Hugh S. Mason, Ph.D.
Associate Professor
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Education:

1976 B.S., Molecular Biology, University of Texas, Austin
1986 Ph.D., Cellular and Developmental Biology, University of Arizona, Tucson
Dissertation: *Alterations in Polyribosome and Messenger RNA Metabolism and Messenger Ribonucleoprotein Utilization in Osmotically Stressed Plant Seedlings*

Previous experience:

2004-present	Member, Biodesign Institute, Center for Infectious Disease & Vaccinology
2002-present	Associate Professor, School of Life Sciences, Arizona State University (Research and teaching in molecular biology, biomedicine, and biotechnology)
2003-2004	Leader, Faculty of Biomedicine & Biotechnology, School of Life Sciences, Arizona State University (Administrative Leader of 18 faculty)
1999-2002	Associate Research Scientist, Boyce Thompson Institute for Plant Research (Research in plant molecular biology, biomedicine, and biotechnology)
1999-2003	Member of Graduate Field of Vegetable and Fruit Crops, Cornell University (Ph.D. committee chair or member)
1998-2003	Member of Graduate Field of Plant Biology, Cornell University (Ph.D. committee chair or member)
1996-2003	Adjunct Assistant Professor, Cornell University Section of Plant Biology
1995-99	Assistant Research Scientist, Boyce Thompson Institute for Plant Research (Research in plant molecular biology, biomedicine, and biotechnology)
1992-95	Research Assistant Professor, Institute of Biosciences and Technology, Texas A&M University (Research in plant molecular biology and biotechnology)
1987-92	Postdoctoral Research Associate, Department of Biochemistry, Texas A&M University; Research related to expression of soybean *vsp* genes and analysis of *vspB* promoter
1986-87	Postdoctoral Research Associate, Department of Soil and Crop Sciences, Texas A&M University; Research in gene expression related to drought in soybean seedlings
1979-85	Graduate Assistant, Department of Cell and Developmental Biology, University of Arizona, Tucson, AZ, Teaching laboratory courses in developmental biology and plant physiology
1977-78	Histology Technician, Methodist Hospital, Indianapolis, IN

Professional Membership: *American Society of Plant Biologists*

Member Editorial Board: *BioMed Central*

Publications, primary peer-reviewed:

1. Mason HS, Matsuda K. (1985) Polyribosome metabolism, growth and water status in the growing tissues of osmotically stressed plant seedlings. *Physiol. Plant.* **64**: 95-104.
2. Mason H, Mullet J, Boyer J. (1988) Polysomes, messenger RNA and growth in soybean stems during development and water deficit. *Plant Physiol.* **86**:725-733.
3. Mason H, Guerrero F, Boyer J, Mullet J. (1988) Proteins homologous to leaf storage proteins are abundant in stems of soybean seedlings. Analysis of proteins and cDNAs. *Plant Mol. Biol.* **11**:845-856.
4. Klein RR, Mason HS, Mullet JE. (1988) Light-regulated translation of chloroplast proteins. I. Transcripts of PsaA-PsaB, PsbA and RbcL are associated with polysomes in dark-grown and illuminated barley seedlings. *J. Cell Biol.* **106**: 289-301.
5. Creelman RA, Mason HS, Bensen RJ, Boyer JS, Mullet JE. (1989) Water deficit and ABA cause differential inhibition of shoot vs. root growth in soybean seedlings. Analysis of growth, sugar accumulation and gene expression. *Plant Physiol.* **92**: 205-214.
6. Mason H, Mullet J. (1990) Expression of two soybean vegetative storage protein genes during development and in response to water deficit, wounding and jasmonic acid. *Plant Cell* **2**:569-579.
7. Mason H, DeWald D, Creelman R, Mullet J. (1992) Co-regulation of soybean vegetative storage protein gene expression by methyl jasmonate and soluble sugars. *Plant Physiol.* **98**:859-867.
8. DeWald DB, Mason HS, Mullet JE. 1992. The soybean vegetative storage proteins VSPα and VSPß are acid phosphatases active on polyphosphates. *J. Biol. Chem.* **267**: 15958-15964.
9. Mason H, Lam D, Arntzen CJ. (1992) Expression of hepatitis B surface antigen in transgenic plants. *Proc. Natl. Acad. Sci. USA* **89**:11745-11749.
10. Mason H, DeWald D, Mullet J. (1993) Identification of a methyl jasmonate responsive domain in the soybean *vspB* promoter. *Plant Cell* **5:**241-251.
11. May GD, Afza R, Mason HS, Weicko A, Novak F, Arntzen CJ. (1995) Genetic transformation of banana (*Musa acuminata)*. *Bio/Technology* **13**:486-492.
12. Haq TA, Mason HS, Clements JD, Arntzen CJ. (1995) Oral immunization with a recombinant bacterial antigen produced in transgenic plants. *Science* **268:714**-716.
13. Thanavala Y, Yang Y-F, Lyons P, Mason HS, Arntzen C. (1995) Immunogenicity of transgenic plant-derived hepatitis B surface antigen. *Proc. Natl. Acad. Sci. USA* **92**:3358-3361.
14. Mason HS, Ball J, Shi JJ, Jiang X, Estes MK, Arntzen CJ (1996) Expression and immunogenicity of Norwalk virus capsid protein from transgenic tobacco and potato. *Proc. Natl. Acad. Sci. USA* **93**: 5335-5340
15. Mason HS, Haq TA, Clements JD, Arntzen CJ (1998) Edible vaccine protects mice against E. coli heat-labile enterotoxin (LT): potatoes expressing a synthetic LT-B gene. *Vaccine* **16**:1336-1343.
16. Tacket CO, **Mason HS**, Losonsky G, Clements JD, Levine MM, Arntzen CJ (1998) Immunogenicity in humans of a recombinant bacterial antigen delivered in transgenic potato. *Nature Medicine* **4**:607-609.
17. Tacket CO, **Mason HS**, Losonsky G, Estes MK, Levine MM, Arntzen CJ (2000) Human immune responses to a novel Norwalk virus vaccine delivered in transgenic potatoes. *J. Infect. Dis.* **182**: 302-305.

18. Dogan B, **Mason HS**, Richter L, Hunter JB, Shuler ML (2000) Process options in hepatitis B surface antigen extraction from transgenic potato. *Biotechnol. Progress* **16**:435-441.
19. Richter L, Thanavala Y, Arntzen CJ, **Mason HS** (2000) Production of hepatitis B surface antigen in transgenic plants for oral immunization. *Nature Biotechnol.* **18**:1167-1171.
20. Mor TS, Sternfeld M, Soreq H, Arntzen CJ, **Mason HS** (2001) Expression of recombinant human acetylcholinesterase in transgenic tomato plants. *Biotechnol. Bioeng*. **75:** 259-266.
21. Kong Q, Richter L, Yang Y-F, Arntzen CJ, **Mason HS**, Thanavala Y (2001) Oral immunization with hepatitis B surface antigen expressed in transgenic plants. *Proc. Natl. Acad. Sci. USA* **98:**11539-11544.
22. Smith ML, Keegan ME, **Mason HS**, Shuler ML (2002) Factors important in the extraction, stability and in vitro assembly of the hepatitis B surface antigen derived from recombinant plant systems. *Biotechnol. Prog.* **18**(3): 538-550.
23. Smith ML, **Mason HS**, Shuler ML (2002) Hepatitis B surface antigen (HBsAg) expression in plant cell culture; the kinetics of antigen accumulation in batch culture and its intracellular form. *Biotechnol. Bioeng.* **80**, 812-822.
24. Chikwamba R, Cunnick J, Hathaway D, McMurray J, **Mason HS**, Wang K (2002). A functional antigen in a practical crop: Maize synthesized LT-B protects mice against *Escherichia coli* heat labile enterotoxin (LT) and cholera toxin (CT). *Transgenic Research*. **11**:479-493.
25. Chikwamba R, McMurray J, Frame B, Scott P, **Mason H**, Wang K (2002). Expression of a bacterial antigen in maize: The role of regulatory sequences, inheritance and level of expression of the synthetic *E. coli* heat labile toxin B sub-unit (LT-B) in maize. *Molecular Breeding* **10**: 253 - 263.
26. Cao J, Ibrahim H, Garcia J, **Mason H**, Granados RR, Earle ED (2002) Transgenic tobacco plants carrying a baculovirus enhancin gene slow development and enhance mortality of *Trichoplusia ni* larvae. *Plant Cell Rep* 21:244-250.
27. Mor TS, Moon Y-S, Palmer KE, **Mason HS** (2003) Geminivirus vectors for high level expression of foreign proteins in plant cells. *Biotechnol. Bioeng.* **81**: 430-437.
28. Sojikul P, Buehner N, **Mason HS** (2003) A plant signal peptide-hepatitis B surface antigen fusion protein with enhanced stability and immunogenicity expressed in plant cells. *Proc. Natl. Acad. Sci. USA* **100**:2209-2214.
29. Walmsley AM, Kirk DD, **Mason HS** (2003) Passive immunization of mice pups through oral immunization of dams with a plant-derived vaccine. *Immunol. Lett.* **86**:71-76.
30. Walmsley AM, Alvarez ML, Jin Y, Kirk DD, Lee SM, Pinkhasov J, Rigano MM, Arntzen CJ, **Mason HS** (2003) Expression of the B subunit of *Escherichia coli* heat-labile enterotoxin as a fusion protein in transgenic tomato. *Plant Cell Rep.*, **21**:1020-1026.
31. Warzecha H, **Mason HS**, Lane C, Tryggvesson A, Rybicki E, Williamson A, Clements JD, Rose RC (2003) Oral immunogenicity of human papillomavirus-like particles expressed in potato. *J. Virol* **77**:8702-8711.
32. Smith ML, Richter L,. Arntzen CJ, Shuler ML, **Mason HS** (2003) Structural characterization of plant-derived hepatitis B surface antigen employed in oral immunization studies. *Vaccine* **21**:4011-4021.
33. Chikwamba RK, Scott MP, Mejia LB, **Mason HS**, Wang K (2003) Localization of a bacterial protein in starch granules of transgenic maize kernels. *Proc. Natl. Acad. Sci. USA* **100**:11127-11132.
34. Judge NA, **Mason HS**, O'Brien AD (2004) Plant cell-based intimin vaccine given orally to mice primed with intimin reduces time of *Escherichia coli* O157:H7 shedding in feces. *Infect. Immun.* **72**:168-175.

35. Huang Z, **Mason HS** (2004) Conformational analysis of hepatitis B surface antigen fusions in an *Agrobacterium*-mediated transient expression system. *Plant Biotechnol. J*. **2**:241-249.
36. Thanavala Y, Mahoney M, Pal S, Scott A, Richter L, Natarajan N, Goodwin P, Arntzen CJ, **Mason HS** (2005) Immunogenicity in humans of an edible vaccine for hepatitis B. *Proc. Natl. Acad. Sci. USA* **102**:3378-3382.
37. Huang Z, Elkin G, Maloney BJ, Beuhner N, Arntzen CJ, Thanavala Y, **Mason HS** (2005) Virus-like particle expression and assembly in plants: hepatitis B and Norwalk viruses. *Vaccine* **23**:1851-1858.
38. Maloney BJ, Takeda N, Suzaki Y, Ami Y, Li TC, T Miyamura, Arntzen CJ, **Mason HS** (2005) Challenges in creating a vaccine to prevent hepatitis E. *Vaccine* **23**:1870-1874.
39. Mihalek CA, Webb S, Miller T, Fanton M, Kirk D, Cardineau G, **Mason H**, Walmsley A, Artnzen A, Van Eck J (2005) Development of plant cell produced vaccines for animal health applications. *Proc. Ann. Meeting U.S. Animal Health Assoc.* **108**:158-163.
40. Zhang X, **Mason HS** (2005) Bean yellow dwarf virus replicons for high-level transgene expression in transgenic plants and cell cultures. *Biotechnol Bioeng*. **93**(2):271-9.
41. Huang Z, Santi L, LePore K, Kilbourne J, Arntzen CJ, **Mason HS** (2006) Rapid, high-level production of hepatitis B core antigen in plant leaf and its immunogenicity in mice. *Vaccine,* **24**(14):2506-2513.
42. Santi L, Giritch A, Roy C, Marillonnet S, Klimyuk V, Gleba Y, Webb R, Arntzen C, **Mason H** (2006) Protection conferred by recombinant *Yersinia pestis* antigens produced by a rapid and highly scalable plant expression system. *Proc. Natl. Acad. Sci. USA* **103**(4):861-866.
43. Saldaña S, Guadarrama FE, de Jesus Olivera Flores T, Arias N, López S, Arias C, Ruiz R, **Mason H**, Mor T, Richter L, Arntzen CJ, Gómez-Lim MA (2006) Production of rotavirus-like particles in tomato (*Lycopersicon esculentum* L.) fruit by expression of capsid proteins VP2 and VP6 and immunological studies. *Viral Immunol*. **19**(1):42-53.
44. Alvarez ML, Pinyerd HL, Crisantes JD, Rigano MM, Pinkhasov J, Walmsley AM, **Mason HS**, Cardineau, GA (2006) Plant-made subunit vaccine against pneumonic and bubonic plague is orally immunogenic in mice. *Vaccine* **24**(14): 2477-2490.
45. Zhang X, Buehner NA, Hutson AM, Estes MK, **Mason HS** (2006) Tomato is a highly effective vehicle for expression and oral immunization with Norwalk virus capsid protein. *Plant Biotechnol. J.* **4:** 419–432.
46. Becerra-Arteaga A, **Mason HS**, Shuler ML (2006) Production, Secretion, and Stability of Human Secreted Alkaline Phosphatase in Tobacco NT1 Cell Suspension Cultures. *Biotechnol. Prog.,* **22**(6):1643-1649.
47. Collens JI, **Mason HS**, Curtis WR (2007) Agrobacterium-mediated viral vector-amplified transient gene expression in Nicotiana glutinosa plant tissue culture. *Biotechnol Prog.* **23(3):**570-6. Epub 2007 Apr 11.
48. Van Eck J, Conlin B, Garvin D, **Mason H**, Navarre D, Brown C (2007) Enhancing [[beta]]-carotene content in potato by RNAi-mediated silencing of the [beta]-carotene hydroxylase gene. *American J. Potato Res.*, **84 (4):**331-342**.**
49. Huang Z, LePore K, Elkin G, Thanavala Y, **Mason HS** (2008) High-yield rapid production of hepatitis B surface antigen in plant leaf by a viral expression system. *Plant Biotechnol. J.* **6 (2)**: 202–209.
50. Santi L, Batchelor L, Huang Z, Hjelm B, Kilbourne J, Arntzen CJ, Chen Q, **Mason HS** (2008) An efficient plant viral expression system generating orally immunogenic Norwalk virus-like particles. *Vaccine* **26**:1846-1854.

51. Huang Z, Chen Q, Hjelm B, Arntzen C, **Mason H** (2009) A DNA replicon system for rapid high-level production of virus-like particles in plants. *Biotechnol. Bioeng.* **103**: 706-714.
52. Webster DE, Wang L, Mulcair M, Ma C, Santi L, **Mason HS**, Wesselingh SL, Coppel RL (2009) Production and characterisation of an orally immunogenic *Plasmodium* antigen in plants using a virus-based expression system. *Plant Biotechnol. J.,* **7:** 846–855.
53. Del Prete G, Santi L, Andrianaivoarimanana V, Amedei A, Domarle O, D' Elios MM, Arntzen CJ, Rahalison L, **Mason HS** (2009) Plant-derived recombinant F1, V, and F1-V fusion antigens of Yersinia pestis activate human cells of the innate and adaptive immune system. *Int J Immunopathol Pharmacol.* 22(1):133-43.
54. Huang Z, Phoolcharoen W, Lai H, Piensook K, Cardineau G, Zeitlin L, Whaley KJ, Arntzen CJ, ***Mason HS**, *Chen Q (2010) High-level rapid production of full-size monoclonal antibodies in plants by a single-vector DNA replicon system. *Biotechnol. Bioeng.***106**: 9-17 PMID: 20047189. *co-corresponding authors
55. Martinez CA, Topal E, Giulietti AM, Talou JR, **Mason HS** (2010) Exploring different strategies to express Dengue virus envelope protein in a plant system. *Biotechnol. Lett,* 32(6):867-75.
56. Daskalova SM, Radder JE, Cichacz ZA, Olsen SH, Tsaprailis G, **Mason H**, Lopez LC (2010) Engineering of N. benthamiana L. plants for production of N-acetylgalactosamine-glycosylated proteins--towards development of a plant-based platform for production of protein therapeutics with mucin type O-glycosylation. *BMC Biotechnol.* 2010 Aug 24;10:62. PMID: 20735851.
57. Pinkhasov J, Alvarez ML, Pathangey LB, Tinder TL, **Mason HS**, Walmsley AM, Gendler SJ, Mukherjee P (2010) Analysis of a cholera toxin B subunit (CTB) and human mucin 1 (MUC1) conjugate protein in a MUC1-tolerant mouse model. Cancer Immunol Immunother **59**: 1801-1811.
58. Mathew LG, Maloney B, Takeda N, **Mason HS** (2011) Spurious polyadenylation of Norovirus Narita 104 capsid protein mRNA in transgenic plants. *Plant Mol Biol.* **75:** 263-275.
59. Phoolcharoen W, Bhoo SH, Lai H, Ma J, Arntzen CJ, Chen Q, **Mason HS** (2011) Expression of an immunogenic Ebola immune complex in *Nicotiana benthamiana*. *Plant Biotechnol. J.,* 9(7):807-16.
60. Pinkhasov J, Alvarez ML, Rigano MM, Piensook K, Larios D, Pabst M, Grass J, Mukherjee P, Gendler SJ, Walmsley AM, **Mason HS** (2011) Recombinant plant-expressed tumor-associated MUC1 peptide is immunogenic and capable of breaking tolerance in MUC1.Tg mice. *Plant Biotechnol. J.* 9(9):991-1001.
61. Phoolcharoen W, Dye JM, Kilbourne J, Piensook K, Pratt WD, Arntzen CJ, Chen Q, **Mason HS**, Herbst-Kralovetz MM (2011) A nonreplicating subunit vaccine protects mice against lethal Ebola virus challenge. *Proc. Natl. Acad. Sci. USA* 108(51):20695-20700.

Publications, invited reviews and chapters:

1. **Mason HS**, Arntzen CJ (1995) Transgenic plants as vaccine production systems. *Trends Biotechnol.* **13**:388-392.
2. Richter L, **Mason HS**, Arntzen CJ (1996) Transgenic plants created for oral immunization against diarrheal diseases. *J. Travel. Med.* **3**:52-56

3. May GD, **Mason HS**, Lyons P (1996) Application of transgenic plants as production systems for pharmaceuticals. In: Fuller G, Bills D, McKeon T, Eds. ACS Symposium Series --Agriculture as a Renewable Source of Raw Materials. Washington, DC: ACS Books, pp. 194-204.
4. Lyons PC, May GD, Mason HS, Arntzen CJ (1996) Production of protein pharmaceuticals in transgenic plants. *Pharmaceutical News* **3**:7-12.
5. Welter LM, Mason HS, Lu W, Lam DMK, Welter MW (1996) Effective immunization of piglets with transgenic potato plants expressing a truncated TGEV S protein. In: *Vaccines: New Technologies and Applications.* (Cambridge Healthtech Institute).
6. Arntzen CJ, Mason HS (1997) Oral vaccine production in the edible tissues of transgenic plants. In: *New Generation Vaccines*, Second Edition (Eds. Levine MM, Woodrow GC, Kaper JB, Cobon GS) Marcel Dekker, New York, Pages 263-277.
7. Mason HS, Tacket CO, Richter LJ, Arntzen CJ (1998) Subunit vaccines produced and delivered in transgenic plants as "edible vaccines" *Res. Immunol.* **149**:71-74.
8. Mason HS, Arntzen CJ (1998) Edible vaccines -- the future for paediatric vaccines delivery? *Vaccines: Children and Practice*, **1**:13-15.
9. Wong SY, Ho KS, Mason HS, Arntzen CJ (1998) Edible vaccines. *Science & Medicine* **5:**36-45.
10. Walmsley AM, Mason HS, Arntzen CJ (1999) The development of transgenic plants as edible vaccines. *Mucosal Immunol. Update* **7**:12-14.
11. Tacket CO, Mason HS (1999) A review of oral vaccination with transgenic vegetables. *Microbes & Infection* 1:1-7.
12. Mor TS, Richter L, Mason HS (1999) Expression of rotavirus proteins in transgenic plants. In: *Plant Biotechnology and In Vitro Biology in the 21st Century* (Altman A, Ziv M, Izhar S, eds.), pp. 521-524, Proceedings of the IXth International Congress of the International Association of Plant Tissue Culture and Biotechnology, Kluwer Academic Publishing, Dordrecht, The Netherlands.
13. Mason HS (2002) Plant-based vaccines: Expression and oral immunogenicity. *In Vitro Cell. Devel. Biol. – Plant* **38**:237-240.
14. Mason HS, Warzecha H, Mor TS, Arntzen CJ (2002) Edible plant vaccines: applications for prophylactic and therapeutic molecular medicine. *Trends Mol. Med.***8**:324-329.
15. Warzecha H, Mason HS (2003) Benefits and risks of antibody and vaccine production in transgenic plants. *J. Plant Physiol.* **160**:755-764.
16. Mason HS, Chikwamba R, Santi L, Mahoney RT, Arntzen CJ (2004) Antigen delivery systems: Transgenic plants for mucosal vaccines. In: Mucosal Immunology, 3rd Edition. Section D. Mucosal Vaccines (McGhee JR, Mestecky JF, Eds) Elsevier Science, London, 2004, pp. 1053-1060.
17. Mason HS (2004) Vaccines produced in transgenic plants. In: Encyclopedia of Plant and Crop Science (Goodman RM, Ed.). Marcel Dekker, New York.
18. Mor TS, Mason HS (2003) Plants as a source for subunit vaccines. In: Handbook of Plant Physiology (Christou P, Klee H, Eds.) John Wiley & Sons, Ltd., West Sussex, 2004, pp. 768-780.
19. Mor TS, Mason HS, Kirk D, Arntzen CJ, Cardineau GA (2004) Plants as a delivery vehicle for orally delivered subunit vaccines. In: New Generation Vaccines, Third Edition (Levine M, Ed.), pp. 305-311. Marcel Dekker, New York.
20. Arntzen CJ, Mahoney RT, Mason HS, Kirk DD (2005) Oral Vaccines Derived from Transgenic Plants. In: Vaccines: Preventing disease and protecting health.

21. Khalsa G, Mason HS, Arntzen CJ (2004) Plant-Derived Vaccines: Progress and Constraints. *In:* Fischer R, Schillberg S, Eds. *Molecular Farming*, pp. 135-160. (Published Online: 6 Jun 2005)
22. Santi L, Huang Z, Mason H (2006) Virus-like particles production in green plants. *Methods* **40**(1):66-76.
23. Thanavala Y, Huang Z, Mason HS (2006) Plant-derived vaccines: a look back at the highlights and a view to the challenges on the road ahead. *Expert Rev Vaccines* **5**(2):249-260.
24. Santi L, Mason HS (2006) Protective plague vaccine produced in tobacco leaves. *Information Systems for Biotechnology News Report*, Virginia Tech University, April 2006, http://www.isb.vt.edu/articles/apr0602.htm.
25. Mayo KJ, Gonazales BJ, Mason HS (2006) Genetic transformation of tobacco NT1 cells with *Agrobacterium tumefaciens. Nat Protoc.* **1(3):**1105-11. http://www.natureprotocols.com/2006/08/17/genetic_transformation_of_toba.php
26. Arntzen C, Mason H, Khalsa G (2007) Designing and delivering plant-based vaccines for the developing world. *PETRIA J. Plant Pathol.* **17**:55-70.
27. Daniell H, Singh ND, Mason H, Streatfield SJ (2009) Plant-made vaccine antigens and biopharmaceuticals. *Trends Plant Sci.* 14(12):669-79.
28. Santi L, Mason HS (2010) Plants as biofactories for vaccine production. *Encyclopedia of Biotechnology in Agriculture and Food* DOI: 10.1081/EBAF-120042331 (D. Heldman, A. Bridges, D.G. Hoover, and M. Wheeler, eds.). Taylor & Francis, New York.
29. Herbst-Kralovetz M, Mason HS (*corresponding author*), Chen Q (2010) Norwalk virus-like particles as vacines. *Expert Rev. Vaccines* 9(3):299-307.
30. Mason HS, Herbst-Kralovetz MM (2010) Plant-derived antigens as mucosal vaccines. In *Current Topics in Microbiology and Immunology, Mucosal Vaccines: Modern Concepts, Strategies, and Challenges* (P. Kozlowski, ed.) Springer, Heidelberg, ***accepted.***
31. Chen Q, He J, Phoolcharoen W, Mason HS (2011) Geminiviral vectors based on bean yellow dwarf virus for production of vaccine antigens and monoclonal antibodies in plants. *Hum Vaccin*. Mar 1;7(3). [Epub ahead of print] PMID: 21358270

PATENT APPLICATIONS:

AZTE:043USP1

Mason HS, Huang Z, Chen Q, Arntzen CJ, Hjelm B, Yuan S.
"A DNA replicon system for high-level rapid production of vaccines and monoclonal antibody therapeutics in plants". Application Number 61092318, Filed 08/27/2008

This patent describes a novel viral vector system that very useful for production of oligomeric proteins that must assemble from separate subunits, such as monoclonal antibodies for use a protein drugs. It overcomes difficulties posed by other plant viral replicon systems which involve competition between co-delivered vectors. This new geminiviral system drives non-competitive co-amplification of multiple replicons to allow accumulation of multiple recombinant proteins in the same cell. The system is an improvement over US Patent ***6,392,121*** in that it allows multiple foreign genes to be co-expressed.

AZTE:065USP1 (M10-018L)

Mason HS, Bhoo SH, Park SH, Arntzen CJ
"*Methods and Compositions Related to Glycoprotein-Immunoglobulin Fusions*"
Filed 02/12/2010

This patent describes a novel strategy to express hepatitis C virus envelope glycoproteins E1 and E2 as fusions with immunoglobulin heavy and light chains, which mediates assembly to produce E1/E2 heterodimers. The process improves the expression and stability of E1/E2 as soluble as a soluble antigen rather than a membrane-bound protein.

SERVICE (2010)

Member of ASU Committees:

ASU Institutional Biosafety Committee
SoLS Research and Training Initiatives Committee
SoLS Greenhouse Committee
Personnel Committee, SoLS Faculty of Biomedicine & Biotechnology

ACNRMI Workshop Biotechnology and Biomedicine for visitors from the Kazan State Technical University (Russia): Prepared and delivered 3 hour workshop on Plant-made Vaccines.

Reviewer of grant proposals for:

NIH ZRG1 IMM-N (12) Microbial Vaccine Development
NIH ZRG1-IMM-E (02) Immunology
NIH ZRG1 IMM-E (55) R - OD-10-005 Director's Opportunity 5 Themes Immunology
USDA SBIR Program Plant Production and Protection – Biology
Natural Sciences and Engineering Research Council of Canada
Wellcome Trust
Fondazione Cariplo – Vaccine Development

Member Editorial Board for *BioMed Central*

Reviewer of manuscripts for journals (number reviewed):

BMC-Biotechnology (1)
Clinical and Vaccine Immunology (1)
Human Vaccines (1)
J. Plant Physiology (1)
Plant Biotechnology Journal (2)
Plant Cell Reports (1)
PloS ONE (1)
Protein Expression and Purification (1)
Vaccine (2)

GRADUATE STUDENT MENTORING

Chair Committees and Director of Research for Ph.D. Graduates:

Emel Topal, Plant Biology Ph.D. 2010, Arizona State University
Dissertation: *Subunit vaccine to prevent Escherichia coli O157:H7 intestinal attachment and colonization*

Waranyoo Phoolcharoen, Plant Biology Ph.D. 2010, Arizona State University
Dissertation: *Plant-produced Ebola Immune Complex as an Ebola Vaccine Candidate*

Shuo Yuan, Plant Biology MS 2009, Arizona State University
Thesis: *Generating and characterizing ethanol-inducible Rep-providing transgenic* Nicotiana benthamiana *lines*

Lolita George, Ph.D. 2008, Plant Biology, Arizona State University
Dissertation: *Examination of coding sequence elements that limit the expression of a norovirus capsid protein in plants*

Kate (Gorlewski) LePore, Ph.D. 2008, Plant Biology, Arizona State University
Dissertation: *Improved mucosal targeting of plant-derived vaccine antigens by fusion to a bacterial invasin protein*

Julia Pinkhasov, Ph.D. 2006, Plant Biology, Arizona State University
Dissertation: *Investigations into a mucosal targeted breast cancer vaccine: Fusion of the epithelial mucin 1 antigen to mucosal carrier peptide and its efficacy in breaking self-antigen tolerance*

Xiuren Zhang, Ph.D. Candidate Ph.D. 2003, Plant Biology, Cornell University
Dissertation: *Norwalk virus vaccine production in transgenic tomato and potato*

Punchapat Sojikul, Ph.D. 2002, Plant Biology, Cornell University.
Dissertation: *Improvement of hepatitis B surface antigen expression in plant cell culture system*

Yong-Sun Moon, Ph.D. 2002, Horticulture, Cornell University
Dissertation: *Geminivirus-mediated enhanced foreign gene expression in plant systems*

Chair Graduate Committees in progress:

Sun Hee Park, Plant Biology Ph.D., Arizona State University

Fan Hong, Biodesign Ph.D., Arizona State University

Member Ph.D. Committees in progress:

Sarah Kessans, Molecular/Cellular Biology, Arizona State University

Member of Committee for Ph.D. Graduates:

Mrinalini Muralidharan, Ph.D. 2009, Molecular/Cellular Biology, Arizona State University
Dissertation: *Characterizing pea acetylcholinesterases*

Lisa Lopez, Ph.D. 2008, Molecular/Cellular Biology, Arizona State University
Dissertation: *Importance of conserved cysteine residues in the coronavirus envelope protein*

Stacey White, Ph.D. 2008, Molecular/Cellular Biology, Arizona State University

Ye Ye, Ph.D. 2007, Molecular/Cellular Biology, Arizona State University
Dissertation: *Role of the Coronavirus E Viroporin Protein Transmembrane Domain in Virus Assembly*

Brian Geyer, Ph.D. 2007, Molecular/Cellular Biology, Arizona State University
Dissertation: *Transgenic Plant-Derived Recombinant Human Acetylcholinesterase-R*

Samuel P. Fletcher, Ph.D. 2005, Plant Biology, Arizona State University
Dissertation: *Chemical Warfare Countermeasures: Expression of Human Acetylcholinesterase in Plants*

Nicole Judge, Ph.D. 2003, Microbiology, Uniformed Services University of the Health Sciences,
Dissertation: *Development and characterization of a transgenic plant-based vaccine to reduce shedding of Escherichia coli O157:H7*

Rachel Chikwamba, Ph.D. 2002, Agronomy, Iowa State University
Dissertation: *Maize as a production and delivery vehicle of edible vaccines against the enterotoxigenic Escherichia coli and the swine transmissible gastroenteritis*

Mark Smith, Ph.D. 2001, Cornell University
Dissertation: *Plant-derived oral hepatitis B vaccine: Characterization of the production system, the antigen and its formulation*

Donna Esposito, Ph.D. 2000, Molecular & Cellular Biology, Cornell University
Dissertation: *Mechanisms of chloroplast translation initiation in Chlamydomonas reinhardtii*

Belgin Dogan, M.Sc. 2000, Cornell University
Thesis: *Process options in hepatitis B surface antigen extraction from transgenic potato*

Member M.S. Committee Graduate:

Irene Cherni, M.S., 2008

RESEARCH SUPPORT, ONGOING

"Influenza vaccine production in plants"
Mason, H. 2/1/11 to 4/30/11 10%
GreenVax (G-CON), Inc. $50,000
The goal is to demonstrate expression of influenza virus HA, NA, and M1 proteins and assembly of virus-like particles in plants using the geminiviral replicon transient system.

"Development of a vaccine for Ebola virus in plant systems"
Arntzen, C. (Mason, H. & Ma, J., co-PIs) 3/15/05 to 02/28/11 5%
NIH $402,668
The goal is to create fusion proteins with Ebola virus glycoprotein GP1 and monoclonal antibody against GP1, express in plants, verify the assembly of "recombinant immune complexes", and test for vaccine efficacy by immunization of model rodents.

"Plant-derived vaccines against hepatitis C"
1 U19 AI066332-01 (Arntzen, C. & Mason, H., co-PIs) 8/1/05 to 7/31/11 10%
NIH $700,000
The goal of this project is to develop plant-based systems for robust expression of candidate vaccine antigens of hepatitis C virus. Antigens will be expressed in plants, qualified by a battery of assays, and tested for immunogenicity in animals.

"Plant-Derived Hepatitis B Vaccine from Biomanufacturing System to Clinical Trial"
Mason, PI 10/10/08 – 12/31/10 5%
Quantum Tubers Corportation (NIH-SBIR) $50,155
This project will optimize methods to extract and stabilize hepatitis B surface antigen from transgenic plant material.

RESEARCH SUPPORT, COMPLETED

"Hepatitis E virus capsid protein expression in plants"
(Takeda, PI; Mason, co-PI) 12/1/07 to 7/30/10 5%
Japan Health Sciences Foundation $58,000
This project aims to develop a plant-derived vaccine for hepatitis E virus, using plant viral replicon systems for transient expression in tobacco leaf and characterization of virus-like particle formation.

"Mucosally targeted plant-based STI vaccine"
Mason, H. (Mor, T, co-PI) 9/1/04 to 8/31/09 5%
NIH U19-AI062150-01, Project 2 $247,605
The goal of this project is to express antigens of sexually transmitted viruses (hepatitis B, HIV, HSV, HPV) as various mucosally targeted fusion proteins in plant systems, and evaluation of antibody responses in pre-clinical studies with mice, ultimately developing clinical trials. Studies will address the question of the importance of mucosal antibodies in prevention of STI.

"Development of Next-generation HPV Vaccines: a Collaboration between ASU Biodesign Institute and Arizona-based Virionics Corporation"
Mason, PI 7/1/08 to 6/30/09 5%
Science Foundation Arizona $100,000
This project will evaluate the potential for plant virus based expression of human papillomavirus L1-E7 fusion protein as a prophylactic and therapeutic vaccine.

"Subunit oral vaccine for hepatitis B virus"
Thanavala, Y. (Mason, H.S., co-PI) 1/1/03 – 11/30/08
NIH R01 AI042836-04A1 $67,000
The goal of this project is to evaluate strategies for enhanced expression and mucosal targeting of hepatitis B surface antigen in plants, to demonstrate oral immunogenicity of plant-derived antigen, and to track orally delivered antigen in mice.

"Pathogenicity of Shiga Toxin-Producing E. coli"
O'Brien, A. (Mason, co-PI) 10/1/03 to 8/31/08
NIH 5R01AI20148-22 $40,000
The goal of this project is to express candidate vaccine antigens of enteropathogenic E . coli, including shiga-like toxoids and intimin, in plant systems for testing by oral delivery in mice.

"Plant production of vaccines and antibodies for protection against biowarfare agents"
Arntzen, C (Mason, co-PI)
Department of Defense 6/01/02 to 5/31/06
The goal of this project is to develop plant expression of *Yersinia pestis* vaccine antigens.

"Small round structured virus capsid protein expression in plants"
Takeda, N. (Mason, co-PI)
Japan Human Sciences Foundation 4/01/02 to 12/31/06
The goal of this project is to develop a plant-derived vaccine for small round structured viruses, using co-expression of capsid proteins of multiple subtypes in potato and tomato.

"Oral immunization against anogenital HPV disease"
Rose, R. (Mason, H.S., co-PI)
NIH 1R01 CA84105 4/1/00-3/31/05
The goal of this project is to express HPV L1 and L2 capsid proteins in transgenic potato and tomato, examine assembly of virus-like particles and antigenicity of recombinant protein.

"Overcoming Barriers to Protein Production in Plant Cell Cultures"
Shuler, M. (Mason, H.S., co-PI)
NSF BES-0109936 11/01/01 to 10/31/05
The goal of this project is to use plant suspension cultured cells to evaluate points of limitation for expression of recombinant proteins in plant cells.

"Transient Protein Expression in Plant Tissue Culture"
Mason, H.S.
NSF-GOALI BES 0134490 10/01/01 to 9/30/05

The goal of this project is to develop a plant tissue culture system for rapid evaluation of recombinant protein expression in plant cells, using callus cell cultures or hairy root cultures transiently infected with recombinant virus or *Agrobacterium*.

"Expression of ETEC enterotoxin in tomato fruit and development of a prototype transgenic tomato for dissemination as an oral vaccine in developing countries"
Friedmann, M. (Mason, H.S., co-PI)
BARD IS-2979-98 1/1/99-12/31/02
The goal of this project was to create transgenic tomato plants that express nontoxic mutant forms of the *E. coli* heat-labile enterotoxin in fruits, and to use plant breeding to develop tomato lines for production and delivery of vaccines against ETEC diarrhea.

"High-level plant expression of vaccines and antibodies"
Mason, H.S.
DARPA N65236-98-1-5411 3/15/98 - 3/14/01
The goal of this project was to develop a plant virus-based expression system for heritable controlled gene amplification and enhanced expression of recombinant vaccines and antibodies in plants.

"Subunit oral vaccine for hepatitis B virus"
Thanavala, Y. (Mason, H.S., co-PI)
NIH AI42836 9/1/98 - 8/31/02
The long term goal of this project was to evaluate strategies for enhanced expression of hepatitis B surface antigen in potato, tomato, and cultured tobacco cells, and to demonstrate oral immunogenicity of transgenic plant tissues.

"Plant-derived vaccine for hepatitis E virus"
Takeda, N. (Mason, H.S., co-PI)
Japanese Society of Pharmacopoeia 1/1/99 - 12/31/01
The long term goal of this project was to express the capsid protein of hepatitis E virus in potato and tomato, with evaluation of virus-like particles and oral immunogenicity in mice.

"Plant-expressed influenza virus vaccine for poultry"
Mason, H.S.
USDA 97-35204-5066 11/1/98 - 10/31/00
The long term goal of this project was to express the hemagglutinin protein of avian influenza virus in cultured tobacco cells, with evaluation antigenicity and immunogenicity in chickens.