87: 184-190.
- Köller, W, and Yao, C. 1996. Targets for plant protection - Can cutinase be counted in ?. Pages 163-172 in: Modern Antifungal Compounds. H. Lyr, P. E. Russel and H. D. Sisler, eds., Intercept Ltd., Andover.
- Köller, W. 1996. Recent developments in DMI resistance. Pages 301-311 in: Modern Antifungal Compounds. H. Lyr, P. E. Russel and H. D. Sisler, eds., Intercept Ltd., Andover.
- Köller, W., Yao, C., Trail, F., and Parker, D. M. 1995. Role of cutinases in the invasion of plants. *Can. J. Bot.* 73 (Suppl.1): S1109-S1118.
- Köller, W. 1995. Managing resistance to sterol demethylation inhibitors. Pages 340-349 in: Eighth International Congress of Pesticide Chemistry - Options 2000. N.N. Ragsdale, P.C. Kearny and J.R. Plimmer, eds., American Chemical Society, Washington, DC.
- Beresniewicz, M. M., Taylor, A. G., Goffinet, M. C, and Köller, W. 1995. Chemical nature of a semipermeable layer in seed coats of leek, onion (Liliaceae), tomato and pepper (Solanaceae). *Seed Sci. Technol.* 23: 135-145.
- Yao, C., and Köller, W. 1995. Diversity of cutinase from plant pathogenic fungi: Different cutinases are expressed during saprophytic and pathogenic stages of *Alternaria brassicicola*. *Molec. Plant-Micr. Interac.* 8: 122-130.
- Köller, W., Smith, F. D., Reynolds, K. L., Wilcox, W. F. and Burr, J. A. 1995. Seasonal changes of

- sensitivities to sterol demethylation inhibitors in *Venturia inaequalis* populations. Mycol. Res. 99: 689-692.
- Parker, D. M., Hilber, U. W., Bodmer, M., Smith, F. D., Yao, C., and Köller, W. 1995. Production and transformation of conidia of *Venturia inaequalis*. Phytopathology 85: 87-91.
- Köller, W. 1994. Chemical Control of Apple Scab - Status Quo and Future. Norwegian J. Agric. Sci. Suppl. 17: 149-170.
- Yao, C., and Köller, W. 1994. Diversity of cutinase from plant pathogenic fungi: Cloning and analysis of a cutinase gene from *Alternaria brassicicola*. Physiol. Molec. Plant Pathol. 44: 81-92.
- Hilber, U. W., Smith, F. D., and Köller, W. 1994. Biolistic transformation of conidia of *Botryotinia fuckeliana*. Curr. Genet. 25: 124-127.
- Trail, F., and Köller, W. 1993. Diversity of cutinases from plant pathogenic fungi: Purification and characterization of two cutinases from *Alternaria brassicicola*. Physiol. Molec. Plant Pathol. 42: 205-220.
- Liyanage, H. D., Köller, W., McMillan, R. T., and Kistler, H. C. 1993. Variation in cutinase from two sub-populations of *Colletotrichum gloeosporioides* from citrus. Phytopathology 83: 113-116.
- Köller, W. 1992. Role of target research in the discovery of fungicides. Pages 255-310 in: Target Sites of Fungicide Action. W. Köller, ed., CRC-Press, Boca Raton.
- Köller, W. 1992. Antifungal target sites in sterol function and biosynthesis. Pages 119-206 in: Target Sites of Fungicide Action. W. Köller, ed., CRC-Press, Boca Raton.
- Köller, W., Smith, F. D., and Reynolds, K. L. 1991. Phenotypic instability of flusilazole sensitivities of *Venturia inaequalis*. Plant Pathol. 40: 608-611.
- Köller, W., Parker, D. M., and Becker, C. M. 1991. Role of cutinase in the penetration of apple leaves by *Venturia inaequalis*. Phytopathology 81: 1375 - 1379.
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