

Philip E. Hammer, Ph.D

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PROFESSIONAL EXPERIENCE

Research Director, AgBiome, Inc., January 2013 to present:

Established laboratories and operations at AgBiome. Helped hire key positions as we grew from a staff of 4 to 85. Helped develop and implement AgBiome's unique self-management structure.

Led discovery efforts in plant pathology and biological control. Served as Containment Director for AgBiome plant pest and pathogen containment facility. Led early development efforts for Howler biological fungicide.

Independent Consultant, January to December 2012:

Managed the upfit of pest containment laboratories for Bayer Crop Science on a contract basis.

Director, Molecular Biology and Operations, L1 AgroSciences, Inc., March to December 2011:

Joined L1 AgroSciences in its third month of operation as director of the molecular biology group. Designed strategy for plant transformation vector system freedom to operate. Led molecular biology group.

Planned and executed the move from incubator space into 15,000 sq. ft. lab and office facility. Coordinated up-fit of the space and acquisition of equipment. Managed operations.

Senior Scientist, Molecular Biology, Bayer Crop Science November 2009 to February 2011; Athenix Corporation, October 2001 to November 2009:

Joined Athenix in its third month of operation as its lead molecular biologist. Worked on all aspects of establishing laboratories as we grew from a staff of 8 to more than 80 and moved operations three times into larger facilities. Selected / designed greenhouses, growth chambers, laboratories and offices, then worked closely with architects and contractors to build and up-fit the facilities. Played key roles in hiring scientists and establishing support functions such as purchasing, stockroom and equipment maintenance.

Led the Herbicide Resistance project to discover and clone several novel genes. Led gene finding and vectoring efforts in the early years of the company, then transitioned these functions to others as the company grew.

Led two nitrogen use efficiency projects. Developed the strategy then directed laboratory, greenhouse and field experiments.

Initiated a disease resistance gene discovery project. Identified key target pathogens, developed and ran screening assays, followed up leads.

On each of these projects I conducted intellectual property searches, helped prepare patent applications, and worked to find and in-license enabling technology as appropriate. Supervised five bench scientists.

Served as containment director for the Athenix plant pathogen containment facility. Wrote SOPs and worked with USDA APHIS PPQ and NC Department of Agriculture to establish the containment facility. Obtained blanket permits to import bacteria and soil for isolation from anywhere in the world. Obtained miscellaneous permits from USDA Plant Protection & Quarantine and Biotechnology Regulatory Services as needed. Responsible for periodic reports to APHIS maintenance and renewal of all PPQ permits.

Staff Scientist I, Syngenta Biotechnology, Inc.

Natural Products Genetics Group, January 1999 to September 2001: Worked as part of the Natural Product Genetics team to clone and characterize genes from a *Streptomyces* sp. responsible for a specific biocatalytic transformation, and to improve the production of polyketide natural products. This work involved extensive cloning and sequencing, gene disruptions and functional complementation, and expression of genes and gene clusters in heterologous hosts.

Biocontrol Group, May 1997 to December 1998: Developed methods and screened recombinant DNA libraries for clones encoding antifungal activity. Designed and constructed plasmids for transforming the pyrrolnitrin biosynthesis gene cluster into plant chloroplasts (in collaboration with Plastid Biotechnology Group). Contributed materially and intellectually to other projects in the Biocontrol group. Hired and supervised summer interns and supervised an associate scientist.

Postdoctoral Associate, Novartis Biotechnology and Genomics Center, October 1993 to April 1997. Isolated and characterized genes for the biosynthesis of the antifungal secondary metabolite pyrrolnitrin from *Pseudomonas fluorescens*. Constructed gene deletion and over-expression strains to elucidate the functions of the *prn* genes. Cloned and sequenced the homologous gene clusters from other *Pseudomonas*, *Burkholderia* and *Myxococcus* spp. Studied pyrrolnitrin gene regulation and the role of pyrrolnitrin in biocontrol. Cloned the ubiquitin 3 promoter from *Arabidopsis* and constructed plant expression vectors. Expressed the four *prn* genes in model plants and studied expression of the transgenes in *Arabidopsis*.

Postdoctoral Associate, The Pennsylvania State University, June 1992 to September 1993. Studied regulation of anthocyanin biosynthesis genes by cytokinins in *Arabidopsis* using reporter gene fusions and transcription analysis of native anthocyanin biosynthesis genes. (Project director: Dr. Jill Deikman.)

TECHNICAL EXPERTISE

Molecular Biology

Recombinant DNA technology
Vector design and construction
RNA isolation and Northern blotting
Gene library construction and screening
(genomic, subgenomic, cDNA)
Southern, Northern, and Western blotting
PCR, DNA sequencing

Plant Pathology

Pathogen isolation and culture
In-vitro antifungal assays
Pathogen inoculation and disease assays
Light and scanning electron microscopy

Plant Biology

Plant transformation and tissue culture
Genomic DNA isolation and analysis
Reporter gene construction and assays

Other

Statistical analysis and model building
Environmental data collection and analysis
Antifungal metabolite analysis (TLC, HPLC)

EDUCATION

Ph.D., Intercollege Program in Plant Physiology, The Pennsylvania State University, May 1992.
Advisor: Dr. Kathleen B. Evensen, Department of Horticulture.

M.S., Vegetable Crops, University of California at Davis, September 1987.
Advisor: Dr. Shang Fa Yang, Department of Vegetable Crops.

B.S., Horticulture, Iowa State University, May 1984.
Production and business management option. Graduated with distinction.

ISSUED US PATENTS

7,807,881	Methods to confer herbicide resistance
7,700,842	Identification of a new class of EPSP synthases
7,674,958	GRG23 and GRG51 genes conferring herbicide resistance
7,659,376	Antibody that binds glyphosate resistance protein
7,538,262	GDC-2 genes conferring herbicide resistance
7,534,937	Genes conferring herbicide resistance
7,504,561	GDC-1 genes conferring herbicide resistance
7,488,866	gro-1 Herbicide resistance gene and methods for its use
7,485,461	Cis-acting regulatory elements from <i>Tripsacum dactyloides</i>

7,405,347	Genes conferring herbicide resistance
7,399,621	Genes conferring herbicide resistance
6,643,774	Genes for the synthesis of antipathogenic substances
6,117,670	Pyrrolnitrin biosynthesis genes and uses thereof
5,817,502	Genes for the synthesis of antipathogenic substances
5,723,759	Pyrrolnitrin biosynthesis genes
5,698,425	Method of protecting plants by transformation with genes for the synthesis of antipathogenic substances.
5,679,560	Genes for the synthesis of antipathogenic substances
5,662,898	Genes for the synthesis of antipathogenic substances
5,639,949	Genes for the synthesis of antipathogenic substances

US PATENT APPLICATIONS

20100144530	Identification of a new class of EPSP synthases
20100144529	Identification of a new class of EPSP synthases
20100071090	Compositions and methods for expression of a heterologous nucleotide sequence in plants.
20090241219	GDC-2 genes conferring herbicide resistance
20090227771	GRG23 and GRG51 genes conferring herbicide resistance
20090203075	Genes conferring herbicide resistance
20090151018	GDC-1 genes conferring herbicide resistance
20090119797	GRO-1 herbicide resistance gene and methods for its use
20080313769	EPSP synthase domains conferring glyphosate resistance
20080312419	Genes conferring herbicide resistance
20070169218	EPSP synthase domains conferring glyphosate resistance
20070136840	GRG23 and GRG 51 genes conferring herbicide resistance
20070107078	Methods to confer herbicide resistance
20070044175	Genes conferring herbicide resistance
20070004907	Genes conferring herbicide resistance
20060277632	Methods for production of chitin and chitosan
20060253921	Identification of a new class of EPSP synthases
20060218662	Cis-acting regulatory elements from <i>tripsacum dactyloides</i>
20060150270	Genes conferring herbicide resistance
20060150269	gro-1 herbicide resistance gene and methods for its use
20060021094	GDC-2 genes conferring herbicide resistance
20060021093	GDC-1 genes conferring herbicide resistance
20050204436	Methods to confer herbicide resistance
20040205847	GDC-1 genes conferring herbicide resistance
20040177399	Genes conferring herbicide resistance
20030068788	Methods and compositions for making emamectin

PUBLICATIONS

Ligon, J.M., D.S. Hill, P.E. Hammer, N.R. Torkewitz, D. Hofmann, H.-J. Kempf and K.-H. van Pée, 2000. Natural products with antifungal activity from *Pseudomonas* biocontrol bacteria. *Pest Manag. Sci* 56:688-695.

Hammer, P.E., W. Burd, D.S. Hill, J.M. Ligon and K.-H. van Pée, 1999. Conservation of the pyrrolnitrin biosynthetic gene cluster among six pyrrolnitrin-producing strains. *FEMS Microbiol. Let.* 180:39-44.

Kirner, S., P.E. Hammer, D.S. Hill, A. Altmann, I. Fischer, L. J. Weislo, M. Lanahan, K.-H. van Pee and J.M. Ligon, 1998. Functions encoded by pyrrolnitrin biosynthetic genes from *Pseudomonas fluorescens*. *J. Bacteriol.* 180:1939-1943.

Hammer, P.E., D.S. Hill and J. Ligon, 1997. Four genes from *Pseudomonas fluorescens* that encode the biosynthesis of pyrrolnitrin. *Appl. Env. Microbiol.* 63:2147-2154.

Hohaus, K., A. Altmann, W. Burd, I. Fischer, P.E. Hammer, D.S. Hill, J.M. Ligon and K.-H. van Pee, 1997. NADH-dependent halogenases are more likely to be involved in halometabolite biosynthesis than haloperoxidases.

Agnew. Chem. Int. Ed. Engl. 36:2012-2013.

Hammer, P.E. and K.B. Evensen, 1996. Effects of the production environment on the susceptibility of rose flowers to postharvest infection by *Botrytis cinerea*. J. Amer. Soc. Hort. Sci. 121:314-320.

Hill, D.S., P.E. Hammer and J. Ligon, 1996. The role of antifungal metabolites in biological control of plant disease. Pages 41-50 in: Current Topics in Plant Molecular Biology. Volume 4: Technology Transfer of Plant Biotechnology. P.M. Gresshoff, ed. CRC Press, Boca Raton, FL.

Deikman, J. and P.E. Hammer, 1995. Induction of anthocyanin accumulation by cytokinins in *Arabidopsis thaliana*. Plant Physiol. 108:47-57.

Hammer, P.E. and K.B. Evensen, 1994. Differences between rose cultivars in susceptibility to infection by *Botrytis cinerea*. Phytopathology 84:1305-1312.

Hammer, P.E., K.B. Evensen and W.J. Janisiewicz, 1993. Postharvest control of *Botrytis cinerea* infections on cut roses with pyrrolnitrin. Plant Dis. 77:283-286.

Evensen, K.B., P.E. Hammer, R. Crassweller, G. Greene and L. Lehman-Salada, 1993. Predicting quality of 'York Imperial' apples after long-term storage. HortTechnology 3:318-322.

Goulart, B.L., P.E. Hammer, K.B. Evensen, W. Janisiewicz and F. Takeda, 1992. Pyrrolnitrin, captan + benomyl, and high CO₂ enhance raspberry shelf life at 0 or 18C. J. Amer. Soc. Hort. Sci. 117:265-270.

Hammer, P.E., S.F. Yang, M.S. Reid, and J.J. Marois, 1990. Fungistatic atmospheres for post-harvest control of *Botrytis cinerea* infections on cut roses. J. Amer. Soc. Hort. Sci. 115:102-107.

Hammer, P.E. and J.J. Marois, 1989. Nonchemical methods for postharvest control of *Botrytis cinerea* on cut roses. J. Amer. Soc. Hort. Sci. 114:100-106.

Hammer, P.E. and J.J. Marois, 1988. Postharvest control of *Botrytis cinerea* on cut roses with micro-cupric-ammonium formate. Plant Dis. 72:347-350.