CURRICULUM VITAE

David A. Christopher
Professor
University of Hawaii, Manoa
Molecular Biosciences & Bioengineering
1955 East-West Rd., Rm 218
Honolulu, HI 96822

Telephone: (808) 956-8550;
Internet: dchr@hawaii.edu
Web: http://www.ctahr.hawaii.edu/site/Bio.aspx?ID=CHRISDAV
College of Tropical Agriculture and Human resources
FTE: 75% Research, 25% Teaching

Education

B.S.	Plant Science	University of New Hampshire	1980
M.S.	Plant Genetics	Weizmann Institute of Science	1983
Ph.D.	Molecular & Cellular Biology	University of Arizona	1989

Professional Appointments and Research Experience — Dates Employed

Professor, Molecular Biosciences & Bioengineering, University of Hawaii	2019-current
Chair and Professor, Molecular Biosciences & Bioengineering, University of Hawaii	2011-2019
Professor, Molecular Biosciences & Bioengineering, University of Hawaii	2006-2011
Visiting Professor, Molecular & Cellular Biology, University of Colorado	2005-2006
Professor, Molecular Biosciences & Bioengineering, University of Hawaii	2002-2005
Associate Professor, Molecular Biosciences & Bioengineering, University of Hawaii	1998-2002
Assistant Professor, Plant Molecular Physiology, University of Hawaii	1994-1998
Postdoctoral Associate in lab of Dr. John E. Mullet, Texas A & M University	1990-1994
Predoctoral Training in lab of Dr. Richard B. Hallick, University of Arizona	1984-1989
M.S. training in lab of Dr. Moshe Feldman, Weizmann Institute of Science	1980-1983

Courses Taught

MBBE/BIOL 304	Biotechnology Science & Ethical Issues (3 cr)	2002-2022
MBBE 499	Undergraduate Directed Research (1-6 cr)	1994-2022
MBBE 699	Graduate Directed Research (1-6 cr)	1994-2022
MBBE 620	Plant Biochemistry (3 cr); + Guest lectures	1994-2012
MBBE/BIOL 401	Created the course, Molecular Biotechnology (3 cr)	1998-2008

Publications

Book Chapters

Carrillo, R., Feldeverd, E., Christopher, D.A. 2022. The use of fluorescent protein fusions to monitor the unfolded protein response and protein foldase-substrate interactions in plant protoplasts. In: "The Unfolded Protein Response: Methods and Protocols." (Robert P. Torrado, Ed.) Spring-Nature Humana Press, *Methods in Molecular Biology*. doi: 10.1007/978-1-0716-1732-8_5

Shimshock, R.G. and Christopher, D.A. 2017. Genetic Manipulation of Stilbene Composition in Plants to Enhance Pathogen Resistance. (In: Stilbene Derivatives Applications and Research, S. Henderson, Ed.), Nova Science Publishers, NY. pp. 23-48.

Teixeira da Silva, J.A., Dobra´nszki, J., Zeng, S.J. , Winarto, B., Lennon, A.M., Jaufeerally-Fakim, Y., Christopher, D.A. (2015) Genetic transformation and molecular research in Anthurium: progress and prospects. *Plant Cell Tissue & Organ Culture*, 123:205–219.

Christopher, D.A. (2003) Photosensory Pathways Regulating Chloroplast Gene Expression, (In: Handbook of Photochemistry & Photobiology, M.S.A. Abdel-Mottaleb & H.S. Nalwa, eds), American Scientific Publishers, 4:249-268.

Book Chapters (Con't)

Christopher, D.A. (1995) Regulation of *psbD-psbC* transcription by blue light and UV-A radiation in higher plant chloroplasts In: *Photosynthesis: From Light to Biosphere.* (P. Mathis, Ed), Vol. III: 563-566, Kluwar Academic Publishers.

Refereed Journal Publications

64. Carrillo, R., Iwai, K., Albertson, A., Dang, G., and Christopher, D.A (2024) Protein disulfide isomerase-9 interacts with the lumenal region of the transmembrane endoplasmic reticulum stress sensor kinase, IRE1, to modulate the unfolded protein response in Arabidopsis. *Front. Plant Sci*. DOI 10.3389/fpls.2024.1389658

63. Elias, M.J., Hasley, J., Tian, M. and Christopher, D.A. (2023) Development of a Mesophyll Protoplast-Based System for Gene Editing of Papaya. *In Vitro Cellular & Developmental Biology-Plant*. https://doi.org/10.1007/s11627-023-10373-1

62. Carrillo, R.M. and Christopher, D.A. (2022) Development of a GFP biosensor reporter for the unfolded protein response-signaling pathway in plants: Incorporation of the bZIP60 intron into the GFP gene. Plant Signaling & Behavior, 17(1): 8 pp. doi: 10.1080/15592324.2022.2098645

61. Feldeverd, E., Porter, B.W., Yuen, C.Y.L, Iwai, K., Carrillo, R., Smith, T., Barela, C., Wong, K., Wang, P.-F., Kang, B.-H., Matsumoto, K., Christopher, D.A (2020) The Arabidopsis Protein Disulfide Isomerase Subfamily M Isoform, PDI9, Localizes to the Endoplasmic Reticulum and Influences Pollen Viability and Proper Formation of the Pollen Exine During Heat Stress. *Frontiers in Plant Science*. 11: 610052,

60. Yuen, C.Y.L, Wang, P.-F., Kang, B.-H., Matsumoto, K., Christopher, D.A. 2017. A Non-Classical Member of the Protein Disulfide Isomerase Family, PDI7 of *Arabidopsis thaliana*, Localizes to the cis-Golgi and Endoplasmic Reticulum Membranes. *Plant & Cell Physiology,* 58: 1103–1117. ***(Cover Feature).***

59. Yuen, C.Y.L, Shek, R., Kang, B.-H., Matsumoto, K., Cho, E.-J., Christopher, D.A. 2016. Arabidopsis protein disulfide isomerase-8 is a type I endoplasmic reticulum transmembrane protein with thiol-disulfide oxidase activity. *BMC Plant Biology,* 16:181-196

58. Yuen, C.Y.L, Wong, K., Christopher, D.A. 2016. Phylogenetic characterization and promoter expression analysis of a novel hybrid protein disulfide isomerase/cargo receptor subfamily unique to plants and chromalveolates. *Molecular Genetics Genomics*, 291: 455–469.

57. Chinnasri, B. Sipes, B.S., Borsics T., Christopher, D.A. (2016) Induction of pathogenesis-related gene 1 (PR-1) by acibenzolar-s-methyl application in pineapple and its effect on reniform nematodes (Rotylenchulus reniformis). *Agricultural & Natural Resources,* 50:368–373.

56. Hilario, L.C., Shimshock, R., Ng, Cheryl, Bingham, J.-P., Christopher, D.A. 2015 Screening *Carica papaya* native promoters driving stilbene synthase expression in *Arabidopsis thaliana* for resveratrol glucoside (piceid) synthesis. *Plant Biotechnology Reports*, 9: 307-317.

55. Hilario, L.C., Christopher, D.A. 2015. Improved Agrobacterium-mediated transformation of *Carica papaya* cultivar 'Kapoho' from embryogenic cell suspension cultures. *In Vitro Cellular & Developmental Biology-Plant* 51: 580-587. *http://dx.doi.org/10.1007/s11627-015-9719-4.*

54. Porter, B.W., Yuen, C.Y.L, Christopher, D.A. 2015. Dual protein trafficking to secretory and non-secretory cell compartments: Clear or double vision? *Plant Science*, 234: 174-179.

53. Porter, B.P., Christopher, D.A. and Zhu, Y.J. 2014. Genomics of Papaya Disease Resistance. In: Genetics and Genomics of Papaya. Ming R and Moore PH (eds). Springer Science and Business Media, New York.

52. Hilario, L.C., Porter, B.W., Zhu, Y.J., Christopher, D.A. 2014. Identification and Characterization of Papaya (Carica papaya, L.) Promoters by Heterologous Expression as eGFP Fusions in *Arabidopsis thaliana. Tropical Plant Biology* 7:85-99.

51. Yuen, C.Y.L, Matsumoto, K.O., Christopher, D.A. 2013. Variation in the subcellular localization and protein

folding activity among *Arabidopsis thaliana* homologs of PDI. *Biomolecules* 3:848-869.

50. Yuen, C.Y.L, Christopher, D.A. 2013. The group IV-A cyclic nucleotide-gated channels, CNGC19 and CNGC20, localize to the vacuole membrane in *A. thaliana*. *AoB Plants* 5: doi:10.1093/aobpla/plt012

49. Cho, E.J., Yuen, C.Y., Kang, B-H.,Ondzighi, C., Staehelin, L. A., Christopher, D.A. (2011) Protein disulfide isomerase-2 of *Arabidopsis* mediates protein folding and localizes to both the secretory pathway and nucleus, where it interacts with maternal effect embryo arrest factor. *Molecules and Cells* 32:459-75.

48. Yuen, C.Y.L and Christopher, D.A. 2010. The role of cyclic nucleotide-gated channels in cation nutrition and abiotic stress. (In: "Ion Channels and Plant Stress Responses, V. Demidchik & F. Maathuis eds), Springer-Verlag, Berlin-Heidelberg, Germany, pp. 137-158.

47. Guo, K.M., Babourina, O., Christopher, D.A., Borsics, T., Rengel, Z. (2010) The cyclic nucleotide-gated channel AtCNGC10 transports Ca^{2+} and Mg^{2+} in Arabidopsis. *Physiologia Plantarum* 139:303-312.

46. Neuteboom L.W., Matsumoto K.O., Christopher D.A. (2009) An extended AE-rich N-terminal trunk in secreted pineapple cystatin enhances inhibition of fruit bromelain and is post-translationally removed during ripening. *Plant Physiology* 151:515-527 ***(Cover Feature).***

45. Porter B.W., Y.J. Zhu, Christopher, DA (2009) *Carica papaya* genes regulated by *Phytophthora palmivora*: A new system for comparative genomics of compatible *Phytophthora*-plant interactions. *Tropical Plant Biology* 2:84–97.

44. Porter, B.W., Zhu, Y.J., Webb, D.T., Christopher, D.A. 2009. Novel thigmomorphogenetic responses in *Carica papaya*: Touch decreases anthocyanin levels and stimulates petiole cork outgrowths. *Annals of Botany* 103:847-858.

43. Ondzighi, C.A., Christopher, D.A., Cho, E.J., Chang, S.C., Staehelin, L.A. 2008. Arabidopsis Protein Disulfide Isomerase-5 Inhibits Cysteine Proteases during Trafficking to Vacuoles before Programmed Cell Death of the Endothelium in Developing Seeds. *The Plant Cell* 20:2205-2220.

42. Lu, D-P, Christopher, DA (2008) Light enhances the unfolded protein response as measured by BiP2 gene expression and the secretory GFP-2SC marker in *Arabidopsis*. *Physiologia Plantarum* 134:360–368.

41. Lu, D-P, Christopher, DA (2008) Endoplasmic reticulum stress activates the expression of a sub-group of protein disulfide isomerase genes and AtbZIP60 modulates the response in Arabidopsis thaliana. *Molecular Genetics & Genomics* 280:199-210.

40. Guo, K.M., Babourina, O., Christopher, D.A., Borsics, T., Rengel, Z. (2008) The cyclic nucleotide-gated channel, AtCNGC10, influences salt tolerance in Arabidopsis. *Physiologia Plantarum* 134: 499-507

39. Porter, BW, Aizawa**,** KS, Zhu, YJ, Christopher DA (2008) Differentially expressed and new non-protein-coding genes from a *Carica papaya* root transcriptome survey. *Plant Science* 174:38-50 (2008).

38. Ming, R et al. (2008) Genome of the transgenic tropical fruit tree papaya (*Carica papaya* L.) *Nature* 452:991-995

37. Lu, D.-P., Christopher, D.A. 2008. The effect of irradiance and redox-modifying reagents on the 52 kDa protein disulfide isomerase of Arabidopsis chloroplasts. Biologia Plantarum 52: 42-48.

36. D. A. Christopher, Borsics T, Yuen CYL, Ullmer W, Andème-Ondzighi C, Andres ML, Kang BH, Staehelin L.A. (2007) The cyclic nucleotide-gated cation channel AtCNGC10 traffics from the ER via Golgi vesicles to the plasma membrane of Arabidopsis root and leaf cells. *Biomedical Central Plant Biology* 7(48): 1471-2229.

35. T. Borsics, D. Webb, C. Ondzighi, L.A. Staehelin, D. A. Christopher, The cyclic nucleotide-gated calmodulin-binding channel AtCNGC10 localizes to the plasma membrane and influences numerous growth responses and starch accumulation in *Arabidopsis thaliana*. *Planta* 225:563-573 (2007).

34. Lau, T.S.L., Eno, E., Goldstein, G., Smith, C. Christopher, D.A. (2006) Ambient levels of UV-B in Hawaii combined with nutrient deficiency decrease photosynthesis in near-isogenic maize lines varying in leaf flavonoids: Flavonoids decrease photoinhibition in plants exposed to UV-B. *Photosynthetica,* 44: 394-403.

33. Lu D-P, Christopher, DA (2006) Immunolocalization of a protein disulfide isomerase to *Arabidopsis thaliana* chloroplasts and its association with starch biogenesis. *Intl. J. Plant Sciences* 167(1):1-9.

32. D.-P. Lu and D.A. Christopher, Analysis of isoforms of protein disulfide isomerase in plants by immuno-microscopy." *Microscopy & Microanalysis*, 11(S2):1160-1161, (2005).

31. X.L. Li, T. Borsics, H.M. Harrington, D.A. Christopher, *Arabidopsis* AtCNGC10 rescues potassium channel mutants of *E. coli*, yeast and *Arabidopsis* and is regulated by calcium/calmodulin and cyclic GMP in *E. coli*. *Functional Plant Biology*, 32:643-653 (2005).

30. D.M. Hayden and D.A. Christopher, Characterization of senescence-associated gene expression and senescence-dependent and -independent cysteine proteases differing in microsomal processing in Anthurium, *Plant Science*, 166:779-790, (2004).

29. L. Zhou, C.-C. Chen, R. Ming, D.A. Christopher, R.P. Paull, Apoplastic invertase and its enhanced expression and post-translational control during papaya fruit maturation and ripening, *J. Amer. Soc. Hort. Sci*. 128:628-635, (2003).

28. L. W. Neuteboom, W. Y. Kunimitsu, D. Webb, D. A. Christopher, Characterization and tissue-regulated expression of genes involved in pineapple (*Ananas comosus* L.) root development. *Plant Science*, 165:1021-1035, (2002)

27. E. Meiri, A. Levitan, F. Guo, D.A. Christopher, D.G. Schaefer, J.P. Zryd, A. Danon. Characterization and knock-out mutations of three PDI-like genes in *Physicomittrella patens. Molecular Genetics & Genomics* 267: 231-240 (2002).

26. K.E. Thum, M. Kim, D.A. Christopher, J.E. Mullet, Cryptochrome 1 and 2 and phytochrome A co-activate the chloroplast *psbD* blue light responsive promoter, *The Plant Cell* 13: 2747-2760 (2001)

25. Y. Shen, A. Danon, and D.A. Christopher, RNA binding-proteins interact specifically with the *Arabidopsis* chloroplast *psbA* mRNA 5' untranslated region in a redox-dependent manner, *Plant & Cell Physiology* 42: 1071-1078 (2001)

24. L. Chun, A. Kawakami, and D.A. Christopher, Phytochrome A mediates blue light and UV-A-dependent chloroplast gene transcription in green leaves, *Plant Physiology* 125:1957-1966 (2001).

23. D. A. Christopher, *Engineering Genes: The Gene Genie's Progeny* THE WORLD & I, Washington Times Press, pp. 172-179, January, 2000.

22. L. Zhou, D.A. Christopher, and R. Paull, Defoliation and fruit removal of papaya (*Carica papaya* C.): Fruit production, sugar accumulation and sucrose metabolism. *J. American Society Horticultural Science*, 125: 644-652 (2000).

21. D.A. Christopher, Y. Shen, P. Dudley, and N.F. Tsinoremas, Expression of a higher plant chloroplast *psbD* promoter in a cyanobacterium (*Synechococcus* sp. strain PCC7942) reveals a conserved cis-element, designated PGT, that differentially interacts with sequence-specific binding factors during leaf development. *Current Genetics* , 35:657-666 (1999).

20. M. Kim, D.A. Christopher, J.E. Mullet ADP-dependent phosphorylation regulates association of a DNA-binding complex with the barley chloroplast *psbD* blue-light-responsive promoter. *Plant Physiology* 119:663-670, (1999).

19. N.F. Tsinoremas, A. Kawakami and D.A. Christopher, High-Fluence Blue Light Stimulates Transcription from a Higher Plant Chloroplast *psbA* Promoter Expressed in a Cyanobacterium, *Synechococcus* (sp. Strain PCC7942) *Plant and Cell Physiology,* 40:448-452 (1999).

18. D.A. Christopher and P. H. Hoffer, DET1 represses a chloroplast blue light-responsive promoter in a developmental and tissue-specific manner *The Plant Journal* , 14:1-11 (1998).

17. P.H. Hoffer and D. A. Christopher, Structure and blue light-responsive transcription of a chloroplast *psbD* promoter from *Arabidopsis thaliana, Plant Physiology,* 115: 213 - 222 (1997).

16. D.A. Christopher, L. Xinli, M. Kim and J.E. Mullet, Involvement of protein kinase and extra-plastidic serine/threonine protein phosphatases in signaling pathways regulating plastid transcription and the *psbD* blue light-responsive promoter in barley (*Hordeum vulgare* L.) *Plant Physiology*, 113: 1273-1282 (1997).

15. D.A. Christopher, Leaf development and phytochrome modulate the activation of *psbD-psbC* transcription by high-fluence blue light in barley chloroplasts *Photosynthesis Research*, 47: 239- 251 (1996).

14. D.A. Christopher and J.E. Mullet, 1994. Separate photosensory pathways co-regulate blue light-ultraviolet-A-activated *psbD-psbC* transcription and light-induced D2 and CP43 degradation in barley (*Hordeum vulgare*) chloroplasts, *Plant Physiology,* 104:1119-1129. ***(Cover Feature).***

13. Kim, M.K, D.A. Christopher and J.E. Mullet, Direct evidence for selective modulation of *psbA, rpoA, rbcL* and 16S RNA stability during barley chloroplast development, *Plant Molecular Biology,* 22: 447-463 (1993).

12. D.A. Christopher, MK Kim, and J.E. Mullet, A novel light-regulated promoter is conserved in cereal and dicot chloroplasts, *The Plant Cell,* 4:785-798 (1992).

11. J.E. Mullet, J.C. Rapp, B.J. Baumgartner, T. Berends-Sexton, and D.A. Christopher, Regulation of chloroplast biogenesis in barley In: *Plant Molecular Biology 2,* R.G. Hermann and B. Larkins, Eds. Plenum Press. NY pp. 439-447 (1991).

10. D. W. Copertino, D.A. Christopher and R.B. Hallick, A mixed group II/group III twintron in the Euglena gracilis chloroplast ribosomal protein S3 gene: evidence for intron insertion during gene evolution. *Nucleic Acids Research*, 19: 6491-6497, (1991)

9. J.K Stevenson, R.G. Drager, D.W. Copertino, D.A. Christopher, K.P. Jenkins, G. Yepiz-Plascencia, R. B Hallick, Intercistronic group III introns in polycistronic ribosomal protein operons of chloroplasts *Molecular & General Genetics*, 228:183-192 (1991).

8. D.A. Christopher and R.B. Hallick, Complex RNA maturation pathway for a chloroplast ribosomal protein operon with an internal tRNA cistron *The Plant Cell*, 2: 659-671 (1990).

7. T.B. Sexton, D.A. Christopher, J.E.Mullet, Light-induced switch in barley *psbD-psbC* promoter utilization: A novel mechanism regulating chloroplast gene expression *J. European Molecular Biology Organization (EMBO J.)* 9:4485-4494 (1990).

6. D.A. Christopher and R.B. Hallick, (1989) *Euglena gracilis* chloroplast ribosomal protein operon: A new chloroplast gene for ribosomal protein L5 and description of a novel organelle intron category designated group III *Nucleic Acids Research*, 17:7591-7608.

5. J.A. Nickoloff, D.A. Christopher, R.G. Drager and R.B. Hallick, (1989) Nucleotide sequence of the *Euglena gracilis* chloroplast genes for isoleucine, phenylalanine and cysteine transfer RNAs and ribosomal protein S14 *Nucleic Acids Research*, 17:4882.

4. D.A. Christopher, J.C. Cushman, C.A. Price, and R.B. Hallick, (1988) Organization of ribosomal protein genes *rpl23, rpl2, rps19, rpl22* and *rps3* on the *Euglena gracilis* chloroplast genome *Current Genetics,* 14: 275-286 (1988).

3. J.C. Cushman, D.A. Christopher, M.C. Little, R.B. Hallick and C.A. Price, (1988) Organization and expression of the *psbE, psbF, orf38* and *orf42* gene loci on the *Euglena gracilis* chloroplast genome *Current Genetics* 13:173-180.

2. D.A. Christopher, D. Atsmon and M. Feldman, (1985) Mode of inheritance and chromosomal allocation of stunting genes in common wheat *Crop Science*, 25:147-151.

1. D.A. Christopher and J.B. Loy, (1982) Influence of foliarly applied growth regulators on sex expression in watermelon *J. American Society Horticultural Science*, 107: 401-404.

Conference Proceedings Published Abstracts (includes presentations)

Carrillo, R., Albertson, A. and Christopher, D.A. (2024) Protein disulfide isomerase-9 interacts with the lumenal region of the transmembrane endoplasmic reticulum stress sensor kinase, IRE1, to modulate the unfolded protein response in Arabidopsis. American Society of Plant Biologists, Honolulu, HI, June 22-26, 2024.

Albertson, A., Carrillo, R. and Christopher, D.A. (2023) "Investigating Heat Stress and Unfolded Protein Response-signaling Pathways in Plants." Conference of the Society for the Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS). Portland, Oregon, October, 2023.

Carrillo, R. and Christopher, D.A. (2023) Protein disulfide isomerase-9 modulates cellular stress in Arabidopsis through two mechanisms: Protein folding and via interaction with the master regulator, IRE1. American Society of Plant Biologists, Savannah, GA, August, 2023.

Christopher, D.A., Feldeverd, E., Carrillo, R., Matsumoto, K.O. (2021) Studies on Protein Disulfide Isomerase to Develop Plant Tolerance to Heat Stress. *Plant Science for Climate Emergency;* June 7-9, 2021.

Carrillo, R., Christopher, D.A. (2021) Protein Disulfide Isomerase 9 modulates cellular stress in plants through interaction with the master regulator, IRE1. *American Society of Plant Biologists WORLDWIDE SUMMIT,* July 19-23, 2021

Yuen, CYL, Matsumoto, KO, Shek, R. Carrillo, R, Christopher, DA (2019) Variations in the structure, subcellular localization and protein folding activity of evolutionary diverse protein disulfide isomerases in *Arabidopsis thaliana*. American Society of Plant Biologists, Aug. 3-7, 2019, San Jose, CA

Yuen, C.Y.L, Wang, P.-F., Kang, B.-H, Matsumoto, K., Christopher, D.A. 2017. A Non-classical Member of the Protein Disulfide Isomerase Family, PDI7 of Arabidopsis thaliana, Cycles Between the cis-Golgi and Endoplasmic Reticulum Membranes. Cell Biology, *American Society of Plant Biologists,* June 24-27, 2017, Honolulu, HI.

Christopher, D.A. , Yuen, C.Y.L, Kang, B.-H., Matsumoto, K., Shek, R., 2016. The Arabidopsis Protein Disulfide Isomerases-7 and -8 are Transmembrane Proteins of the cis-Golgi and Endoplasmic Reticulum: Oxidase and Secretory Functions. Concurrent Symposium 20: Cell Biology**,** *American Society of Plant Biologists,* July 9-13, 2016, Austin, TX

Yuen, CYL, Matsumoto, KO, Kang, B-H, Christopher, DA (2015) PDI7, a Novel Membrane-bound Member of the Protein Disulfide Isomerase Family, Localizes to the Cis-Golgi Cisternae and Endoplasmic Reticulum in *Arabidopsis Thaliana*. (700-023-Z **)** Annual Meeting of the American Society of Plant Biologists, July 25-30, 2015, Minneapolis, MN

Hilario, LC, Christopher, DA (2015) Comparative functional identification and analysis of *Carica papaya* promoters in the model system *Arabidopsis thaliana* revealed post-transcriptional regulation of gene expression. 20th Plant Biology Symposium (Plant Stress-Omics in a Changing Climate), Penn State University. May 13-16, 2015.

Shimshock, R, Hilario, LC, Bingham, JP, Christopher, DA (2015) Biochemical analysis of the antimicrobial resveratrol glucoside in transgenic papaya calli differentially expressing the stilbene synthase gene controlled by three native papaya promoters. Ann. Meeting, American Soc. Plant Biologists, July 25-30, 2015, Minneapolis, MN

Hilario, LC, Christopher, DA (2015) P06028-C Comparative functional identification and analysis of Carica papaya promoters in the model system Arabidopsis thaliana revealed post-transcriptional regulation of gene expression. Annual Meeting of the American Society of Plant Biologists, July 12-16, 2014 Portland, OR

Yuen, CYL, Matsumoto, KO, Shek, R, Christopher, DA (2013) Variation in the subcellular localization and protein folding activity among *Arabidopsis thaliana* homologs of protein disulfide isomerase. Annual Meeting of the American Society of Plant Biologists, July 20-24, 2013 Providence, RI

Christopher DA, Cho EJ, Yuen CY, Ondzighi-Assoume CA, Staehelin LA (2011) Protein disulfide isomerase-2 mediates protein folding in the endoplasmic reticulum and also localizes to the nucleus, where it interacts with

maternal effect embryo arrest factor, P02050, Annual Meeting of the American Society of Plant Biologists, Aug. 6-10, 2011, Minneapolis, MN

Christopher DA, Cho EJ, Ondzighi-Assoume CA, Staehelin LA (2009) Protein disulfide isomerase-2 (PDI2) interacts with, and localizes to, diverse components of the nucleus and secretory pathway, including the embryo arrest transcription factor (MEE8) involved in seed biogenesis. Annual Meetings of the American Society of Plant Biologists and the Phycological Society of America, July 18-22, Honolulu, HI, USA.

Neupane, KR, Lum, JM, Messa-Oh, C, Perez, PA, Christopher, David A (2009) Advances in Biosciences Education for Community Colleges: The journey from summer workshop to year-round independent research project. Annual Meetings of the American Society of Plant Biologists and the Phycological Society of America, July 18-22, Honolulu, HI, USA.

Porter BW, Zhu J, Christopher DA (2009) Root-expressed Carica papaya genes regulated by Phytophthora palmivora: A promising new system for comparative genomics of Phytophthora-plant interaction American Phytopathological Society Annual Meeting, August 1-5 in Portland, OR, USA

Porter B.W., Zhu Y.J., Webb DT, Christopher DA (2009) Novel thigmomorphogenetic responses in *Carica papaya*: touch decreases anthocyanin levels and stimulates petiole cork outgrowths. Annual Meetings of the American Society of Plant Biologists and the Phycological Society of America. Honolulu, Hawai‘i, July 18-22.

Zhu, YJ, Porter, BW and Christopher, DA (2009) Characterization and Cloning of Pathogen-inducible genes and promoters of *Carica papaya* to Improve resistance to *Phytophthora palmivora*. The Workshop on Induced Resistance in Plants Against Insects and Diseases, p. 22, May, Granada, Spain.

Ondzighi-Assoume C., Christopher D.A., Cho, EJ, Shu S.C., Staehelin L.A. (2008) Protein Disulfide Isomerase-5 Regulates The Proteases Involved in Programmed Cell Death in Arabidopsis, P30002. American Society of Plant Biologist Conference, June 26 - July 1, Merida, Mexico

Ondzighi-Assoume C., Christopher D.A., Cho, EJ, Shu S.C., Staehelin L.A. (2007) During Biogenesis of Nucellus Cells in Developing Seeds, Arabidopsis Protein Disulfide Isomerase 5 Traffics Together with Cysteine Proteases to Protein Storage and Lytic Vacuoles. American Society of Plant Biology & Botany Joint Congress, July 7-11, Chicago, IL

Ondzighi-Assoume C., Christopher D.A. ,Shu S.C., Staehelin L.A. 2006. Characterization and immunolocalization of two isoforms of protein disulfide isomerase AtPDI5 and AtPDI7 in Arabidopsis. Published Abstract. American Soc.Plant Biologists Conference, Boston, MA. Aug. 5-9.

Matsumoto K.O., Neuteboom, L., Christopher D.A. 2006. Expression and biochemical characterization of a novel pineapple cystatin. Published Abstract. American Soc. Plant Biologists Conference, Boston, MA. Aug. 5-9.

Lu, DP, Christopher, D.A. 2006. Immunolocalization of protein disulfide isomerase to Arabidopsis thaliana chloroplasts and its association with starch granule biogenesis. Published Abstract. American Soc. Plant Biologists Conference, Boston, MA. Aug. 5-9.

Porter B.W., Aizawa K., Zhu J., Christopher, D.A. 2006. Identification and characterization of root cDNAs and analysis of their differential expression in papaya (Carica papaya L.) Published Abstract. American Soc. Plant Biologists Conference, Boston, MA. Aug. 5-9.

Christopher D.A. Borsics T, Ondzighi-Assoume, C. Staehelin L.A. 2006. Plasma membrane localization, genetic complementation, and function of CNGC10, a calmodulin-binding potassium channel of *Arabidopsis.* Published Abstract. American Soc. Plant Biologists Conference, Boston, MA. Aug. 5-9.

Christopher, D.A. Borsics, T., Penner, R., Ondzighi-Assoume, C., Staehelin, L.A. (2006) AtCNGC10, a calmodulin-binding, cGMP-regulated potassium channel of Arabidopsis localizes to the plasma membrane in plant and HEK cells and confers tolerance to Na+ and Cs+ in a yeast K+ uptake mutant. Keystone Symposium on “Plant Responses to Abiotic Stress.” Copper Mountain, CO. April 8-13, 2006.

Matsumoto, K. Neuteboom, L. and Christopher, D.A. (2006) Expression and Biochemical Characterization of a Novel Pineapple Cystatin. BIO Pacific Rim Summit on Industrial Biotechnology and Bioenergy. Honolulu, HI Jan.12-13.

Christopher, D.A., and Borsics, T. 2005. A Calmodulin- and cGMP-modulated K_+ channel, AtCNGC10, regulates potassium uptake, palisade cell size and the rate of root gravitropism in Arabidopsis. Plant Cell Signaling: In vivo and omics approaches. Sante Fe, NM

Chinnasri, B., Christopher, D.A. and Sipes, B.S. 2005. Evidence for the induction of SAR by Acibenzolar in cultivated pineapple. 2004. 5th International Pineapple Symposium, Port Alfred, S.Africa, April 11-15.

Christopher, D.A. 2004. Plenary Speaker "Pineapple Genomics, Economics, and Applied Research." International Conference on Crassulacean Acid Metabolism, Tahoe City, CA, July 29- Aug 1, 2004.

Christopher, D.A., and Lu, D.-P. 2004. Immunolocalization of a protein disulfide isomerase to chloroplasts of Arabidopsis and its association with starch granule biogenesis. Published Abstract. American Soc. Plant Biologists Conference, Lake Buena Vista, FL. July 24-29, 2004.

Borsics, T., Christopher, D.A. 2004. A cyclic nucleotide-gated, calmodulin-binding potassium channel involved in several developmental processes in *Arabidopsis thaliana*. Published Abstract. American Soc. Plant Biologists Conference, Lake Buena Vista, FL. July 24-July 29.

Christopher, D.A., and Lu, D.-P. 2004. "A chloroplast-localized protein disulfide isomerase and redox-regulated processes involved in plant adaptation to high light stress." Published Abstract. Keystone Symposia: Plant Responses to Abiotic Stress. Sante Fe, NM. Feb. 19-24.

Christopher, D.A., and Lu, D.-P. 2004. "A chloroplast-localized protein disulfide isomerase and redox-regulation of mRNA-binding proteins in *Arabidopsis*". Oral Presentation and Published Abstract. Western Photosynthesis Conference, Pacific Grove, CA, Jan. 8-11.

Borsics, T., Li, X., Wu, C., Harrington, H.M. and Christopher, D.A. 2003. A cyclic nucleotide-gated, calmodulinbinding potassium channel involved in photomorphogenesis in *Arabidopsis thaliana*. Published Abstract. American Soc. Plant Biologists Conference, Honolulu, HI. July 25-30.

Neupane, K.R., Neuteboom, L.W., Okazaki, K.J. and Christopher, D.A. 2003. A novel cystatin gene is upregulated in pineapple fruit and its product is proteolytically processed by microsomes. Published Abstract. American Soc. Plant Biologists Conference, Honolulu, HI. July 25-30.

Christopher, D.A., Li, X., Wu, C., Harrington, H.M. 2003. A cyclic nucleotide-gated, calmodulin-binding potassium channel involved in photomorphogenesis in *Arabidopsis*. Published Abstract. A Systems Biology Approach: Plant Biology Symposium. Univ. California, Riverside. Jan 15-18.

Christopher, D.A., and Lu, D.-P. 2003. A chloroplast-localized protein disulfide isomerase preferentially associates with thylakoids in Arabidopsis. Published Abstract. American Soc. Plant Biologists Conference, Honolulu, HI. July 25-30.

Hayden, D.M., Perez, P., and Christopher, D.A. 2003. Characterization of senescence-activated cysteine protease gene expression in Anthurium and application of methods to reduce leaf and flower senescence. Published Abstract. American Soc. Plant Biologists Conference, Honolulu, HI. July 25-30.

D.A. Christopher and Neuteboom, L.W. 2002. Identification and characterization of tissue-enhanced cDNAs and analysis of their differential expression in cultivated pineapple. American Society of Plant Biologists Conference, "Plant Biology: Heightened Frontiers". Denver, CO. Aug. 3-8.

D.A. Christopher and Neuteboom, L.W. 2002. Pineapple Genomics: Isolation and Characterization of Tissue-Enhanced cDNAs and Promoters from Pineapple. Internat. Assoc. Plant Tissue Culture and Biotechnology Conference, "Plant Biotechnology 2002 and Beyond". Orlando, FL. June 23-28, 2002.

D.A. Christopher, L. Chun, and A. Kawakami, "The role of phytochrome-A in light-induced transcription of chloroplast genes in green leaves", International Conference on Tetrapyrrole Photoreceptors in Photosynthetic Organisms, Brown University, Providence, R.I. July 25-30, 2001

Y. Shen and D.A. Christopher, "Evidence for redox-regulation of RNA-binding protein interaction with the *psbA* mRNA 5' untranslated region in chloroplasts of Arabidopsis. American Society of Plant Biologists, Providence, R.I. July, 21-25, 2001.

D.A. Christopher, L. Chun, and A. Kawakami, "Photoreceptor functions in light-induced transcription of chloroplast genes in green leaves", Plant Photobiology, Current Topics in Plant Biochemistry, Physiology and Molecular Biology, University of Missouri, May 30-June 2, 2001.

D.A. Christopher, L. Chun, A. Kawakami, "High-fluence blue light/UV-A radiation, phytochrome-A, and chloroplast

gene transcription during leaf development." American Society of Plant Physiol, San Diego, CA, July, 15-19, 2000.

Y. Shen and D.A. Christopher, "Evidence for the association of RNA binding-proteins with the *psbA* mRNA 5' UTR in chloroplasts of Arabidopsis thaliana and for redox-regulation of protein binding." American Society of Plant Physiologists, San Diego, CA, July, 15-19, 2000.

D.A. Christopher, L. Chun, A. Kawakami "High-fluence blue light, phytochrome A, and transcription of chloroplast genes for the photosynthetic apparatus", 9th Western Photosynthesis Conference., Pacific Grove, CA, Jan. 6-9, 2000.

K.G. Rohrbach, D.A. Christopher, J. Hu and ten co-authors."Management of a multiple goal pineapple genetic engineering program". 3rd Intl. Pineapple Symposium, Acta Horticulturae, pp. 111-113. 2000

D.A. Christopher, Y. Shen, N. Tsinoremas, P. Dudley, "Heterologous expression of a higher plant chloroplast blue light-responsive *psbD* promoter in *Synechococcus* PCC7942 reveals a conserved regulatory element", 8th Western Photosynthesis Conf., Pacific Grove, CA, Jan. 7-10, 1999.

L. Zhou, D.A. Christopher, R.E. Paull, "Cloning and expression of a gene encoding cell wall invertase in papaya fruit". American Society of Plant Physiologists, Madison, WI, June 27-July 1, 1998.

D.A. Christopher, Y. Shen, P. Dudley, A. Kawakami, N.F. Tsinoremas, "Analysis of transcription of a chloroplast blue light-responsive promoter in the *Arabidopsis det1*, *phy* and *cry* mutants and by using a heterologous cyanobacterial expression system". American Society of Plant Physiol, Madison, WI, June 27-July 1, 1998.

D.A. Christopher, "Activation of chloroplast transcription in mature *Arabidopsis* leaves is mediated by a novel cryptochrome and modulated by phytochrome A". 9th International Conference on *Arabidopsis* Research, University of Wisconsin-Madison, June 24-28, 1998.

D.A. Christopher and P.H. Hoffer, "Phototransduction pathways regulating light-responsive photosystem II genes", 7th Western Photosynthesis Conf., Pacific Grove, CA, Jan. 8-11, 1998.

T.S.L. Lau, G. Goldstein, C.M. Smith, D.A. Christopher, "Effects of UV-B radiation on photosynthesis in near-isogenic maize lines varying in leaf anthocyanin and nutrient levels", 7th Western Regional Photosynthesis Conf., Pacific Grove, CA, Jan. 8-11, 1998.

D.A. Christopher and P.H. Hoffer, "Signal Transduction pathways regulating chloroplast gene expression and photosystem II biogenesis", Conference on Photosynthetic Membranes: Biogenesis and Adaptation, University of British Columbia, Vancouver, BC, July 31-Aug. 2, 1997.

D.A. Christopher, P.H. Hoffer, Xinli Li, "Blue light, protein phosphorylation and DET1-mediated pathways interact to regulate transcription from a chloroplast blue light-responsive promoter", Annual Meeting of the American Society of Plant Physiologists , Vancouver, BC, Aug. 2-6, 1997.

D.A. Christopher, "Signal transduction pathways regulating chloroplast gene expression and photosystem II biogenesis", 6th Western Regional Photosynthesis Conf., Pacific Grove, CA, Jan. 9-12, 1997.

D.A. Christopher, "Regulation of *psbD-psbC* transcription by blue light and ultraviolet-A radiation in higher plant chloroplasts". Xth Int. Photosynthesis Conference and Proceedings., Montpellier, France, Aug. 20-25, 1995.

D.A. Christopher, "Coordination of blue light/UV-A-activated *psbD-psbC* transcription and PSII subunit turnover in chloroplasts", The 34th NIBB Conference, Responses of the photosynthetic apparatus to environmental light conditions, Okazaki, Japan, Dec. 10-12, 1994.

Published Invited Commentary:

Christopher, D.A. (March 29, 2020) Ramp up the science and testing to defeat Covid-19. https://www.staradvertiser.com/2020/03/29/editorial/insight/ramp-up-the-science-and-testing-to-defeat-coronavirus/ Front page of the Honolulu StarAdvertiser Sunday Edition.

Leadership Roles: Professional, Academic, Administrative and Scientific Activities

Department Chair: *Molecular Biosciences & Bioengineering,* Sept. 1, 2011 – Sept. 30, 2019

Vice Chair, Institutional Biosafety Committee (14 years): Evaluated all UH recombinant DNA protocols. Ensured compliance of the university with all federal and state EHS rules. Jan. 2003- Dec. 2018

Leadership and Service Roles (con't)

Awards: Dean's Excellence in Teaching Award, CTAHR, 2022; Excellence in Research Award 2012, Molecular Biosciences, University of Hawaii, CTAHR

Professional Organizations*:* American Society of Plant Biologists

Funded Competitive Grants: $6,124,544. since 1994: NSF, DOE, USDA, US-Israel Binational Ag Res.

Journal Reviewer**:** Functional Plant Biology, Nucleic Acids Research, Plant & Cell Physiology, Plant Physiology, Physiologia Plantarum, Plant Science, The Plant Cell, The Plant Journal, Experimental Botany.

Grant Review Panels and Grant reviewer: National Science Foundation (Molecular Cellular Biology, Genomics, IOS, MRI); U.S. Dept. of Energy Biosciences Program; USDA-Tropical & Subtropical Agricultural Research; U.S. Civilian Research & Development Foundation; Australian Research Council, Hong Kong Research Grants Council, US-Israel Binational Agricultural Research.

Conference Presentation Highlights:

Speaker, Symposium "Cell Biology" *American Society of Plant Biologist*s (ASPB) 7/9-13/2016, Austin, TX
Speaker, Symposium "Crop Improvement" ASPB, Plant Biology, 8/5/2009, Honolulu, HI
Speaker, Symposium "Membrane Transport" ASPB, Plant Biology, 8/5-9/2006, Boston, MA
Chair and Session Organizer, "Advances in Structural Analysis of Plant Cell Function," Microscopy & Microanalysis, Honolulu, HI, 7/31- 8/4/05.
Plenary Speaker, International Conference: Crassulacean Acid Metabolism, Tahoe City, CA, 7/29-8/1/04.
Program Committee Member, The Annual Conference of the ASPB in Honolulu, HI, 2003.
Participant, Keystone Symposia, Plant Responses to Abiotic Stress, Sante Fe, NM, 02/19-24, 2004;
Chair Session and Mini-symposium Speaker, "Transcription Regulation & Emerging Technologies", ASPB, Plant Biology – Honolulu, HI, 07/25-7/30, 2003.

Graduate Students

Category	Current number of students	Number graduated (career)
Chair of Master Committees	1	8
Chair of PhD Committees	1	6
Member of Master Committees	1	8
Member of PhD Committees	2	9

GRANT SUPPORT ($6,124,544 career total)

1996, Seed Grant, University Research & Training Revolving Fund,
Project title: "Genetic Control of Photosynthesis in Response to High Intensity Light",
Principle Investigator: David A. Christopher,
Amount Funded: $8,685. Duration: February 15, 1996 to February 14, 1997.

1996, USDA-Tropical and Subtropical Agricultural Research Grant,
Project Title: "Source-sink relationships during papaya fruit growth and development".
Principle Investigators: Robert E. Paull and David A. Christopher

Amount Funded: $99,444. Duration: July 1, 1996 to June 30, 1999.

1997, U. S. Department of Energy, Division of Energy Biosciences,
Project Title: "Mechanisms regulating *psbD* transcription in higher plants".
Principle Investigator: David A. Christopher
Amount Funded: $239,667. Duration: June 15, 1997 to June 14, 2000.

1997, USDA-Tropical and Subtropical Agricultural Research Grant
Project Title: "Genetic engineering of *Anthuriums* to improve productivity and post-harvest life".
Principle Investigators: David A. Christopher and Robert E. Paull,
Amount Funded: $133,465., Duration: July 1, 1997 to June 30, 2001.

1997, Hawaii Experiment Station Research Mini-grant,
Project Title: "Bioengineering plant cells as a new source of human malarial vaccine".
Principle Investigators: Winston Su, David A. Christopher, Sandra Chang
Amount Funded: $20,000. Duration: January 1, 1998 to December 31, 1999.

1997, Hawaii Experiment Station Research Mini-grant,
Project Title: "Genetic engineering of higher plant chloroplasts to improve plant productivity".
Principle Investigator: David A. Christopher .
Amount Funded: $10,000. Duration: October 1, 1997 to June 31, 1998.

1998-2003, USDA and State of Hawaii Department of Agriculture
Project Title: "Development of Molecular Markers and Genomics for Pineapple"
Principle Investigators: David A. Christopher, Kenneth Rohrbach
Amount Funded: $347,028. Duration: July 1, 1998, to June 30, 2003.

1998, Hawaii Community Foundation,
Project Title: "Bioengineering plants to produce human malarial vaccine".
Principle Investigators: Sandra Chang , Winston Su, David A. Christopher,
Amount Funded: $30,000. Duration: January 1, 1998 to December 31, 1999.

1999, USDA National Research Initiative Competitive Grants Program
Project Title: "Structure and function of protein disulfide isomerase in higher plant chloroplasts."
Principle Investigator: David A. Christopher
Amount Funded: $100,000. Duration: December 1, 1999 to November 30, 2001.

2000, U. S. Department of Energy, Division of Energy Biosciences,
Project Title: "Mechanisms regulating blue light-activated *psbD* transcription in plant chloroplasts".
Principle Investigator: David A. Christopher
Amount Funded: $283,694. Duration: June 15, 2000 to June 14, 2003.

2000, U.S.-Israel Binational Agricultural Research and Development Fund (BARD).
Project Title: "Plant adaptation to light stress: Genetic regulatory mechanisms
Principle Investigator: David A. Christopher , Avihai Danon
Amount Funded: $275,000. Duration: August 1, 2000 to July 31, 2003.

2002, USDA-Tropical and Subtropical Agricultural Research Grant
Project Title: "Bioengineering of *Anthuriums* to delay senescence and increase shelf life and plant yield".
Principle Investigator: David A. Christopher,
Amount Funded: $131,484., Duration: October 1, 2002 to September 30, 2005.

2003, U. S. Department of Energy, Division of Energy Biosciences,
Project Title: "Defining the blue light signaling pathways regulating photosynthetic gene expression in plant chloroplasts".
Principle Investigator: David A. Christopher
Amount Funded: $318,827. Duration: August 15, 2003 to August 14, 2006.

2003, USDA-Tropical and Subtropical Agricultural Research Grant
Project Title: "Improved cystatins in Agriculture, medicine and Industry".
Principle Investigator: David A. Christopher,
Amount Funded: $31,162., Duration: October 1, 2003 to September 30, 2005.

2004, National Science Foundation, Molecular Biochemistry Program
Project Title: "Functional genomics of the protein disulfide isomerase gene family: Unraveling protein folding and redox-regulatory networks".
Principle Investigator: David A. Christopher
Amount Funded: $1,216,697., Duration: March 1, 2004-February 28, 2009

2004, USDA-Tropical and Subtropical Agricultural Research Grant
Project Title: "Genetic Transformation of Sugarcane Chloroplasts to Improve Expression and Containment of Genes Encoding Human Vaccines."
Principle Investigators: David A. Christopher, Judy Zhu
Amount Funded: $274,215., Duration: October 1, 2004 to September 30, 2007

2004, USDA-Tropical and Subtropical Agricultural Research Grant
Project Title: " Characterization and Cloning of Pathogen-Inducible Genes and Promoters to Improve Resistance of Papaya to Fungal Disease."
Principle Investigators: David A. Christopher, Judy Zhu
Amount Funded: $275,215., Duration: October 1, 2004 to September 30, 2007

2009, USDA-Floriculture Research (National Institute of Food and Agriculture)
Project Title: "Genetic modification of anthurium for resistance to nematodes."
Principle Investigators: David A. Christopher, Judy Zhu
Amount Funded: $40,000. Duration: September 1, 2009 to August 31, 2012

2010, USDA-Tropical and Subtropical Agricultural Research Grant
Project Title: "Genetic modification of anthurium to increase post- harvest life and flower yield."
Principle Investigators: David A. Christopher, Judy Zhu
Amount Funded: $96,117. Duration: September 1, 2010 to August 31, 2013

2010, Minor Crops Papaya Pests and Diseases, USDA-Research Services
Project Title: "Isolating NBS-LRR *Phytophthora palmivora* resistance gene(s) from *Vasconcellea goudotiana* to create *Phytophthora* resistance in papaya"
Principle Investigators: David A. Christopher, Judy Zhu
Amount Funded:$40,000 Duration: September 28, 2010 to September 27, 2015

2010-2015, Minor Crops Papaya Pests and Diseases, USDA-Research Services
Project Title: "Bioengineering Papaya for Resistance to *Phytophthora palmivora"*
Principle Investigators: David A. Christopher, Judy Zhu
Amount Funded: $42,433. Duration: September 28, 2010 to September 27, 2015

2010-2012, National Science Foundation, Cellular Biology Program
Project Title: "Functional genomics of the protein disulfide isomerase gene family: Unraveling protein folding and redox-regulatory networks".
Principle Investigator: David A. Christopher, Byung-Ho Kang
Amount Funded: $447,000., Duration: February 1, 2010-May 31, 2012

2011-2013, National Science Foundation, Major Research Instrumentation
Project Title: "Acquisition of Instrumentation for Transmission Electron Microscopy at the University of Hawaii
Principle Investigators: Marilyn Dunlap, David A. Christopher, Alison Sherwood, Daniel Hartline
Amount Funded: $404,128., Duration: September 1, 2010-August 31, 2013

2012-2014, National Science Foundation, Cellular Biology Program
Project Title: "Functional genomics of the protein disulfide isomerase gene family: Unraveling protein folding and redox-regulatory networks".
Principle Investigator: David A. Christopher, Byung-Ho Kang
Amount Funded: $395,000., Duration: June 1, 2012-May 31, 2014

2013-2016, USDA-Research Services Papaya Pests and Diseases,
Project Title: "Characterization and Cloning of Pathogen-Inducible Genes and Promoters to Improve Resistance of Papaya to Fungal Disease"
Principle Investigators: David A. Christopher
Amount Funded: $125,433. Duration: September 28, 2013 to September 30, 2016

2014-2016, Hatch Agriculture, Federal Funds
Project Title: "Deciphering mechanisms underlying the development of seed protein storage bodies in plants during abiotic stress."
Principle Investigator: David A. Christopher .
Amount Funded: $63,190. Duration: October 1, 2014 to June 31, 2016.

***2014-2017, USDA-Floriculture Crops-Hawaii Agricultural Research Center**
Project Title: "A new approach to create broad range resistance to nematodes in *Anthurium*"
Principle Investigator: David A. Christopher and Y. Judy Zhu
Amount Funded: $60,000. Duration: July 1, 2016 to June 30, 2018

***2017-2020, USDA-Minor crops program on pests and diseases**
Project Title: "Bioengineering Papaya for Resistance to *Phytophthora palmivora*"
Principle Investigator: David A. Christopher
Amount Funded: $186,760. Duration: July 1, 2017to June 30, 2020

***2017-2019, USDA-Hatch**
Project Title: "Deciphering the Roles of Protein Disulfide Isomerases in Protein Folding and Seed Development in Plants"
Principle Investigator: David A. Christopher
Amount Funded: $78,000. Duration: Oct 1, 2017 to Sept 30, 2019

***2019-2020, USDA-Minor crops program on pests and diseases**
Project Title: "Preharvest and Postharvest Technologies to Improve Production, Disease Management and Quality of Papaya and Other Tropical Fruit"
Principle Investigator: David A. Christopher
Amount Funded: $27,005. Duration: Oct 1, 2019 to Sept 3, 2020

***2020-2022, USDA-AFRI-NIFA**
Project Title: "Genome editing of papaya for functional analysis, metabolic engineering and crop improvement"
Principle Investigator: Miaoying Tian, David A. Christopher
Amount Funded: $299,895 ($149,000 to DAC). Duration: Aug 1, 2020 to July 31, 2023

***2021-2022, USDA-Hatch**
Project Title: "Studies on protein disulfide isomerase to develop plant tolerance to heat stress"
Principle Investigator: David A. Christopher
Amount Funded: $25,000. Duration: Aug 1, 2021 to July 30, 2022.

***2022-2023, USDA-Hatch 5046-H**
Project Title: Pongamia: "Studies on protein disulfide isomerase to develop plant tolerance to heat stress"
Principle Investigator: David A. Christopher
Amount Funded: $18,812. Duration: Aug 1, 2022 to July 30, 2023.

***2022-2023, USDA-Hatch 5046-H**
Project Title: Pongamia: "Studies on protein disulfide isomerase to develop plant tolerance to heat stress"
Principle Investigator: David A. Christopher
Amount Funded: $19,190. Duration: Aug 1, 2023 to July 30, 2024.