DAVID R. BENSON, PhD, FAAM
Professor of Microbiology

Department of Molecular and Cell Biology, U-3125
University of Connecticut
Storrs, Connecticut 06268

e-mail: david.benson@uconn.edu
Tel: 860-486-4258
Fax: 860-486-4331

Education and Professional Appointments

2012-17	- Jefferson Science Fellow, US Dept. State ISN/BPS
2007-2012	- Head, Dept. Molecular & Cell Biology
2005-present	- Fellow - American Academy Microbiology
1994	- Visiting Professor, University of Waikato, New Zealand
1991-present	- Professor of Microbiology, Univ. Connecticut
1985-1991	- Associate Professor of Biology, Univ. Connecticut
1980-1985	- Assistant Professor of Biology, Univ. Connecticut
1978-1980	- Postdoctoral Research Associate, Biochemistry, Univ. Wisconsin, Madison
1973-1978	- Ph.D., Research Assistant, Microbiology and Biochemistry, Rutgers University
1968-1972	- B.A., Moravian College, Bethlehem, PA, English/Biology

Research Areas

Microbial genomics, microbial biogeography and ecology, physiology and molecular biology of bacteria, symbiosis, psychrophile evolution, food microbiology, bio-security

Teaching

Applied Micro. (Undergrad.), Intro. Micro. (Undergrad.), Advanced Micro. (Undergrad.), Industrial Microbiology (Grad.), Physiological Genetics of Bacteria (Grad.), Microbial Physiology (Grad.), Special Topics Seminars (Grad. and Undergrad.), Coastal Ecology (Undergrad.), Microbes that Changed History (Undergrad. W), Plagues and Pandemics (Undergrad. Honors)

Professional Societies

American Society for Microbiology
American Academy of Microbiology
AAAS
Leo F. Rettger Society (CT ASM)
Sigma Xi

Honors

Elected Fellow of the American Academy Microbiology (2005); Elected Connecticut Academy of Arts and Sciences (2008); Editorial Board, Applied and Environmental Microbiology (ASM); Chair-elect, Chair and Councilor General Microbiology Division I, American Society for Microbiology (1989-1991; 2004-2005); Appointed as a Jefferson Science Fellow (National Academy of Sciences) to the U.S. Dept. of State (2012-2017)

Positions

National and International: Editorial Board, Applied and Environmental Microbiology (1986-1996); Chair-Elect, General Microbiology Division (I) American Society for Microbiology (1989-1990); Chairman, General Microbiology Division (I) ASM (1990-1991); Chairman, Organizing Committee for the 7th International Meeting on *Frankia* and Actinorhizal Plants, (1988); USDA-CRGO Grants review panel (1990, 1988, 1986); Chair, Organizing Committee, Conn. Valley Branch ASM Annual Meeting (1990); Faculty Opponent, Univ. Umeå, Sweden (1990), Visiting Scientist, Univ. Chile, Santiago (1999-2001), Chair-Elect, General Microbiology Division I ASM

(2003-2004), Chair, General Microbiology Division I, American Society for Microbiology (2004-2005), panel member NSF-GENEN Program (2004); Division I Councilor, American Society for Microbiology (2005-2006); Nominating Committee, Proctor & Gamble Award, American Academy of Microbiology (2006-present); Presidential Policy Directive-2 (PPD-2) coordinator for the U.S. Dept. State, 2012-2013; Member of Delegation, Meeting of Experts, Biological Weapons Convention, 2013; Jefferson Science Advisor, U.S. Dept. State (2012-2017).

Intramural: Head, Department of Molecular & Cell Biology (2007-2012); Microbiology Graduate Program Chair (1985, 1986, 1990, 1991-1993, 1997-1999); MCB PTR Committee (1985-1989, 1991-1993, 1995, 1996 (Chair), 1998, 1999 (Chair), 2000, 2002-2005, 2006 (Chair), 2007, 2013, 2014); Provost's Faculty Review Board (20134-2016); Member, Faculty Senate (2014-2017); Graduate Awards Committee (1984); Graduate Admissions Committee (1984, 1985 Chairman, 1986 Chairman, 1987 Chairman); Training Grant Committee (1987); Honors Committee (1988-1990); Biotechnology Steering Committee (1984, 1985); Radiation Safety Committee (1987-1990); Executive Committee, Institute of Water Resources (1987-1989); UCRF Grants Review Panel - 1988, 1989, 1991, Chairman,. '89; Building Committee Liason, 1992-1997; Microbial Physiologist Search Committee (1996-1997; Chair), Microbiology Search Committee (2006-2007), Food Microbiology Search Committee (1998), Chancellor's Research Excellence Advisory (1998), Microbiology Section PTR Committee (1981); Pathogenic microbiologist search committee (1998-2001), Phase II Biology Building (1996-1999), Storrs Research Advisory Council (1997-2001), Self-study Steering Committee (2000-2001), Conflict of Interest Committee (2000-2004), Animal Science Department External Review Committee (2001), Departmental Advisory Committee (2002-2007), Graduate Education (Interim Chair) (2003-2004); MRIRC Review Committee for University Center review (2008-2011); Confidential Committee on Scientific Misconduct (Chair; 2010). Provost's Faculty Review Board (2013-2015; Chair, 2014-15), University Senate (2013-2016), Univ. Growth and Development Committee (2013-2016); Graduate Faculty Council (2015-2018).

Invited Lectures

"Depth and Breadth of Diversity in the *Frankia* symbiosis". Invited presentation at the 11th International Frankia and Actinorhizal Plant Conference, June, 1998.

"Biodiversity of *Geotrichum candidum* strains isolated from traditional cheese." French Chapter of the American Institute of Wine and Food, Paris, invited presentation. 1998.

"Biodiversité des souches de *Geotrichum candidum* isolées des fromages francais". Institut National de la Recherche Agronomique, Poligny, France, invited presentation. 1998.

"Biodiversity of *Geotrichum candidum* strains isolated from surface-ripened cheeses". COST Symposium: Quality and Microbiology of Traditional and Raw Milk Cheeses, Dijon, France, 1998.

"Diversity and molecular ecology of *Frankia* in the actinorhizal symbiosis." Univ. Chile, Santiago. 1999.

"Molecular evolution of *Frankia* in the actinorhizal symbiosis." Univ. Chile, Santiago. 1999.

"Coastal nitrogen cycling". UMass Nantucket Field Station. 1999.

"Evolution of the actinorhizal root nodule symbiosis." UMass Nantucket Field Station. 1999.

"Cheese wars - biodiversity in a moldy world" Presented at Dept. Nutrition, UConn. 2000.

"Evolution of the actinorhizal symbiosis." Invited presentation, Univ. Chile, Santiago. 2000.

"Biochemical adaptations to cold environments", Invited presentation, Umass Nantucket Field Station. 2001.

"Nitrogen-fixing symbioses in near-shore environments", Invited presentation, UMass Nantucket Field Station, 2001.

"French Lessons in fungal biodiversity", Invited presentation at The American Cheese Society meetings, Knoxville, TN.

"Cheese Fungi - Cat's Fur and Toadskin", Invited seminar at the Copia, Napa, CA. California Milk Advisory Board Meeting. 2002.
"Biodiversity and ecology of fungal surface ripened cheeses." Cornell University, Ithaca, NY. April, 2003.
"Sequencing of the Frankia CcI3 genome". National Science Foundation, Awardees Conference, Arlington, January, 2004.
"Living Small, the reduced genome of *Frankia* sp. strain CcI3". Univ. Umea, Sweden. 2006.
"Workshop on Genome Analysis of *Frankia*", Univ. Umea, Sweden. 2006
"Frankia genomes recapitulate host biogeography", Rutgers Univ., 2007
"Unraveling the molecular interactions in the Frankia symbiosis" Invited presentation at the 20th North American Symbiotic Nitrogen Fixation Congress. Milwaukee. 2007.
"The *Frankia* proteome using heterologous root nodules" Bariloche, Argentina, 2008
"Proteomics of *Frankia* in culture, in vesicles and in root nodules". Tunis, Tunisia. 2009.
"Biological warfare and biological weapons." Invited presentation, UConn Medical School, 2013.
"The kitchen sink approach to the *Frankia* symbiosis." Invited presentation, Rutgers University, 2013.
"Principles and Potential of Molecular Diagnostics." Geneva, Switzerland, Meeting of Experts for the Biological Weapons Convention. 2013.
"Jefferson projects and science diplomacy initiatives" Washington, DC, National Academy of Sciences, 2013.
"Mental porpoising and the motatorious life" Invited presentation. Rutgers University, 2014.
"The strange history of biological warfare, Part I and Part II" CLIR public presentation, 2014.

Web sites created

Lab site:	http://web.uconn.edu/mcbstaff/benson/BensonHome/BensonHome.htm#
Frankia site:	http://web.uconn.edu/mcbstaff/benson/Frankia/FrankiaHome.htm#
Course site:	http://web.uconn.edu/mcbstaff/benson/mcb235/index.htm/
Department site:	http://mcb.uconn.edu/

Publications

1. Brooks, J. M. and D. R. Benson. 2016. Comparative metabolomics of root nodules infected with *Frankia* strains and uninfected roots from *Alnus glutinosa* and *Casuarina cunninghamiana*. Symbiosis DOI: 10.1007/s13199-016-0379-x.

2. Normand, P., D. R. Benson and L. S. Tisa. 2015. Genome characteristics of Frankia sp. reflect host range and host plant biogeography. p. 245-251 *In* Biological Nitrogen Fixation, DeBruijn, F., ed. John Wiley Sons.

3. [Benson, D. R. *et al*.] 2014. Advances in science and technology: Understanding pathogenicity and virulence. National paper to the Biological and Toxins Weapons Convention Meeeting of Experts, 2014 (BWC/MSP/2014/MX/WP.2).

4. Benson, D. R. and R. Kjelgren. 2014. Tacit diplomacy in the life sciences. A foundation for science diplomacy. Science and Diplomacy (AAAS). 3(1): http://www.sciencediplomacy.org/perspective/2014/tacit-diplomacy-in-life-sciences

5. Marcellino, N. and D. R. Benson. 2014. The good, the bad and the ugly: Tales of mold-ripened cheeses. Microbiol Spectrum 1(1): doi:10.1128/microbiolspec.CM-0005-12.

6. Normand, P., Benson, D. R., Berry. A. M. and L. S. Tisa. 2014. 183. Family *Frankiaceae*. *In* E. Rosenberg et al. (eds.), The Prokaryotes – The *Actinobacteria*, DOI 10.1007/978-3-642-30138-4_183, Springer-Verlag Berlin Heidelberg.

7. [Benson, D. R.]. 2013. "Developments in science and technology - diagnostics: Submitted by the United States of America." National Paper to the Biological and Toxins Weapons Convention Meeting of Experts, 2013 (BWC/MSP/2013/MX/WP.5).

8. Normand, P. and D. R. Benson. 2012. Order *Frankiales* ord. nov. pp. 508-510 *In* Bergey's Manual of Systematic Bacteriology, Volume 5, Spinger-Verlag, New York, ISBN 978-0-387-95043-3.

9. Normand, P. and D. R. Benson. 2012. Family I. *Frankiaceae* Becking 1970, 201[AL] emend. Hahn, Lechevalier, Fischer and Stackebrandt 1989, 241 emend. Normand, Orso, Cournoyer, Jeannin, Chapelon, Dawson, Evtushenko and Misra 1996, 8 emend. Stackebrandt, Rainey and Ward-Rainey 1997, 487. pp. 511 In Bergey's Manual of Systematic Bacteriology, Volume 5 The Actinobacteria. , Spinger-Verlag, New York, ISBN 978-0-387-95043-3

10. Normand, P. and D. R. Benson. 2012. Genus I. *Frankia* Brunchorst 1886, 174[AL]. p. 511-518 In Bergey's Manual of Systematic Bacteriology, Volume 5 The Actinobacteria, Spinger-Verlag, New York, ISBN 978-0-387-95043-3

11. Normand, P., A. Berry, and D. R. Benson. 2012. Family II. *Acidothermaceae* Rainey, Ward-Rainey and Stackebrandt 1997, 487[VP]. pp. 519 In Bergey's Manual of Systematic Bacteriology, Volume 5 The Actinobacteria, Spinger-Verlag, New York, ISBN 978-0-387-95043-3

12. Normand, P., A. Berry and D. R. Benson. 2012. Genus I. *Acidothermus* Mohagheghi, Grohmann, Himmel, Leighton and Updegraff 1986, 442[VP]. pp. 519-520 In Bergey's Manual of Systematic Bacteriology, Volume 5 The Actinobacteria, Spinger-Verlag, New York, ISBN 978-0-387-95043-3

13. Normand, P. and D. R. Benson. 2012. Genus I. *Cryptosporangium* Tamura, Hayakawa and Hatano 1998, 1003[VP]. p. 521-523 In Bergey's Manual of Systematic Bacteriology, Volume 5 The Actinobacteria, Spinger-Verlag, New York, ISBN 978-0-387-95043-3

14. Normand, P. and D. R. Benson. 2012. Family IV. *Geodermatophilaceae* Normand 2006, 2277[VP] (effective publication: Normand, Orso, Cournoyer, Jeannin, Chapelon, Dawson, Evtushenko and Misra 1996, 8). p. 526 In Bergey's Manual of Systematic Bacteriology, Volume 5 The Actinobacteria, Spinger-Verlag, New York, ISBN 978-0-387-95043-3

15. Normand, P. and D. R. Benson. 2012. Genus I. *Geodermatophilus* Luedemann 1968, 1857[AL]. 526-528 In Bergey's Manual of Systematic Bacteriology, Volume 5 The Actinobacteria, Spinger-Verlag, New York, ISBN 978-0-387-95043-3.

16. Normand, P. and D. R. Benson. 2012. Genus III. *Modestobacter* Mevs, Stackebrandt, Schumann, Gallikowski and Hirsch 2000, 344[VP] emend. Reddy, Potrafka and Garcia-pichel 2007, 2018. pp. 534-537 In Bergey's Manual of Systematic Bacteriology, Volume 5 The Actinobacteria, Spinger-Verlag, New York, ISBN 978-0-387-95043-3

17. Normand, P. and D. R. Benson. 2012. Family VI. *Sporichthyaceae* Stackebrandt, Rainey and Ward-Rainey 1997, 487[VP]. p. 542 In Bergey's Manual of Systematic Bacteriology, Volume 5 The Actinobacteria, Spinger-Verlag, New York, ISBN 978-0-387-95043-3

18. Normand, P. and D. R. Benson. 2012. Genus I. *Sporichthya* Lechevalier, Lechevalier and Holbert 1968, 279[AL]. pp. 542-544 In Bergey's Manual of Systematic Bacteriology, Volume 5 The Actinobacteria, Spinger-Verlag, New York, ISBN 978-0-387-95043-3

19. Normand, P. and D. R. Benson. 2012. Family I. *Kineosporiaceae* Zhi, Li and Stackebrandt 2009, 596[VP]. p. 560 In Bergey's Manual of Systematic Bacteriology, Volume 5 The Actinobacteria, Spinger-Verlag, New York, ISBN 978-0-387-95043-3

20. Normand, P. and D. R. Benson. 2012. Genus I. *Kineosporia* Pagani and Parenti 1978, 401[AL] emend. Itoh, Kudo, Parenti and Seino 1989, 172 emend. Kudo, Matsushima, Itoh, Sasaki and Suzuki 1998, 1253. p. 560-563 In Bergey's Manual of Systematic Bacteriology, Volume 5 The Actinobacteria, Spinger-Verlag, New York, ISBN 978-0-387-95043-3.

21. Normand, P. and D. R. Benson. 2012. Genus II. *Kineococcus* Yokota, Tamura, Nishii and Hasegawa 1993, 56[VP]. p. 563-565 In Bergey's Manual of Systematic Bacteriology, Volume 5 The Actinobacteria, Spinger-Verlag, New York, ISBN 978-0-387-95043-3.

22. Normand, P. and D. R. Benson. 2012. Genus III. *Quadrisphaera* Maszenan, Tay, Schumann, Jiang and Tay 2005, 1774[VP]. p. 565-567 In Bergey's Manual of Systematic Bacteriology, Volume 5 The Actinobacteria, Spinger-Verlag, New York, ISBN 978-0-387-95043-3.

23. Marusov, G. P., A J Sweatt, K Pietrosimone, D R Benson, S J Geary, L K Silbart, S Challa, J Lagoy, D A Lawrence, and M Lynes. 2011. A Microarray Biosensor for Multiplexed Detection of Microbes Using Grating-Coupled Surface Plasmon Resonance Imaging. Environmental Science and Technology 46:348-359.

24. T. Persson, D. R. BENSON, P. Normand, B. Vanden Heuvel, P. Pujic, O. Chertkov, H. Teshima, D. Bruce, C. Detter, R. Tapia, C. Han, J. Han, T. Woyke, S. Pitluck, L. Pennacchio, M. Nolan, N. Ivanova, A. Pati, M. Land, K. Pawlowski, and A. Berry. 2011. The genome of *Candidatus* Frankia datiscae Dg1, the uncultured microsymbiont from nitrogen-fixing root nodules of the dicot *Datisca glomerata*. J. Bacteriol. 193:7017-7018.

25. Bickhart, D. M. and D. R. Benson. 2011. Transcriptomes of *Frankia* sp. strain CcI3 in growth transitions. BMC Microbiology 11:192.

26. Benson, D. R., J. M. Brooks, Y. Huang, D. M. Bickhart and J. E. Mastronunzio. 2011. The biology of *Frankia* sp. strains in the post-genome era. Mol. Plant Microbe Interact. 24:1310-1316.

27. Huang, Y. and D. R. Benson. 2011. Growth and development of *Frankia* sp. strain CcI3 at the single-hypha level in liquid culture. Archives Microbiology 194:21-28.

28. Mastronunzio, J. E. and D. R. Benson. 2010. Wild nodules can be broken: proteomics of *Frankia* in field-collected root nodules. Symbiosis 50:13-26.

29. Bickhart, D. M., J. P. Gogarten, P. Lapierre, L. S. Tisa, P. Normand and D. R. Benson. 2009. Insertion sequence content reflects genome plasticity in strains of the root nodule actinobacterium *Frankia*. BMC Genomics 2009, 10:468-480.

30. J. E. Mastronunzio, Y. Huang, and D. R. Benson. 2009. Diminished Exoproteome of *Frankia* spp. in Culture and Symbiosis. Appl. Environ. Microbiol. 75: 6721-6728

31. Sen, A., S. Sur, A. K. Bothra, D. R. Benson, P. Normand and L. S. Tisa. 2008. The implication of life style on codon usage patterns and predicted highly expressed genes for three *Frankia* genomes. Antonie van Leeuwenhoek 93:335–346.

32. C. L Santos, Vieira, J. , Tavares, F., Benson, D. R., Tisa, L. S. , Berry, A. M. , Moradas-Ferreira, P., and Normand, P. 2008. On the nature of *fur* evolution: A phylogenetic approach in *Actinobacteria*. BMC Evol. Biol. 8:185-198.

33. J. E. Mastronunzio, L. S. Tisa, P. Normand and D. R. Benson. 2008. Comparative secretome analysis suggests low plant cell wall degrading capacity in *Frankia* symbionts. BMC Genomics 9:47-65.

34. Tisa, L.S., D.R Benson, G.B. Smejkal, P. Lapierre, J. P. Gogarten, P. Normand, M. P. Francino, and P. Richardson. 2008. Living large: Elucidation of the *Frankia* EAN1pec genome sequence shows gene

expansion and metabolic versatility. In F. Dakora, W. E. Newton, C. Elmerich, V Newton (eds) Proceeding of the 15th International Congress on Nitrogen Fixation.p. 255-256.

35. Normand, P., P. Lapierre, L. S. Tisa, J. P. Gogarten, N. Alloisio, E.Bagnarol, C.A. Bassi, A.M. Berry, D. M. Bickhart, N. Choisne,, A. Couloux, B. Cournoyer, S. Cruveiller, V. Daubin, N. Demange, M. P. Francino, E. Goltsman, Y. Huang, O.R. Kopp, L. Labarre, A. Lapidus, C. Lavire, J. Marechal, M. Martinez, J. E. Mastronunzio, B. C. Mullin, J. Niemann, P. Pujic, T. Rawnsley, Z. Rouy, C. Schenowitz, A. Sellstedt, F. Tavares, J. P. Tomkins, D.Vallenet, C. Valverde, L.G. Wall, Y.Wang, C. Medigue, & D. R. Benson. 2007. Genome sizes of facultatively symbiotic *Frankia* sp. strains reflect host plant biogeography. Genome Res. 17:7-15.

36. Swensen, S. and D. R. Benson. 2008. Evolution of Actinorhizal Host Plants and *Frankia* Endosymbionts. Chapter 4 In: *Frankia* and Actinorhizal Plants. W. Newton, K. Pawlowski, eds.

37. Normand, P, C. Queiroux, L. Tisa, D. Benson, Z. Rouy, C. Médigue. 2007. Exploring the genomes of *Frankia*. Physiologia Plantarum 130:331-343.

38. Nasr, H., A -M. Domenach, M. H. Ghorbel and D. R. Benson. 2007. Divergence in symbiotic interactions between same genotypic PCR-RFLP *Frankia* strains and different Casuarinaceae species under natural conditions. Physiologia Plantarum 130:400-408.

39. Benson, D. R. and J. O. Dawson. 2007. Recent advances in the biogeography and genecology of symbiotic *Frankia* and its host plants. Physiologia Plantarum 130:318-330.

40. Bassi, C. A. and D. R. Benson 2006. Growth characteristics of the slow-growing Actinobacterium *Frankia* sp. strain CcI3 on solid media. Physiologia Plantarum 130:391-399.

41. Brian D. Vanden Heuvel, David R. Benson, Esteban Bortiri, and Daniel Potter.2 2004. Low genetic diversity among *Frankia* spp. strain nodulating sympatric populations of actinorhizal species of Rosaceae, Ceanothus (Rhamnaceae) and *Datisca glomerata* (Datiscaceae) west of the Sierra Nevada (California). Can. J. Microbiol. 50(11):989-1000.

42. Gawronski, J. D. and David R. Benson. 2004. Microtiter assay for glutamine synthetase biosynthetic activity using inorganic phosphate detection. Anal. Biochem. 327:114-118.

43. Benson M. J, J. D. Gawronski D. E. Eveleigh and D. R. Benson. 2004. Intracellular symbionts and other bacteria associated with deer ticks (Ixodes scapularis) from Nantucket and Wellfleet, Cape Cod, Massachusetts. Appl. Environ. Microbiol. 70:616-620.

44. Clawson, M. L., A. Bourret, and David R. Benson. 2004. Assessing the phylogeny of *Frankia*-actinorhizal plant nitrogen-fixing root nodule symbioses with *Frankia* 16S rRNA and glutamine synthetase gene sequences. Mol. Phyl. Evol. 31:131-138.

45. Benson, D. R., B. Vandenheuvel, B. and D. Potter. 2004. Actinorhizal Symbioses: Diversity and Biogeography. pp. 97-127 In: *Plant Microbiology*, M. Gillings and A. Holmes ed., BIOS Scientific Publishers, Oxford.

46. Silvester, W. B. and D. R. Benson. 2002. Making Nitrogen Available in Forests: The Role of Nitrogen-Fixing Plants. pp. 135-155 In *Biotechnology in Sustainable Forestry and Food Security*.

47. Marcellino, E. Beuvier, R. Grappin M. Guéguen and D.R. Benson. 2001. Diversity of Geotrichum candidum strains isolated from traditional cheesemaking fabrications in France. Applied Environ. Microbiol. 67:4752-4759.

48. Benson, D. R., and M. L. Clawson. 2000. Evolution of the actinorhizal plant nitrogen-fixing symbiosis, pp. 225-236 in Prokaryotic Nitrogen Fixation: A Model System for the Analysis of a Biological Process, ed. Eric Triplett, Horizon Scientific Press, Wymondham, England.

49. Clawson, M. L. and D. R. Benson. 1999. Natural diversity of *Frankia* strains in actinorhizal root nodules from promiscuous hosts in the family Myricaceae. Applied Environ. Microbiol. 65:4521-4527.

50. Clawson, M. L. and D. R. Benson. 1999. Dominance of *Frankia* strains in stands of Alnus incana subsp. rugosa and Myrica pensylvanica. Can. J. Bot. 77:1203-1207.

51. Clawson, M. L., M. Caru and D. R. Benson. 1998. Diversity of *Frankia* strains in root nodules of plants from the families Elaeagnaceae and Rhamnaceae. Appl. Environ. Microbiol. 64:3539-3543.

52. Clawson, M. L., D. W. Stephens, W. B. Silvester, S. C. Resch, and D. R. Benson. 1997. Typical *Frankia* infect exotic actinorhizal plants in New Zealand. New Zealand J. Bot. 35:361-367.

53. Marcellino, N. and D. R. Benson. 1997. Characteristics of Bethlehem cheese, an American fungal-ripened cheese. pp. 114-120, In T. M. Cogan, P. F. Fox & R. P. Ross (eds.), 5th Cheese Symposium, Teagasc, Dublin, Ireland.

54. Benson, D. R., D. W. Stephens, M. L. Clawson, W. B. Silvester. 1996. Amplification of 16S rRNA genes from *Frankia* in root nodules of *Ceanothus griseus, Coriaria arborea, Coriaria plumosa, Discaria toumatou*, and *Purshia tridentata*. Appl. Environ. Microbiol. 62:2904-2909.

55. Harriott, O. T., T. J. Hosted, and D. R. Benson. 1995. Sequences of nifX, nifW, nifZ, nifB and two ORFs in the *Frankia* nitrogen fixation gene cluster. Gene 161:63-67.

56. Hosted, T. J., D. A. Rochefort, and D. R. Benson. 1993. Close linkage of genes encoding glutamine synthetases I and II in *Frankia* alni CpI1. J. Bacteriol. 175:3679-3684.

57. Benson, D. R. and W. Silvester. 1993. The biology of *Frankia*: actinomycete symbionts of actinorhizal plants. Microbiol. Rev. 57:293-319.

58. Kumada, Y., D. R. Benson, D. Hillemann, T. J. Hosted, D. A. Rochefort, C. J. Thompson, W. Wohlleben, and Y. Tateno. 1993. Evolution of the glutamine synthetase gene: One of the oldest genes ever studied. Proc. Natl. Acad. Sci. USA 90:3009-3013.

59. Berry, A., O. T. Harriott, R. A. Moreau, S. Osman, A. D. Jones, and D. R. Benson. 1993. Hopanoid Lipids Compose the *Frankia* vesicle envelope, presumptive barrier of oxygen diffusion to nitrogenase. Proc. Natl. Acad. Sci. USA 90:6091-6094.

60. Marcellino, N. and D. R. Benson. 1992. Scanning electron and light microscopic study of microbial succession on Bethlehem St. Nectaire cheese. Appl. Environ. Microbiol. 58:3448-3454.

61. Zhang, X., and D. R. Benson. 1992. Utilization of amino acids by *Frankia* sp. strain CpI1. Archiv. Microbiol. 158:256-261.

62. Harriott, O. T., L. Khairallah, and D. R. Benson. 1991. Isolation and structure of the lipid envelopes from the nitrogen-fixing vesicles of *Frankia*. J. Bacteriol. 173: 2061-2067.

63. Rochefort, D. A. and D. R. Benson. 1990. Molecular cloning, sequencing and expression of the glutamine synthetase II (glnII) gene from the actinomycete root nodule symbiont *Frankia* sp. strain CpI1. J. Bacteriol. 172:5335-5342.

64. Schultz, N. A., D. R. Benson. 1990. Enzymes of ammonia assimilation in the hyphae and vesicles of *Frankia* sp. strain CpI1. J. Bacteriol. 172:1380-1384.

65. Schultz, N. A., D. R. Benson. 1989. Developmental potential of *Frankia* vesicles. J. Bacteriol. 171:6873-6877.

66. Tsai, Yu-Li, D. R. Benson. 1989. Physiological characteristics of glutamine synthetases I and II of *Frankia* sp. strain CpI1. Arch. Microbiol. 152:382-386.

67. Tunlid, A., N. A. Schultz, D. R. Benson, D. B. Steele, D. C. White. 1989. Differences in fatty acid composition between vegetative cells and N2-fixing vesicles of *Frankia* sp. strain CpI1. Proc. Natl. Acad. Sci. USA. 86:3399-3403.

68. Benson, D. R., N. A. Schultz. 1989. Physiology and biochemistry of *Frankia* in culture. pp. 107-127, In C. R. Schwintzer and J. D. Tjepkema eds., The biology of *Frankia* and actinorhizal plants. Academic Press, Orlando.

69. Benson, D. R. 1988. The genus *Frankia*: Actinomycete symbionts of plants. Microbiological Sciences 5:9-12.

70. Edmands, J. A., N. A. Noridge, D. R. Benson. 1987. The actinorhizal root nodule symbiont *Frankia* sp. strain CpI1 has two glutamine synthetases. Proc. Natl. Acad. Sci. USA 84:6126-6130.

71. Noridge, N. A. and D. R. Benson. 1986. Isolation and nitrogen-fixing activity of *Frankia* sp. strain CpI1 vesicles. J. Bacteriol. 166:301-305.

72. Tjepkema, J. D., C. R. Schwintzer, D. R. Benson. 1986. Physiology of actinorhizal root nodules. Ann. Rev. Plant Physiol. 37:209-232.

73. Mazzucco, C. E., D. R. Benson. 1984. Ammonium ([^{14}C]methylammonium) transport by *Frankia* sp. strain CpI1. J. Bacteriol. 160:636-641.

74. Benson, D. R., S. E. Buchholz, D. G. Hanna. 1984. Identification of *Frankia* strains by two-dimensional polyacrylamide gel electrophoresis. Appl. Environ. Microbiol. 47:489-494.

75. Benson, D. R., C. E. Mazzucco, T. J. Browning. 1984. Physiological aspects of *Frankia* , pp. 175-182, In P. W. Ludden and J. E. Burris (eds.), Nitrogen Fixation and CO_2 Metabolism, Proc. 14th Steenbock Symposium, American Elsevier Publ. Co., N.Y.

76. Benson, D. R. 1984. Consumption of atmospheric nitrogen, pp. 155-198 In E. R. Leadbetter and J. S. Poindexter, (eds.), Bacteria in Nature, Vol. 1, Plenum Publ. Corp., N. Y.

77. Benson, D. R., D. Hanna. 1983. *Frankia* diversity in an alder stand as estimated by sodium dodecyl sulfate-polyacrylamide gel electrophoresis. Can. J. Bot. 61:2919-2923.

78. Benson, D. R. 1982. Isolation of *Frankia* strains from alder actinorhizal root nodules. Appl. Environ. Microbiol. 44:461-465.

79. Burris, R. H., D. J. Arp, and D. R. Benson et al. 1980. The biochemistry of nitrogenase, pp. 37-54, In W. D. P. Stewart and J. R. Gallon (eds.), Nitrogen Fixation, Academic Press, N. Y.

80. Benson, D. R., D. J. Arp, R. H. Burris. 1980. Hydrogenase in N_2-fixing actinorhizal root nodules and symbionts. J. Bacteriol. 142:138-144.

81. Benson, D. R., D. J. Arp, R. H. Burris. 1980. Cell-free nitrogenase and hydrogenase from actinorhizal root nodules. Science 205:688-689.

82. Benson, D. R. and D. E. Eveleigh. 1979. Nitrogen-fixing homogenates from Myrica pensylvanica (bayberry) root nodules. Soil Biol. Biochem. 11:331-334.

83. Benson, D. R. and D. E. Eveleigh. 1979. Ultrastructure of the nitrogen-fixing symbiont of Myrica pensylvanica L. (bayberry) root nodules. Bot. Gaz. 140(Suppl.):S15-S21.

84. Benson, D. R., D. E. Eveleigh, V. A. Greenhut. 1979. Scanning electron microscopy of the N_2-fixing root nodules of Myrica pensylvanica L. (bayberry). New Phytol. 83:755-760.

85. Tiffney, W. N., D. R. Benson, D. E. Eveleigh. 1979. Does *Arctostaphylos uva-ursi* have nitrogen-fixing root nodules. Amer. J. Bot. 65:625-628.

Recent Abstracts (last 20 out of >200)

1. B. VandenHeuvel, D. Potter, and D. R. Benson. 2005. Direct characterization of uncultured Group 1 *Frankia* diversity from the rhizoshere of *Chamaebatia foliolosa* (Rosaceae), *Datisca glomerata* (Datiscaceae), and *Ceanothus* spp. (Rhamnaceae). Poster presentation, Bot. Soc. American. Annual Meetings, Tucson, Arizona.

2. Normand P, Alloisio N, Marechal J, Lavire C, Pujic P, Berry AM, Mullin BC, Tomkins J, Tisa L, Benson D, Choisne N, Demange N., Truong Cong YC., Coulloux A, Rouy Z, Cruveiller S, Labarre L, Médigue C. 2005. The genome of the N_2-fixing symbiotic *Frankia alni* ACN14A. Symposium at Univ. Gottingen, Germany.

3. P. Normand, P Pujic, LS Tisa, JP Gogarten, N Alloisio, AM Berry, N Choisne, A Couloux, S Cruveiller, V Daubin, N Demange, MP Francino, L Labarre, C Lavire, B Mullin, Z Rouy, C Schenowitz, Anita Sellstedt, F Tavares, JP Tomkins, D Vallenet, C Valverde, L Wall, C Medigue, & DR Benson. 2006. What the genomes of *Frankia* tell us about the symbiosis. Symposium - 7th European Nitrogen Fixation Congress, Aarhus, Denmark.

4. C. A. Bassi, L. S. Tisa and D. R. Benson. 2006. Breaking the *Frankia* CcI3 speed limit. Poster at 14th Intermational Meeting on Frankia and Actinorhizal Plants, Umea, Sweden.

5. J.M. Niemann, J.D. Tjepkema, D. R. Benson, and L.S. Tisa. 2006. Effect of Environmental Stimuli on the Expression of Truncated Hemoglobin in *Frankia*. Poster at 14th Intermational Meeting on *Frankia* and Actinorhizal Plants, Umea, Sweden.

6. L. S Tisa, J. M. Niemann, T. Rawnsley, T. Furnholm, D. R Benson, G. B. Smejkal, P. Lapierre, J.P.Gogarten, Y. Huang, J. Mastronunzio, C. A. Bassi, M. P. Francino, and P. Richardson. 2006. Elucidation of the *Frankia* EAN1pec genome sequence shows gene expansion and versatility. Poster at 14th Intermational Meeting on Frankia and Actinorhizal Plants, Umea, Sweden.

7. J. Mastronunzio, L. S. Tisa, P. Normand and D. R. Benson. 2006. The common secretome of *Frankia*. Poster at 14th Intermational Meeting on Frankia and Actinorhizal Plants, Umea, Sweden.

8. D. Bickhart and D. R. Benson. 2006. Analysis of the abundance of atypical Insertion Sequence families in Frankia strains CcI3, ACN14a and EAN1pec.Poster at 14th Intermational Meeting on *Frankia* and Actinorhizal Plants, Umea, Sweden.

9. L. S Tisa, J. M. Niemann, T. Rawnsley, T. Furnholm, D. R Benson, G. B. Smejkal, P. Lapierre, J.P.Gogarten, Y. Huang, J. Mastronunzio, C. A. Bassi, M. P. Francino, and P. Richardson. 2006. Post-Genomic Exploration of the Actinorhizal Symbiosis: What can we learn from the *Frankia* genomes and where do we go from here? 5th International Symbiosis Society Congress, Vienna, Austria.

10. Mastronunzio, J., L. S. Tisa, P. Normand and D. R. Benson. 2007. The reduced secretome of *Frankia* suggests symbiosis by passivity. ASM Annual Meetings, May, Toronto.

11. Bickhart, D. M., P. Lapierre, and D. R. Benson. 2007. *Frankia* strain genome differences are related to the presence and activity of mobile genetic elements. ASM Annual Meetings, May, Toronto.

12. Huang, Y. 2007. Growth kinetics of individual hyphae and development of *Frankia* sp. strain CcI3 in liquid culture. ASM Annual Meetings, May, Toronto.

13. Bickhart, D.M., P. Lapierre, J.P. Gogarten, and D.R. Benson. 2008. Comparative genome analysis of Insertion Sequences in Frankia sp. Presentedat the 108th General Meeting of the Am. Society for Microbiol., Boston, MA.

14. Mastronunzio, J.E., Huang, Y., and D.R. Benson. 2008. Proteomics of Frankia sp. strain CcI3 in Root Nodules. Presented at the 15th International Meeting on Frankia and Actinorhizal Plants, Bariloche, Argentina.

15. Huang, Y., J.E. Mastronunzio, and D.R. Benson. 2008. Shotgun proteomics sheds light on Frankia metabolism in culture. Presented at the 108th General Meeting of the Am. Society for Microbiol., Boston, MA.

16. Huang, Y. and D. R. Benson. 2007. Growth Kinetics of Individual Hyphae and Development of *Frankia* sp. CcI3 in Liquid Culture. ASM General 106th meeting, 2007, Toronto, Canada.

17. J.M. Brooks and D.R. Benson. 2009. Genome Mining Reveals a Treasure Trove of Lantibiotics in Frankia. Presented at the 109th General Meeting of the American Society for Microbiology, Philadelphia, PA.

18. J.M. Brooks, L.S. Tisa, P. Normand, and D.R. Benson. 2008. Genome Mining Reveals the Core Secondary Metabolome of Frankia. Presented at the 108th General Meeting of the American Society for Microbiology, Boston, MA.

19. J. M. Brooks and D. R. Benson. 2011. Characterization of Secondary Metabolite Biosynthesis Genes from *Frankia* sp. HFPCcI3. Presented North Eastern Microbiologists: Physiology, Ecology and Taxonomy (NEMPET) Conference. Blue Mountain Lake, New York.

20. Brooks, J. M. and D. R. Benson. 2011. Cloning and Characterization of a Tryptophan Halogenase Involved in Antibiotic Biosynthesis in *Frankia* sp. CcI3. 2011. Presented at the 46th Region I Meeting of the American Society for Microbiology, Randolph, MA

21. Brooks, J. M. and D. R. Benson. 2014. Metabolomic Profiling of Roots and Nodules in Frankia-Plant Symbioses. 114rh General Meeting ASM, Boston, MA, May.

Books

"Selected Papers from the 7TH INTERNATIONAL CONFERENCE ON *FRANKIA* AND ACTINORHIZAL PLANTS. D. R. Benson). Kluwer Publ. Co., Dordrecht, Netherlands. Plant and Soil Vol. 118, Nos. 1-2 (1989).

PhD students

James Brooks 2013, Asst. Professor, Charleston Southern Univ.
Ying Huang 2011.
Derek Bickhart 2010, USDA-ARS, Animal Bovine Functional Genomics Laboratory, Beltsville, MD, 20705, USA.
Juliana Mastronunzio 2009, PostdocYale University School of Medicine, New Haven, CT; Faculty, Fairfield Univ.
Jeffrey Gawronski 2004, Res Scientist, Microbiol & Physiol Systems, UMass Med. School, Worcester, MA
Noella Marcellino 2003, Abbey Regina Laudis & Adjunct at Univ. Vermont, Burlington, VT
Michael Clawson 1999, Res. Mol. Biologist, USDA-ARS, Clay Center, NE

Olivia Harriott 1994, Professor, Fairfield Univ., Fairfield, CT
Xiaojun Zhang 1993, Asst. Professor, Indiana State Univ. deceased
Jack Leonard 1992, VP Research, Pathogenica Corp., Boston MA
Thomas Hosted 1992, Principle Scientist, Schering Plough Corp., Madison, NJ (retired)
Deborah Rochefort 1990, Professor of Microbiology, Shepherd Univ., Shepardville, WV (retired)
Nancy Schultz 1988, VP Global Quality Assurance, Unilever Corp. Madison, CT

MS students
Jannie Edmunds – Wentworth Douglas Hospital, NH
Charles Mazzucco – Bristol-Myers Squibb, CT
Malika Meemongkolkiat – Federal Health Services, Thailand
Nancy Noridge – Unilever Corp. CT
Aaron Bourret – Novartis Pharmaceuticals Corp.
Carla Bassi – Unilever Corp., CT
Frank Zappulla – USDA,-ARS Plum Island, NY
Rebecca Seliga - Current