

John G. Carman
Vita – November, 2016

Personal Data

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Education

PhD: Genetics - Texas A&M University, 1982

MS: Botany and Range Science - Brigham Young Univ. 1978

BS: Brigham Young University, 1976

Major Research Interests

Molecular biology of plant reproduction and development

Professional Experience

Professor - Utah State University, July 1997 to present

Associate Professor - Utah State University, July 1988-1997

Assistant Professor - Utah State University, August 1982-1988

Slick Graduate Fellow, College of Agriculture, Texas A&M University, 1981-1982

Membership in Professional Societies

Crop Science Society of America

American Society of Plant Biologists

International Association of Sexual Plant Reproduction Research

Professional Service

Editorial board, *Journal of Plant Physiology* (1990 - 1996)

Associate Editor, *Crop Science* (1990 - 1996)

Refereed Journal Articles

Windham MD, Beck JB, Li F-W, Allphin L, Carman JG, Sherwood DA, Rushworth CA, Sigel E, Alexander PJ, Bailey CD, Al-Shehbaz IA. 2015. Searching for diamonds in the apomictic rough. I: Do rare sexual populations of *Boechera lignifera* (Brassicaceae) represent a distinct species? *Systematic Botany* 40: 1031-1044 <http://dx.doi.org/10.1600/036364415X690076>

Carman JG, Hole P, Salisbury FB, Bingham GE. 2015. Developmental, nutritional and hormonal anomalies of weightlessness-grown wheat. *Life Sciences in Space Research* 6: 59-68

Dwivedi K. K., Roche D. J., Clemente T. E., Ge Z. & Carman J. G. 2014. The OCL3 promoter from *Sorghum bicolor* directs gene expression to abscission and nutrient-transfer zones at the bases of floral organs. *Annals of Botany* 114: 489-498

Hojsgaard D, Klatt S, Baier R, Carman JG, Hörandl E. 2014. Taxonomy and biogeography of apomixis in angiosperms and associated biodiversity characteristics. *Critical Reviews in Plant Sciences* 33(5): 414-427

Fuller RJ, Liddiard V, Hess JR, Carman JG. 2011. Improving cotton embryo culture by simulating in ovulo nutrient and hormone levels. *In Vitro Cellular and Developmental Biology Plant* 47: 410-419

- Bhattarai K, Bushman BS, Johnson DA, Carman JG. 2011. Searls Prairie Clover (*Dalea Searlsiae*) for Rangeland Revegetation: Phenotypic and Genetic Evaluations. *Crop Science* 51: 716-727
- Carman JG, Jamison M, Elliott E, Dwivedi KK, Naumova TN. 2011. Apospory appears to accelerate onset of meiosis and sexual embryo sac formation in sorghum ovules. *BMC Plant Biology* 11:9, <http://www.biomedcentral.com/1471-2229/11/9>
- Bhattarai K, Bushman BS, Johnson DA, Carman JG. 2010. Phenotypic and genetic characterization of western prairie clover collections from the western United States. *Rangeland Ecol Manage* 63: 696-706
- Dwivedi KK, Roche D, Carman JG. 2010. Expression in *Arabidopsis* of a nucellus-specific promoter from watermelon (*Citrullus lanatus*). *Plant Sci* 179: 549-552
- Liddiard VM, Carman JG. 2010. Simulating in ovulo osmotic potentials and O₂ tensions normalize growth and pigmentation of immature cotton embryos. *Plant Cell Tiss Organ Cult* 102: 1-8
- Fuller RJ, Carman JG, Hess JR. 2009. Nutrient and hormone levels in cotton ovules during embryony. *Plant Cell Tiss Org Cult* 99: 183-192
- Bradley JE, Carman JG, Jamison MS, Naumova TN. 2007. Heterochronic features of the female germline among several sexual diploid *Tripsacum* L. (Andropogoneae, Poaceae). *Sex Plant Reprod* 20:9-17
- Carman JG, Reese G, Fuller RJ, Ghermay T, Timmis R. 2005. Nutrient and hormone levels in Douglas fir corrosion cavities, megagametophytes and embryos during embryony. *Canad J Forest Res* 35:2447-2456
- Carman JG, Bishop DL. 2004. Diurnal O₂ and carbohydrate levels in wheat kernels during embryony. *J Plant Physiol* 161:1003-1010
- Carman JG. 2004. Apomixis for crop production: Status of technology development and commercialization implications. *Willamette J Intern Law Dispute Resol* 12:28-48
- Salisbury FB, Campbell WF, Carman JG, Bingham GE, Bubenheim DL, Yendler B, Sytchev V, Levinskikh MA, Ivanova I, Chernova L, Podolsky I. 2003. Plant growth during the greenhouse II experiment on the Mir orbital station. *Adv Space Res* 31:221-227
- Parrott DL, Anderson AJ, Carman JG. 2002. *Agrobacterium* induces plant cell death in wheat (*Triticum aestivum* L.). *Physiol Mol Plant Pathol* 60:59-69
- Nan R., Carman JG, Salisbury FB. 2002. Water stress, CO₂ and photoperiod influence hormone levels in wheat. *J Plant Physiol* 159:307-312
- Hess JR, Carman JG, Banowetz GM. 2002. Hormones in wheat kernels during embryony. *J Plant Physiol* 159:379-386
- Monje O, Bingham GE, Salisbury FB, Campbell WF, Carman JG, Eames BK, Sytchev V, Levinshikh MA, Podolsky I. 2000. Canopy photosynthesis and transpiration in microgravity: gas exchange measurements aboard Mir. *Adv Space Res* 26:303-306
- Nan R, Carman JG, Salisbury FB. 1999. Low irradiances affect abscisic acid, indole-3-acetic acid, and cytokinin levels of wheat (*Triticum aestivum* L.) tissues. *J Plant Physiol* 155: 556-560

- Jiang LM, Salisbury FB, Campbell WF, Carman JG, Nan R. 1998. Studies on flower initiation of super-dwarf wheat under stress conditions simulating those on the space station, Mir. *J Plant Physiol* 152:323-327
- Hess JR, Carman JG. 1998. Embryogenic competence of immature wheat embryos: genotype, donor plant environment, and endogenous hormone levels. *Crop Sci* 38:249-253
- Banowetz GM, Hess JR, Carman JG. 1997. Monoclonal antibodies against the plant cytokinin, dihydrozeatin riboside. *Hybridoma* 16:479-483
- Hou Q, Carman JG, Varga W-A. 1997. Micropropagation of sego lily (*Calochortus nuttallii*). *Plant Cell Tis Org Cult* 49:149-151
- Carman JG. 1997. Asynchronous expression of duplicate genes in angiosperms may cause apomixis, bispory, tetraspory, and polyembryony. *Biol J Linn Soc* 61:51-94
- Peel MD, Carman JG, Liu Z-W, Wang RR-C. 1997. Meiotic anomalies in hybrids between wheat and apomictic *Elymus rectisetus* (Nees in Lehm.) A. Löve & Connor. *Crop Sci* 37:717-723
- Peel MD, Carman JG, Leblanc O. 1997. Megasporocyte callose in apomictic buffelgrass, Kentucky bluegrass, *Pennisetum squamulatum* Fresen, *Tripsacum* L. and weeping lovegrass. *Crop Sci* 37:724-732
- Rasmussen RD, Hole D, Hess JR, Carman JG. 1997. Wheat kernel dormancy and +abscisic acid levels following exposure to fluridone. *J Plant Physiol* 150:440-445
- Carman JG, Bishop DL, Hess JR. 1996. Carbohydrates, minerals and free amino acids in *Triticum aestivum* L. kernels during early embryony. *J Plant Physiol* 149:714-720
- Bingham GE, Salisbury FB, Campbell WF, Carman JG, Bubenheim DL, Yendler B, Sytchev NN, Berkovitch YuA, Levinskikh MA, Podolsky IG. 1996. The Spacelab-MIR-1 "Greenhouse-2" experiment. *Adv Space Res* 18:225-232
- Salisbury FB, Bingham GE, Campbell WF, Carman JG, Bubenheim DL, Yendler B, Jahns G. 1995. Growing super-dwarf wheat in SVET on MIR. *Life Support Biosphere Sci* 2:31-39
- Banowetz GM, Hess JR, Carman JG. 1995. Monoclonal antibodies against the plant growth regulator abscisic acid. *Hybridoma* 13:537-541
- Leblanc O, Peel MD, Carman JG, Savidan Y. 1995. Megasporogenesis and megagametogenesis in several *Tripsacum* species (Poaceae). *Amer J Bot* 82:57-63
- Liu Z-W, Wang RR-C, Carman JG. 1994. Hybrids and backcross progenies between wheat (*Triticum aestivum* L.) and apomictic Australian wheatgrass [*Elymus rectisetus* (Nees in Lehm.) A. Löve & Connor]: karyotypic and genomic analyses. *Theor Appl Genet* 89:599-605
- Hess JR, Carman JG. 1993. Normalizing development of cultured *Triticum aestivum* L. embryos. I. Low oxygen tensions and exogenous ABA. *J Exp Bot* 44:1067-1073
- Riera-Lizerazu O, Dewey WG, Carman JG. 1992. Gibberellic acid and 2,4-D treatments for wheat X barley hybridization using detached spikes. *Crop Sci* 32:108-114
- Carman JG, Crane CF, Riera-Lizarazu O. 1991. Comparative histology of cell walls during meiotic and apomeiotic megasporogenesis in two australasian *Elymus* L. species. *Crop Sci* 31:1527-1532
- Hashim ZH, Campbell WF, Carman JG. 1991. Normalization of the DNA content of telophase cells from wheat calli by nutrient modification. *Theor Appl Genet* 82:413-416

- Carman JG. 1990. Embryogenic cells in plant tissue cultures: occurrence and behavior. *In Vitro* 26:746-753
- Hashim ZH, Campbell WF, Carman JG. 1990. Morphological analysis of spring wheat (CIMMYT cv PCYT-10) somaclones. *Plant Cell Tissue Organ Cult* 20:95-99
- Carman JG. 1989. The *in ovulo* environment and its relevance to cloning wheat via somatic embryogenesis. *In Vitro* 25: 1155-1162
- Carman JG. 1988. Improved somatic embryogenesis in wheat by partial simulation of the *in-ovulo* oxygen, growth-regulator and desiccation environments. *Planta* 175: 417-424
- Carman JG, Jefferson NE, Campbell WF. 1988. Induction of embryogenic *Triticum aestivum* L. calli. II. Quantification of organic addenda and other culture variable effects. *Plant Cell Tissue Organ Cult* 12:97-110
- Carman JG, Jefferson NE, Campbell WF. 1988. Induction of embryogenic *Triticum aestivum* L. calli. I. Quantification of genotype and culture medium effects. *Plant Cell Tissue Organ Cult* 12:83-95
- Torabinejad J, Carman JG, Crane CF. 1987. Morphology and genome analyses of interspecific hybrids of *Elymus scabrus*. *Genome* 29:150-155
- Crane CF, Carman JG. 1987. Mechanisms of apomixis in *Elymus rectisetus* from Eastern Australia and New Zealand. *Amer J Bot* 74: 477-496
- Papenfuss JM, Carman JG. 1987. Enhanced regeneration from wheat callus cultures using dicamba and kinetin. *Crop Sci* 27:588-593
- Carman JG, Briske DD. 1985. Morphologic and allozymic variation between long-term grazed and nongrazed populations of the bunchgrass *Schizachyrium scoparium* var. *frequens*. *Oecologia* 66:332-337
- Carman JG. 1984. Morphological characterization and defoliation responses of selected *Schizachyrium scoparium* genotypes. *Amer Midl Nat* 114:37-43
- Brotherson JD, Carman JG, Szyski LA. 1983. Population dynamics and stem diameter-age relationships in *Tamarix ramosissima* in central Utah. *J Range Manage* 37:362-364
- Carman JG, Hatch SL. 1982. Aposporous apomixis in *Schizachyrium* (Poaceae:Andropogoneae). *Crop Sci* 22:1252-1255
- Carman JG 1982. A non-destructive stain technique for investigating root growth dynamics. *J Appl Eco* 19:873-879
- Carman JG, Briske DD. 1982. Root initiation and root and leaf elongation of dependent little bluestem tillers following defoliation. *Agron J* 74:432-435
- Carman JG, Brotherson JD. 1982. Comparisons of sites infested and not infested with *Tamarix pentandra* and *Elaeagnus angustifolia*. *Weed Sci* 30:360-364

Chapters in Books

- Carman JG, Jamison MS, Pattanayak J, Lacey J, Kim J-S, Elliott EG, Klein P, Ulrich T, Dwivedi K. 2007. Genetic analyses of aposporous embryo sac formation in sorghum. In: Z Xu, J Li, IK Vasil, Y Xue and W Yang (eds) *Proceedings of the 11th International Association of Plant Tissue Culture and Biotechnology Congress*, Beijing, China, August, 13-18, 2006, Springer Verlag, 305-307.

- Carman. J. G. 2007. Do duplicate genes cause apomixis? In *Apomixis: Evolution, Mechanisms and Perspectives*, pp. 63-91, eds. Hörandl, E., Grossniklaus, U., Van Dijk, P., Sharbel, T., International Association for Plant Taxonomy, Ruggel
- Dresselhaus T, Carman JG, Savidan Y. 2001. Genetic engineering of apomixis in sexual crops: A critical assessment of the apomixis technology. In: Y Savidan, JG Carman, and T. Dresselhaus eds: *The Flowering of Apomixis: From Mechanisms to Genetic Engineering*. Mexico, D.F.: CIMMYT, IRD, European Commission DG VI (FAIR).
- Carman JG. 2001. The gene effect: genome collisions and apomixis. In: Y Savidan, JG Carman, and T. Dresselhaus eds: *The Flowering of Apomixis: From Mechanisms to Genetic Engineering*. Mexico, D.F.: CIMMYT, IRD, European Commission DG VI (FAIR), 95-110
- Carman JG. 2000. The evolution of gametophytic apomixis. In: T Batygina ed: *Embryology of Flowering Plants, Vol. 3: The Systems of Reproduction*, 218-245. Russian Academy of Sciences, St. Petersburg.
- Carman JG. 1995. Somatic embryogenesis in wheat. In Y.P.S. Bajaj (ed.) *Biotechnology in agriculture and forestry, Vol. 31, Somatic embryogenesis and synthetic seed II*. Springer-Verlag, Heidelberg, p. 3-13.
- Carman JG. 1995. Nutrient absorption and the development and genetic stability of cultured meristems. In: Terzi M, Cella R, Falavigna A (ed.) *Current Issues in Plant Molecular and Cellular Biology, Proceedings of the VIII International Congress on Plant Tissue and Cell Culture, Florence, Italy, June, 1994*, Kluwer Academic Publishers, Dordrecht, p 393-403.
- Wang RR-C, Liu Z-W, Carman JG. 1993. The introduction and expression of apomixis in hybrids of wheat and *Elymus rectisetus*. *Proceedings, Eighth International Wheat Genetics Symposium, Beijing, China, July 20-35, 1993*.
- Carman JG, Hess JR, Bishop D, Hole DJ. 1993. *In ovulo* environments and embryo dormancy in wheat. In Walker-Simmons MK, Ried JL (ed.) *Pre-harvest Sprouting in Cereals 1992*, Amer. Assoc. Cereal Chemists, p 163-170.
- Carman JG, Wang RR-C. 1992. Apomixis in the Triticeae. p 26-29. In J. H. Elgin and J. P. Miksche (eds.) *Proceedings of the apomixis workshop, February 11-12, 1992, Atlanta, Georgia. USDA-ARS, ARS-104*, 66 pp.
- Carman JG, Campbell WF. 1990. Factors affecting somatic embryogenesis in wheat. In Y.P.S. Bajaj (ed.) *Biotechnology in Agriculture and Forestry, Vol. 13, Wheat*. Springer-Verlag, Berlin, p 68-87
- Carman JG. 1987. Cellular and molecular approaches to the ecophysiology and genetic improvement of shrubs. *Proceedings: Symposium on Shrub Ecophysiology and Biotechnology, Logan, UT, June 30-July 2, 1987*, Intermountain Research Station, Forest Service, USDA, Ogden, Utah, p 31-36.
- Briske DD, Hinnant RT, Brown JR, Carman JG, Stuth JW. 1982. Tiller utilization, demography and response to defoliation in a *Schizachyrium - Paspalum* grassland. In: D.D. Briske and M.M. Kothmann (eds.) *Proc. Nat. Conf. Grazing Manage. Technol*, Texas A&M University.

Books (Editor)

- Savidan Y, Carman JG, Dresselhaus T (eds). 2001. *The Flowering of Apomixis: From Mechanisms to Genetic Engineering*. Mexico, D.F.: CIMMYT, IRD, European Commission DG VI (FAIR).

GenBank Publications

- Dwivedi KK, Roche D, Carman JG, Mayhew D, Pattanayak J, Maughan A, Jamison M, Kowallis B. 2010. Characterization of promoter expression pattern of seed nucellar specific promoter of maize (*Zea mays*). NCBI GenBank Accession GQ906798
- Dwivedi KK, Mayhew D, Roche D, Carman JG. 2010. Cloning and characterization of sorghum outer cell layer promoter that is specifically expressed in basal endosperm transfer layer (BETL) of seeds. NCBI GenBank Accession HM035541
- Dwivedi, K.K., Lacey, J.A., Pattanayak, J., Jamison, M., Kowallis, B., Ulrich, T.H., Roche, D. and Carman, J.G. 2008. Cloning and characterization of a *Sorghum bicolor* lammer-type protein kinase (AFC1) mRNA, complete cds. GenBank, NIH, Accession no. EU100064.
- Dwivedi KK, Roche D, Carman JG, Kowallis B, Pattanayak J, Jamison M. 2008. Cloning and characterization of a *Sorghum bicolor* sucrose phosphatase gene. NCBI GenBank EU424176
- Dwivedi KK, Roche D, Carman JG, Kowallis B, Pattanayak J, Jamison M. 2008. Cloning and characterization of the *Sorghum bicolor* alpha kafirin gene. NCBI GenBank EU424175
- Dwivedi KK, Roche D, Carman JG, Kowallis B, Pattanayak J, Jamison M. 2008. Cloning and characterization of a *Sorghum bicolor* fatty acid desaturase (FAD2) gene. NCBI GenBank EU424175
- Dwivedi KK, Lacey JA, Pattanayak J, Jamison M, Kowallis B, Ulrich TH, Roche D, Carman JG. 2007. *Sorghum bicolor* mitogen-activated protein kinase family protein (MAPKK3) mRNA, partial cds. GenBank, NIH, Accession no. EU165191.

Invited Presentations

- Carman JG. 2016. Apomixis in eukaryotes: an ancient fair-weather alternative to sex. Seminars on Advances in the Genetic and Molecular Characterization of Apomixis V. Argentine National Scientific and Technical Research Council (CONICET), Center for Natural Resources in the Semi-Arid Zone (CERZOS), Bahia Blanca, Argentina, Nov. 14-16
- Carman JG. 2016. Effects of stress on reproductive mode in *Boecheera* (Brassicaceae). Seminars on Advances in the Genetic and Molecular Characterization of Apomixis V. Argentine National Scientific and Technical Research Council (CONICET), Center for Natural Resources in the Semi-Arid Zone (CERZOS), Bahia Blanca, Argentina, Nov. 14-16
- Carman JG, Mateo de Arias M, Shilling M, Sherwood DA, Dwivedi KK, Srivastava M, Lawit SJ. 2016. A stress-induced polyphenic switch from apomeiosis to meiosis occurs in *Boecheera* (Brassicaceae) that is cytologically and molecularly comparable to those of other kingdoms. Apomixis Workshop, International Plant & Animal Genome XXIV Conference, San Diego, CA, January 9-13, 2016 (with abstract).
- Shilling M, Carman JG, Mateo de Arias M, , Sherwood DA, Dwivedi KK, Srivastava M, Lawit SJ. 2016. Differential gene expression in diploid sexual, diploid apomictic and triploid apomictic species of *Boecheera*. Apomixis Workshop, International Plant & Animal Genome XXIV Conference, San Diego, CA, January 9-13, 2016 (with abstract).
- Albertini, E, Srivastava M, Carman JG. 2016. DNA Methylation events specific of apomictic lineages in the *Boecheera* genus. Apomixis Workshop, International Plant & Animal Genome XXIV Conference, San Diego, CA, January 9-13, 2016 (with abstract).
- Carman JG, Mateo de Arias M, Nelson SM, Zhao X, Gao L, Srivastava M, Sherwood DA, Windham MD. 2015. Hot on the trail of the sex-apomixis switch in *Boecheera* (Brassicaceae).

- Apomixis Workshop, International Plant & Animal Genome XXIII Conference, San Diego, CA, January 10-14, 2015 (with abstract).
- Srivastava, MK, Mateo de Arias M, Sherwood DA, Carman JG. 2015. Status and role of antioxidant enzymes in sexual and apomictic species of *Boechea*. XXIII International Grasslands Congress, New Delhi, India, Nov. 20-24
- Carman JG. 2013. Apomictic life cycles: ancient fair-weather alternatives to sexual life cycles. European Frontiers of Plant Reproduction Research 2013, Harnessing Plant Reproduction for Crop Improvement, European Cooperation in the Field of Scientific and Technical Research (COST), Oslo, Norway, Oct. 2-4
- Carman JG. 2013. *Boechea* and *Sorghum* inputs for the development of self-reproducing hybrid crops. Bill and Melinda Gates Foundation Convening: Genetic approaches to modify crop reproduction for smallholder farmers, San Juan Island Conference Room, Bill & Melinda Gates Foundation, Jan. 28-29, 2013, Seattle, WA
- Carman JG. 2012. Ovule transcriptomes of weakly aposporous and non-aposporous sorghum sibs. Apomixis Workshop, International Plant & Animal Genome XVIII Conference, San Diego, CA, January 14-18, 2012 (with abstract).
- Carman JG. 2012. Apomixis for crop improvement: insight from studies of apomixis in other kingdoms, invited presented at the National Training Program on Apomixis: Components, Importance and Utilization/exploitation, Indian Grassland and Fodder Research Institute (IGFRI), Ministry of Agriculture, Jhansi, Uttar Pradesh, India, Dec 3-16, 2012 (with abstract).
- Carman JG. 2012. Apomixis for crop improvement: insights from expression profiling of sexual and apomictic *Boechea* and aposporous and non-aposporous sorghum, invited presented at the National Training Program on Apomixis: Components, Importance and Utilization/exploitation, Indian Grassland and Fodder Research Institute (IGFRI), Ministry of Agriculture, Jhansi, Uttar Pradesh, India, Dec 3-16, 2012 (with abstract).
- Carman JG. 2012. Gene regulation during sexual and apomictic development in immature ovules of *Boechea* (Brassicaceae) and sorghum. Directorate of Sorghum Research (DSR), Ministry of Agriculture, Hyderabad, India, Dec 18, 2012
- Carman JG. 2012. Gene regulation during sexual and apomictic development in immature ovules of *Boechea* (Brassicaceae) and sorghum, International Crops Research Institute for the Semi-arid Tropics (ICRSAT), Patanchura, India, Dec 17, 2012
- Carman JG, Hörandl E, Hojsgaard D, Sherwood DA. 2011. Updated distributions of apomictic and polysporic species in angiosperms. Apomixis Workshop, International Plant & Animal Genome XVIII Conference, San Diego, CA, January 15-19, 2011 (with abstract).
- Carman JG. Ancient alternatives to sex. Invited presentation, XXI International Congress on Sexual Plant Reproduction, University of Bristol, Bristol, UK, August 2-6, 2010 (with abstract)
- Carman JG, Dwivedi KK, Roche D, Ganesan B. 2010. Expression profiling of ovules and anthers from apomictic and sexual *Boechea* (Brassicaceae). Apomixis Workshop, International Plant & Animal Genome XVII Conference, San Diego, CA, January 9-13, 2010 (with abstract).
- Carman JG, M Jamison, E Elliott, B Kowallis, T Naumova. 2009. The apospory program in sorghum accelerates initiation of the sexual processes of megasporogenesis and embryo sac formation. Invited presentation, Apomixis Workshop, International Plant & Animal Genome XVI Conference, San Diego, CA, January 14-19, 2009 (with abstract).

- Carman JG. 2008. Ovules of apomictic *Boecheira* suppress maleness but invest precociously in filial development – typical behaviors for apomictic eukaryotes. XXth International Congress on Sexual Plant Reproduction, Aug 4-8, Brasillia-DF, Brazil (with abstract).
- Carman JG. 2008. Genetics of apomictic embryo sac formation and other morphometric variables of ovule development in sorghum. American Society of Agronomy Abstracts. Houston, TX, Oct 4-9, 2008, on CD (with abstract).
- Roche D, Carman JG. 2008. Apomixis in eukaryotes, an ancient phenomenon. Invited presentation, Apomixis Workshop, International Plant & Animal Genome XVI Conference, San Diego, CA, January 14 - 19, 2008 (with abstract).
- Carman JG, Roche D. 2007. Apomixis Among Sexual Eukaryotes. Invited presentation, 3rd International Conference on Apomixis, The 9th Gatersleben Research Conference, June 27 – July 3, 2007, Wernigerode, Germany (with abstract).
- Carman JG, Roche D. 2007. Molecular phylogenies and the identity, age and evolution of apomictic clades. Invited presentation, Apomixis Workshop, International Plant & Animal Genome XV Conference, San Diego, CA, January 13 - 17, 2007 (with abstract).
- Carman JG, Jamison MS, Pattanayak J, Lacey J, Kim J-S, Elliott EG, Klein P, Ulrich T, Dwivedi K. 2006. Genetic analyses of aposporous embryo sac formation in sorghum. Proceedings of the XI International Association of Plant Tissue Culture and Biotechnology Congress, Beijing, China, August, 13-18, 2006, Springer Verlag (with abstract).
- Carman JG. 2005. Apomixis may evolve by reticulate evolution and appears to be stabilized by asexuality or structural heterozygosity. Invited presentation, XVII International Botanical Congress, Vienna, Austria, July 17-23, 2005 (with abstract).
- Carman JG. 2005. Probing for “apomixis genes” among sexual plants. Invited presentation, Apomixis Workshop, International Plant & Animal Genome XIII Conference, San Diego, CA, January 15 - 19, 2005 (with abstract).
- Carman JG. 2004. Inducing elements of apomixis through plant breeding. Invited presentation, Apomixis Workshop, International Plant & Animal Genome XII Conference, San Diego, CA, January 10-14, 2004 (with abstract).
- Carman JG. 2003. Evolution of apomixis in *Antennaria* (Asteraceae): A model involving hybrid origins and karyotypic stabilization. Invited presentation, Apomixis Workshop, International Plant & Animal Genome XI Conference, San Diego, CA, January 11-15, 2003 (with abstract).
- Naumova T, Carman JG. 2001. Advances in Apomixis Research. From Gametes to Embryos, Xth International Conference on Plant Embryology, Sep 5-8, 2001, Nitra, Slovak Republic (with abstract).
- Carman JG. 2000. Apomixis: an inducible hybrid phenotype for plant improvement. International Crops Research Institute for the Semi-arid Tropics (ICRSAT), Hyderabad, India, May 22, 2000.
- Carman JG. 2000. Apomixis: an inducible hybrid phenotype for plant improvement. International Rice Research Institute (IRRI), Los Baños, Laguna, Philippines, May 18, 2000.
- Carman JG, Kowallis BM, Naumova TN, Bradley JE, Jamison M. 2001. Evolution of angiospermous apomicts. Program and Abstracts Book, p 22, Presentation to the “2nd Int Apomixis Conf, APO 2001,” Apr 24-28, 2001, Como, Italy. EU, Rockefeller Foundation, FAO, IRD (with abstract).

- Carman JG. 2000. New findings support new models for the origins and stabilization of agamic complexes. Presentation to the conference XVIth Int Cong Sex Plant Repro, April 1-5, 2000, Banff, Alberta, Canada, Program and Abstracts, p 26. Intern Assoc Sex Plant Repro, Plant Biotech Inst, NRC (with abstract).
- Carman JG. 1998. When, where and how did angiospermous apomicts evolve? Presentation at the workshop “Designing a Research Strategy for Achieving Asexual Seed Reproduction in Cereals”, April 27-May 1, 1998. Rockefeller Foundation, Bellagio Studio and Conference Center, Bellagio, Italy (with abstract).
- Carman JG. 1995. Phylogeny of apomictic, polysporic and polyembryonic angiosperms: evolutionary and regulatory implications. Presentation to the 1st Int Apomixis Conf, Harnessing Apomixis: A New Frontier in Plant Science, p 25, Sep 25-27, 1995. College Station, TX. FAO, ORSTOM, USDA-ARS, Rockefeller Foundation, Texas Ag Exp Stat, Texas A&M Univ, Pioneer Hi-Bred Int, Inc (with abstract).
- Carman JG. 1994. Nutrient absorption and the development and genetic stability of cultured meristems. VIII International Congress on Plant Tissue and Cell Culture, Florence, Italy, June, 1994 (with abstract)
- Wang, RR-C, Liu Z-W, Carman JG. 1993. The introduction and expression of apomixis in hybrids of wheat and *Elymus rectisetus*. Proceedings, 8th Int Wheat Genet Sym, Beijing, China, July 20-35, 1993 (Presented by R.R-C Wang) (with abstract).
- Carman JG. 1992. Unifying our efforts to create apomictic crops. *In*: Y. H. Savidan and C. F. Crane (eds) Apomixis Newsl 5, Proc 1st Int Aponet Workshop, Presentation to the Workshop, Montpellier, France, April 22-24, 1992, Int Network Apomixis Res (with abstract).
- Carman JG, Wang RR-C. 1992. Apomixis in the Triticeae. *In* J. H. Elgin and J. P. Miksche (eds.) Proc Apomixis Workshop, p 26-29, Presentation at the Apomixis Workshop, @ Feb 11-12, 1992, Atlanta, Georgia. USDA@ARS, ARS-104, 66 pp (with abstract).
- Carman JG, Hess JR, Bishop D, Hole DJ. 1992. *In ovulo* environments and embryo dormancy in wheat. Sixth International Symposium on Pre-harvest Sprouting in Cereals, Amer. Assoc. Cereal Chemists, Coeur d’Alene, ID, July 25-29, 1992 (with abstract)
- Carman JG. 1989. Understanding and increasing production of embryogenic cells. Control of Morphogenesis, Moët-Hennessy Louis Vuitton, Aix Les Bains, France, September 18-20, 1989 (with abstract).
- Carman JG. 1989. The *in ovulo* environment and its relevance to cloning wheat via somatic embryogenesis. *In Vitro* 25:1155-1162. Invited address, 39th Annual Meeting of the Tissue Culture Association of America, June 12-15, 1988, Los Vegas, NV (with abstract).
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- Hörandl E., Hojsgaard D, Klatt S, Carman JG. 2015. The significance of apomixis for evolution and biodiversity of angiosperms. Botanikertagung 2015. From Molecules to the Field. Ludwig-Maximilians-Universität & Technische Universität München, Munich, Germany, Aug. 30 - Sep. 3.
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Popular Articles

- Hashim ZN, Ahmed SU, Campbell WF, Carman JG. 1988. Somaclonal variation - a new source of wheat germplasm. Utah Sci 49:83-88
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Chaired Conference Sessions

- Meristem Culture Section, VIII International Congress on Plant Tissue and Cell Culture, Florence, Italy, June, 1994.
- Somatic Embryogenesis Section. Control of Morphogenesis, Moet-Hennessy Louis Vuitton sponsored conference, Aix Les Bains, France, September 18-20, 1989.
- Tissue Culture and Microinjection Session, 1988. Annual Meeting of the American Society of Agronomy.

Patents

- Carman JG. 2009. Methods for producing apomictic plants. U.S. Patent No. 7,541,514
- Carman JG. 2004. Methods for producing apomictic plants. U.S. Patent No. 6,750,376

Technology Commercialization

Founder, Caisson Laboratories, Inc., Mar 2, 1998 - present. Produces plant and animal cell culture media and supplies (Caissonlabs.com)

Funded Projects

Current Funding:

Carman JG. 2013-18. Cytological and molecular characterizations of reproduction in sexual and apomictic *Boechera* (Brassicaceae). UAES (\$ 11,000 ann.)

Davies C. et al. 2016-2019. USDA-AFRI Competitive Grants Program, Undergraduate Research and Extension Experiential Learning Fellowships Program, \$ 274,503 (expected to Carman USU lab: \$ 12,000 plus paid undergraduate researcher for 12 weeks each summer)

Previous Funding:

Carman JG. 2012-2015. Bioinformatic analysis and functional characterization of *Boechera* genetic leads for developing synthetic apomixis in crops. Pioneer Hi-Bred, a DuPont Company (\$50,000)

Carman JG. 2011. Bioinformatic analysis and functional characterization of *Boechera* genetic leads for developing synthetic apomixis in crops. Pioneer Hi-Bred, a DuPont Company (\$10,000)

Carman JG and Sherwood D. 2011. Reactive oxygen species signaling and reproductive development in *Boechera* (Brassicaceae). Utah State University, VP Research, Research Catalyst Grant (\$20,000)

Carman JG. 2010. Corn transformation. Research sponsored by Caisson Labs, subcontract from an NSF-SBIR grant (\$48,000)

Carman JG. 2010. Analyses of putative epigenome-associated regulators of apomixis identified from ovule transcriptomes of sexual and apomictic *Boechera* (Brassicaceae). UAES mini-grant. (\$12,460)

Carman JG, D Roche. 2008. Enhancing starch quantity and quality in hybrid grain sorghum. National Science foundation, SBIR, Phase I and Ib. \$120,000 (awarded to Caisson Laboratories, Inc., with \$50,000 to USU)

Carman JG. 2008-2013. Genetic and epigenetic regulation of apomixis: pursuing the headwaters. UAES (\$ 11,000 ann.)

Carman JG. 2007-2010. Platforms for producing bio-contained high-value products in hybrid seed crops. Advanced Technology Program (ATP), National Institute of Standards and Technology (NIST), Department of Commerce. \$2,000,000 (awarded to Caisson Laboratories, \$43,000 to Carman lab, USU)

Carman JG. 2004-2007. Biotechnology for conferring apomixis (asexual seed formation) to crops. Advanced Technology Program (ATP), National Institute of Standards and Technology (NIST), Department of Commerce. \$1,975,002 (Awarded to Caisson laboratories, Inc., \$ 80,000 to Carman lab, USU).

Carman JG. 2003-08. Understanding and synthesizing angiosperm apomicts. UAES (\$ 55,000).

Carman JG. Methods development: expressing apomixis in typically-sexual angiosperms. Caisson Laboratories, Inc. January 1998 - 2008 (approximately \$ 350,000).

Carman JG, Jensen KB. 1991-1996. Center of excellence, Center for Value-added Seed Technology (CVAST). Utah Centers of Excellence Program, Salt Lake City, UT (\$ 470,000 total).

Carman JG, Wang RR-C. 1993-1996. Selection, characterization and gene mapping of apomixis in rice. USDA-NARS Specific Cooperative Agreement. \$ 195,550.

Carman JG. Research contract from INEL, Improved transformation and regeneration techniques for cotton. April 1 through September 30, 1996: \$ 5,000.

Salisbury FB (P.I.) Gas-exchange and seed-to-seed experiments on Russian space station Mir. October 1, 1995, through September 30, 1996: \$ 600,001 (\$ 60,000 for JGC).

Carman JG. Research contract from INEL, System for growing conifer embryos. October 1, 1994, through September 30, 1995: \$ 17,000

Carman JG. Research contract from INEL, Improved transformation and regeneration techniques for cotton. October 1, 1994, through September 30, 1995: \$ 7,000

Carman JG. Research contract from INEL, Prototype plant embryo growth chamber. July 1 through December 30, 1994: \$ 9,460

Carman JG. Research contract from INEL, Improved transformation and regeneration techniques for cotton. April 1 through September 30, 1994: \$ 13,723.

Salisbury FB (P.I.) Gas-exchange and seed-to-seed experiments on Russian space station Mir. October 1, 1994, through September 30, 1995: \$ 600,001 (\$ 61,540 for research conducted by JGC).

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Carman JG, Cai D. 1992-1995. Characterization of a new apomictic rice line (HDAR): cytology, histology and genetics. Rockefeller Foundation, Environmental Fellowships in International Agriculture Program. \$ 28,000.

Carman JG, Wang RR-C. 1991-1994. Transfer of apomixis from *Elymus rectisetus* into wheat. USDA-ARS, Specific Cooperative Agreement, Northern Plains Area, Fort Collins, CO. (\$50,000).

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Carman JG, Hood EE, Hole DJ. 1991-1993. Embryogenic tissue cultures of wheat: production, transformation and regeneration. USDA, National Research Initiative, Competitive Grants Program, Washington, D.C. (\$ 80,000 total).

Albrechtsen RS, Hole DD, Carman JG. 1990-1993. Control of dwarf bunt (TCK) of wheat through breeding resistant varieties. (\$24,000 annual).

Carman JG. 1991-1992. Production and screening of monoclonal antibodies against five plant hormones. Utah State University Biotechnology Center (\$ 14,000 total).

Carman JG. 1989-90. Synthetic seed for high yielding hybrids of soybean, sweet potato, celery, cucumber and tomato. Utah State University, Biotechnology Center grant. (\$12,500)

Carman JG, Campbell WF. 1987-90. Rapid *in vitro* propagation of CELSS-developed hybrid and non-hybrid wheat cultivars. Independently reviewed section *in*: F.B. Salisbury (P.I.). Studies on maximum yield of wheat for the controlled environment of spacecraft (Renewal of NASA-

- Ames Cooperative Agreement No. NNC 20139), NASA, Dr. J. Brett, Administrator, Washington D.C. - \$24,000 annual).
- Carman JG. 1988-89. Somatic embryogenesis in wheat: exploring causes for tissue competence, USU Biotechnology Center, competitive grant. (\$12,000)
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- Carman JG. 1984-85. Molecular cytology of wide Triticeae hybrids: Construction of DNA probes and *in situ* hybridization. USU Faculty Grant \$10,000.
- Carman JG. and D.R. Dewey. 1983-1985. Transferring apomixis to wheat via wide-hybridization - The necessary first steps. USDA Comp. Grant - \$80,000.
- Carman JG. 1983-84. Surmounting pre- and post-fertilization barriers in wide Triticeae hybridizations. USU Faculty Grant - \$9,998.
- Carman JG. 1982-1987. Extending the hybridization limits of cereals and forages via tissue culture techniques. Utah Agr. Exp. Sta. - \$8,100-\$11,000 (Annual).