CURRRICULUM VITAE

Gabriel P Holbrook
Department: Biological Sciences (BIOS)
Date : Jan 2016

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EDUCATION:

B.Sc., University of York (U.K.), 1979
Ph.D., Rothamsted Experimental Station (U.K.) and University of York, 1986

AREAS OF SPECIALIZATION:

Plant Biology, Cell Biology, Physiology/Biochemistry, Photosynthesis, Carbon metabolism, Plant Stress, Renewable Biofuels, Biodiesel Production from Algae, Wastewater Phytoremediation

PROFESSIONAL EXPERIENCE

Department of Botany, Rothamsted Experimental Station, Harpenden (U.K.)
Department of Biology, University of York, Heslington, York (U.K.).
Ph.D. Thesis title - "Limitations to photosynthesis associated with photorespiration in wheat leaves", 1979-1983
Postdoctoral Associate, Department of Agricultural Biochemistry, University of Nebraska, Lincoln, 1983-1985
Postdoctoral Associate, Department of Botany, University of Florida, Gainesville, 1985-1987
Assistant Professor, Department of Biological Sciences, Northern Illinois University, 1987-1993
Associate Professor, Department of Biological Sciences, Northern Illinois University, 1993-present

TEACHING AND PROFESSIONAL ASSIGNMENT

Courses Taught:

BIOS 101, Plant Products and Human Affairs 3 credit hour(s), Lecture. A non-majors General Education class consisting of 3 Lecture periods per week covering major economic uses for plants in agriculture, horticulture, pharmaceuticals and breeding programs. Students take three lecture exams, and in-class quizzes for assessment and participation. (Offered in NIU Oxford Program)

BIOS 208, Fundamentals of Cell Biology. Lecture/Lab. This is an important core course for Biology majors, with enrollments of 100-200 students per semester. The lecture portion of the course is taught 3 times a week, and assessment is via lecture quizzes every 2 weeks and a final comprehensive exam. The lab portion (BIOS 210) is assessed separately, and I assign all grades for this. The course is offered every Spring at NIU.

BIOS 208H, Fundamentals of Cell Biology "Honors" section, meets once a week separately from the BIOS 208 lectures in the auditorium. This class section discusses special topics involving students with term papers and presentations related to main themes covered in lectures.

BIOS 305, Biology of Land Plants, 4 credit hour(s), Lecture/Lab Land plants studied in an evolutionary sequence. Basic anatomy, morphology, and physiology. Emphasis on the probable selective advantage of structures unique to each group of plants. Three hours of lecture and one three-hour laboratory per week. (Offered in NIU Oxford Program)

BIOS 370, Directed research problems under the guidance of a faculty member (1.0-3.0 credits) (Offered and taught in my lab every semester).

BIOS 411/511, Plant Physiology, (4 credits) Lecture/Lab
This senior level/graduate class is taught each Fall semester. Aside from the lecture portion of the class, there are two 2 hour lab sections per week using fresh plant material custom-grown in the NIU greenhouses. Assessment is via 3 lecture exams including both multiple choice and short essay responses, and a comprehensive final. The lab portion of the course also has 3 exams and a lab notebook with the requirement that 20-experiments are written up as graded lab reports. (Offered every Fall semester at NIU, and in the NIU Oxford program).

BIOS 493/616, Plant Metabolism is a senior undergraduate/graduate level class, focusing on more advanced aspects of plant biochemistry and physiology. The students are senior level undergraduates and graduate students, and the class is in a lecture format for the first 2 hrs followed by weekly student participation in literature presentations and discussions. The assessment is via a midterm and final exam which include essays. The students also work on and hand in a term paper for more a in-depth writing project and current literature discussion. (It is offered in the Spring semester, and also during the NIU Oxford program).

BIOS 493/700, Plant Stress (3 Credits). This is a team-taught class offered by Plant Science faculty for senior undergraduates and grad students. Lectures are twice per week with student assignments in the form of essays. The course is organized into Abiotic and Biotic Stress sections from water and heat stress effects on plants to pathogen-related stresses, adaptation, evolution and survival.

BIOS 761, Graduate Seminar in Plant Sciences. Taught on rotation with other faculty each semester.

BIOS 770, Independent study lab research under the supervision of an adviser. Offered every semester to Graduate students in my laboratory.

2. Advising, membership on graduate student committees and exam guidance (Last 3 years)

Graduate Advisor (for MS)

Adam Hage, Tony Kephart, Nicholas Kirchner; Zachary Davidson; Jeremy Lederhouse; Michele Crase; Kristin McConnell; Jessica Williams; Julie Heldt; Mark Kuhlmann (SAL); Michael Mackey

Committee Member (for MS)

Sean Burke; Shane Theado; Joan Mason; Diwa Malla; Deepali Merchant; Sarah Netherton; Michelle Whalen; Bevy Kolondam; Samuel Jones; Michael Flinn

Committee Member (for PhD)

Quinzhou Qi; Katie Harmata; Austin Parrin; Rob Hussain; Erin Garza; Phillip Weber; William Wysocki; Robert Srygler

3. Research guidance and support.

Independent Study Students (Last 4 years) and Engaged Learning awardees for BIOS 370, BIOS 495H

Undergraduates: Sean Hicks, Josh Pierson, Fred Rose (SEF), LeRoy Reinke, Ayemide Adelaye, Amir Toghraee; Dan Izor; Brian Keefe (USOAR); Hector Alvarado; Stanislav Berestovyy (URAP); Daniele Scheer; Phil Persino (Hons); Asmaa Mustafa (Hons); Tim Harper; Hayden Hallgren; Marcin Jaloszynski; Eliot Fagman; Samantha Melton; Matthew Kispert; Sarah Marcheschi; Peter Miller; Amin Aburomi; David Meyer; Lindsey Tuntland (USOAR); Greg Pipis

II. SCHOLARLY AND RESEARCH/CREATIVE ACTIVITIES

1. Publications (Refereed)

Holbrook, G., Sterner, E. (2016). Regulation of RuBP Carboxylase oxygenase and photosynthetic induction in soybeans at canopy light levels. *Journal of Experimental Botany*. (in revision)

Holbrook, G., Turner, J., Sterner, E. (2016) CA1P synthesis during leaf development in Soybean. *Plant Cell Physiology* (in preparation).

Grayburn WS, Holbrook GP (2016) Use of the filamentous alga Cladophora and associated periphyton for waste water treatment and biofuel production. Current Biotechnology (in review).

Holbrook GP , Z Davidson*, R Tatara, N Ziemer, K Rosentrater and WS Grayburn (2014) Use of the microalga *Monoraphidium* sp. grown in wastewater as a feedstock for biodiesel: cultivation and fuel characteristics. Applied Energy 131:386-393

Grayburn, S., Tatara, R., Rosentrater, K., Holbrook, G. (2013). Harvesting, oil extraction, and conversion of local filamentous algae growing in wastewater into biodiesel. *International Journal of Energy and Environment, 4 (2): 185-190*

Holbrook, G., Navaleza, A., Kwong, F. (2006). In J. de Teixteira (Ed.), *"Water stress effects on Impatiens wallerana" IN: "Floriculture Ornamental and Plant Biotechnology: advances and topical issues"* (pp. Ch. 25, pp. 239-244). Global Science Books.

Glockling, S. L., Holbrook, G. (2005). Endoparasites of soil nematodes and rotifers II The genus Haptocillium. *Mycologist, 19,* 2-9.

Duvall, M., Saar, D., Grayburn, W. S., Holbrook, G. (2003). Complex transitions between C3 and C4 photosynthesis during the evolution of Paniceae: a phylogenetic case study emphasizing the position of Steinchisma hians (Poaceae), a C3 - C4 intermediate. *International Journal of Plant Sciences, 164,* 949-958.

Glockling, S. L., Holbrook, G. (2003). Endoparasites of soil nematodes and rotifers 1: the common and the rare. *Mycologist, 17 Part 4*, 150-154.

Holbrook, G., Keys, A. J. (2003). Evidence for recycling of inorganic phosphate by wheat chloroplasts during photosynthesis at air levels of CO2 and O2. *Journal of Plant Physiology, 160,* 1351-1360.

Swiech, R., Browning, S., Molsen, D., Stenger, D. C., Holbrook, G. (2001). Photosynthetic responses of sugar beet and Nicotiana benthamiana Domin. infected with Beet Curly Top Virus. *Physiological and Molecular Plant Pathology, 58,* 43-52.

Heo, J., Holbrook, G. (1999). Regulation of 2-carboxyarabinitol 1-phosphate phosphatase: Activation by glutathione and interaction with thiol reagents. *Biochemical Journal, 338,* 409-416.

Holbrook, G., Campbell, W. J., Rowland-Bamford, A., Bowes, G. (1994). Intraspecific variation in the light/dark modulation of ribulose 1,5 bisphosphate carboxylase/oxygenase activity in soybean. *J. Exp. Bot., 45*, 1119-1126.

Holbrook, G., Hansen, J., Wallick, K., Zinnen, T. M. (1993). Starch accumulation during hydroponic growth of spinach and basil plants under carbon dioxide enrichment. *Environ. Exp. Bot., 33*(2), 313-321.

Holbrook, G., Turner, J. A., Polans, N. O. (1992). Dark inhibition of ribulose-1,5-bisphosphate carboxylase/oxygenase in legumes: a biosystematic study. *Photosynthesis Research, 32,* 37-44.

Holbrook, G., Galasinski, S. C., Salvucci, M. E. (1991). Regulation of 2-carboxyarabinitol 1-phosphatase. *Plant Physiol., 97*, 894-899.

Beer, S., Spencer, W., Holbrook, G., Bowes, G. (1990). Gas exchange and carbon fixation properties of the mat forming cyanophyte Lyngbya birgei. *Aquatic Botany, 38*, 221-230.

Holbrook, G., Bowes, G., Salvucci, M. E. (1989). Degradation of 2-carboxyarabinitol 1-phosphate by a specific chloroplast phosphatase. *Plant Physiol., 90*, 673-678.

Salvucci, M. E., Holbrook, G. (1989). Purification and properties of 2-carboxy-D-arabinitol 1-phosphatase. *Plant Physiol., 90*, 679-685.

Salvucci, M. E., Holbrook, G., Anderson, J. C., Bowes, G. (1988). NADPH-dependent metabolism of the ribulose bisphosphate carboxylase inhibitor 2-carboxyarabinitol 1-phosphate by a chloroplast protein. *FEBS Lett., 231*, 197-201.

Holbrook, G., Beer, S., Spencer, W. E., Reiskind, J. B., Davis, J. S., Bowes, G. (1988). Photosynthesis in marine macroalgae: evidence for carbon limitation. *Can. J. Bot., 66*, 577-582.

Holbrook, G., Campbell, W. J., Bowes, G. (1987). In J. Biggins (Ed.), *"Effect of light intensity during soybean growth on the activation state of RuBP carboxylase from leaves in the light and dark" IN: "Progress in Photosynthesis Research"* (vol. 3, pp. pp. 399-402). Boston, MA: Martinus Nijhoff Publ..

2. Abstracts and Presentations

N. Kirchner*, WS Grayburn, GP Holbrook (2015) Determining optimal conditions for growth and lipid production by the green microalga *Monoraphidium* sp. DeK19 in waste water. American Society for Plant Biology (Midwest section) Abstract P21, Donald Danforth Center, St. Louis MO, March 21, 22, 2015

A. Hage*, GP Holbrook (2015) Production of *Monoraphidium* sp. DeK19 in waste water as a potential biofuel feedstock. American Society for Plant Biology (Midwest section) Abstract P19, Donald Danforth Center, St. Louis MO, March 21, 22, 2015

A Kephart*, GP Holbrook (2015) Scaling up: Mesocosm growth of *Monoraphidium* sp. DeK19 for production of biodiesel. American Society for Plant Biology (Midwest section) Abstract P20, Donald Danforth Center, St. Louis MO, March 21, 22, 2015

N. Kirchner*, A. Kephart*, L. Reinke*, WS Grayburn, GP Holbrook (2014) Physical and Chemical considerations for the growth of cold tolerant algae for the production of biodiesel. American Society for Plant Biology (Midwest section) Abstract P34, Ohio State University, March 22, 23, 2014

N. Kirchner*, GP Holbrook (2014) Determining optimal growth conditions of *Monoraphidium* sp. for algal biodiesel. American Academy for the Advancement of Science, Abstract P18, Chicago IL, March 2014

Z Davidson, B Keefe, W Izor, A Toghraee, WS Grayburn, GP Holbrook (2013) Growth of *Monoraphidium* sp.microalgae in wastewater as a feedstock for biodiesel. American Society for Plant Biology (Midwest section) Abstract P18, Chicago State University, March 23, 24 2013

N Kirchner, GP Holbrook (2013) Determining optimal growth conditions of Monoraphidium for the production of biodiesel. Central States Universities, Symposium for Science, Engineering, and Mathematics, Argonne National Laboratory, Argonne, IL. November 1st 2013

Davidson Z, Keefe B, Persino P, Crase M, Tatara R, Grayburn S, Holbrook GP (2012**)** Growth of microalgae in wastewater as feedstocks for biodiesel production. American Society of Plant Biologists meeting, Midwest Section, University of Nebraska., Lincoln, NE , March 24,25, Abstract 209

Keefe B, Davidson Z, Holbrook GP (2012) Growing Native Microalgae in Waste Water for Use in Biodiesel Production**.** Central States Universities Incorporated Research Conference, Argonne Ntl Labs, October 12th 2012

Holbrook GP (2012) "Use of algae grown in wastewater as feedstocks for biodiesel" National University of Kaohsiung, Taiwan, May 2012 (invited talk)

Holbrook GP (2012) "Use of algae grown in wastewater as feedstocks for biodiesel" Department of Marine Environment and Engineering, National Sun Yat-sen University, Kaohsiung 804, Taiwan., May 2012 (invited talk).

McConnell K, Tatara R., Holbrook GP, Grayburn S. (2011) Use of microalgae as feedstocks for biodiesel production using wastewater as a growth medium. American Society for Plant Biology Abstract PO1058, Minneapolis MN Aug 6th-10th 2011

McConnell K, Lederhouse J, Young B, Tatara R., Holbrook GP, Grayburn S. (2011) Use of microalgae as feedstocks for biodiesel production using wastewater as a growth medium. Midwest American society for Plant Biology Abstract P18, Purdue University March 19 2011

Young B, Allison B, Tuntland L, and Holbrook GP (2010) RuBisCO degradation in plants which accumulate differing levels of CA1P. American Society of Plant Biologists, Midwest Section. Purdue Univ. IN March 26,27, 2010

Williams J, Nitti J , Holbrook GP (2010) Response of the drought-sensitive plant Impatiens wallerana to water stress. American Society of Plant Biologists, Midwest Section. Purdue Univ. IN March 26,27, 2010

Holbrook, G., & Sterner, E. (2009). Regulation of ribulose 1,5 bisphosphate carboxylase/oxygenase by CA1P in soybean.. American Society for Plant Biology Midwest section meeting, Peoria, IL, Academic, Regional. Abstract #39

Carey, L., Nitti, J., & Holbrook, G. (2009). Water Stress responses of the drought sensitive plant Impatiens wallerana. American Society for Plant Biology Midwest section meeting, Peoria, IL, Abstract #23

Sterner, E., & Holbrook, G. (2008). Regulation of ribulose 1, 5 bisphosphate carboxylase oxygenase in Soybean leaves. American Society for Plant Biology Midwest section meeting, Iowa State University, Abstracts 23:44

Serena, P., & Holbrook, G. (2008). The effects of Water Stress on key carbon fixation enzymes and sucrose levels in Impatiens wallerana. American Society for Plant Biology Midwest section meeting, Iowa State University, Abstract 23:37

Heldt, J., & Holbrook, G. (2007). A novel lab-based method for making 2D carboxyarabinitol 1 phosphate, a regulatory inhibitor of the Calvin Cycle enzyme, Rubisco. American Society for Plant Biology, Midwest section meeting, Michigan State University, East Lansing, MI, Abstracts 58:36

Sterner, E., & Holbrook, G. (2006). Synthesis of 2D carboxyarabinitol 1 phosphate, a regulatory inhibitor of the Calvin Cycle enzyme, Rubisco. University of Illinois, Chicago, IL, Abstract 31

McHugh, V., Beck, H., & Holbrook, G. (2004). A taxonomic and chemical examination of Mate de Coca (Erythroxylum spp.). Conference March 2004, University of Illinois, Rockford School of Medicine, Rockford, IL

Duvall, M., Saar, D., Grayburn, W. S., & Holbrook, G. (2002). Phylogenetics of the C3-C4 intermediate Steinchisma hians (=Panicum milioides, Poaceae); evidence for multiple origins in one tribe. International Congress on Botany 2002, Madison, WI

Heo, J., & Holbrook, G. (2002). An improved method for the laboratory synthesis of 2-carboxyarabinitol 1 phosphate (CA1P). Gordon Research Conference CO_2 fixation in Green Plants, Mt. Holyoke College, South Hadley, MA

Cowan, C. and Holbrook GP (2001) Water uptake during growth of Impatiens plants. Ball Helix seed company, West Chicago, IL , May 11, 2001 invited talk

Ray, J and Holbrook GP. (2001) Water stress responses of Impatiens plants. Ball Helix seed Company, West Chicago, IL, May 11, 2001 invited talk

Stuckey B. and Holbrook GP (2001) A new laboratory synthesis method for CA1P, an inhibitor of carbon fixation by plants. Illinois Academy of Sciences meeting. Western Illinois University, Macomb, IL April 21 2001

Stuckey B. and Holbrook GP (2001) Synthesis of CA1P, a regulator of photosynthesis. American Society of Plant Biology. Midwest Section. Knox College. Galesburg, IL March 2001

R. Swiech, Stenger DC and G.P. Holbrook (1999) Physiological changes accompanying infection of sugar beet with Beet Curly Top Virus. American Society of Plant Physiologists Meeting MidWest Section. Michigan State University, March 3rd 1999

Cohn A. and G.P. Holbrook (1999) Light /Dark regulation of RuBP carboxylase in Rhodobacter Sphaerodies. Abbott Laboratories Scholarship Presentation. April 26 1999. Invited talk.

Heo, J., Holbrook, G.P. (1997) Regulation of 2 carboxyarabinitol 1-phosphate phosphatase: influence of effectors and interaction with reagents modifying enzyme sulfhydryl groups. Plant Physiol. 113S: 39

Heo, J., Kuhl, S., and Holbrook, G.P. (1995). Evidence for the regulation of Rubisco by CA1P in the photosynthetic bacterium, *Rhodobacter sphaeroides*. Plant Physiol. 107S: 50

Borgwardt, J. E., Holbrook, G. (1994). Interaction of 2-carboxyarabinitol-1-phosphatase with thioredoxin and stromal metabolites. Plant Physiol.. vol. 105S, pp. 445.

Hansen, J., Wallick, K., Zinnen, T., Holbrook, G. (1993). Starch accumulation during hydroponic growth of spinach and basil plants under CO2 enrichment. Plant Physiol. vol. 102S, pp. 211

Turner, J. A., Minster, J., Salvucci, M. E., Holbrook, G. (1992). Inhibition of Rubisco activity by 2-carboxyarabinitol 1-phosphate (CA 1-P) during soybean leaf development. Plant Physiol. vol. 99S, pp. 105.

Turner, J. A., Polans, N. O., Holbrook, G. (1991). Dark inhibition of ribulose-1,5-bisphosphate carboxylase/oxygenase in legumes: a biosystematic study. Plant Physiol.. vol. 96S, pp. 327

Holbrook, G., Turner, J. A., & Polans, N. O. (1991). Dark inhibition of ribulose-1,5-bisphosphate carboxylase/oxygenase in legumes: a biosystematic study. Amoco Research Center, Naperville IL, Poster Session. B18

Holbrook, G., Galasinski, S. C., & Salvucci, M. E. (1990). Regulatory properties of 2-carboxyarabinitol 1-phosphatase. 9th Annual Symposium on Plant Biochemistry, University of Missouri-Columbia, published in proceedings.

Holbrook, G., Galasinski, S. C., Salvucci, M. E. (1990). Regulation of 2-carboxyarabinitol 1-phosphatase (CA 1-Pase*).* Plant Physiol. vol. 93S, pp. 121.

Holbrook, G. (1989) "Discovery and significance of a new chloroplast enzyme: CA1P phosphatase" Invited talk. Chicago Plant Science Group. UIC Meeting March 1989,

Reiskind, J., Spencer, W. E., Holbrook, G., Beer, S., Bowes, G. (1988). Marine algae: oxygen inhibition and carbonic anhydrase activity. Plant Physiol. vol. 86S, pp. 50.

Holbrook, G., Salvucci, M. E., Anderson, J. C., Bowes, G. (1988). NADPH-dependent metabolism of the RuBP carboxylase inhibitor 2-carboxyarabinitol 1-phosphate by a chloroplastic protein. Plant Physiol. vol. 86S, pp. 27.

Bowes, G., Holbrook, G. (1988). Species, cultivar, and developmental variation in the production of 2-carboxyarabinitol 1-phosphate by leaves during darkness. Plant Physiol. vol. 86S, pp. 26

Holbrook, G., Campbell, W. J., Bowes, G. (1987). Effect of changes in light intensity on RuBP carboxylase activity modulated by the endogenous inhibitor of the enzyme in soybean leaves. Plant Physiol.. vol. 83S, pp. 49

Spencer, W. E., Holbrook, G., Beer, S., Reiskind, J., Davis, S., Bowes, G. (1987). Marine macroalgal photosynthesis is carbon limited in seawater. Plant Physiol. vol. 83S, pp. 66

Bowes, G., Holbrook, G. (1987). Regulation of rubisco activity in the light by the nocturnal inhibitor carboxyarabinitol monophosphate. University of Cambridge: The Genetics and Physiology of Photosynthesis and Crop Yield. OECD Workshop proceedings (pp. 79)

Beer, S., Spencer, W. E., Holbrook, G., & Bowes, G. (1987). *Photosynthetic carbon fixation in Lyngbya as related to its environment*. XIV International Botanical Congress, Berlin, West Germany, Academic, International. Abstract, pp. 34

Presentations at NIU involving students* (Last 4 years)

N. Kirchner*, WS Grayburn, GP Holbrook (2015) Determining optimal conditions for growth and lipid production by the green microalga *Monoraphidium* sp. DeK19 in waste water. American Society for Plant Biology (Midwest section) Abstract P21, Donald Danforth Center, St. Louis MO, March 21, 22, 2015)

W Izor*, GP Holbrook (2013) Optimizing Conditions for flocculation of monoraphidium algae as a sustainable source of biofuel. Phi Sigma Conference NIU April 13, 2013

A Toghraee*, GP Holbrook, WS Grayburn (2013) lipid rich Monoraphidium algae cultivation as a source of biodiesel fuel. Phi Sigma Conference NIU April 13, 2013

B Keefe*, Z Davidson, WS Grayburn, GP Holbrook (2013) Microalgae grown in wastewater as a feedstock for biodiesel. Undergraduate Research and Artistry Conference, NIU April 23, 2013

A Toghraee*, GP Holbrook, WS Grayburn (2013) lipid rich Monoraphidium algae cultivation as a source of biodiesel fuel. Undergraduate Research and Artistry Conference, NIU April 23, 2013

W Izor*, GP Holbrook (2013) Optimizing Conditions for flocculation of monorahpidium algae as a sustainable source of biofuel. Undergraduate Research and Artistry Conference, NIU April 23, 2013

Z Davidson*, WS Grayburn, GP Holbrook (2013) Microalgae grown in wastewater as a feedstock for biodiesel. Graduate Student Research Association Conference, NIU April 27th, 2013

Persino* P, Grayburn S, Holborok GP 2012 Lipid extraction from algae as a potential source of biofuel. Phi Sigma Meeting ,NIU, DeKalb, April 2012

Mustafa *A and Holbrook GP (2012) The degradation of Rubisco during senescence of common crop plants. Phi Sigma Meeting ,NIU, DeKalb, April 2012

Davidson *Z, Keefe B, Grayburn S, Holbrook GP (2012) Growing Ankistrodesmus Species in Wastewater for use in Biofuels. GSRA Conference, NIU, DeKalb, March 31st

McConnell K, Lederhouse J, Young* B, Tatara R., Holbrook GP, Grayburn S. (2011) Use of microalgae as feedstocks for biodiesel production using wastewater as a growth medium. Phi Sigma Meeting NIU April 9th 2011

M Kispert*, S Grayburn, G Holbrook (2011) Supplemental Lighting effects on growth of microalgae used as feedstocks for biofuel. Phi Sigma Meeting NIU April 9th 2011

B. Young*, G.Holbrook, SC Grayburn R Tatara (2011) Processing Algae as Feedstocks for biodiesel production. Phi Sigma Meeting NIU April 9th 2011

Mackey M*, Grayburn, S, Holbrook GP (2010) Algae from wastewater: determining the utility of Cladophora Glomerata and associated freshwater algae as a source for biodiesel and ethanol. NIU Undergraduate Research Day April 29th 2010

Kispert, M*, Grayburn S, Holbrook GP (2010) Microalgae isolation and cultivation for use in potential biofuels. NIU Undergraduate Research Day April 29th 2010

Research Grant Proposals (Last 4 years)

Holbrook G. (Principal), W S Grayburn, Norbert Ziemer (Co-Principals) Venturewell "Wastewater Treatment, Algae Productivity, and Biofuel" Stage 2. (submitted 1/27/16)

Holbrook G. (Principal), W S Grayburn, Norbert Ziemer (Co-Principals) Venturewell "Wastewater Treatment, Algae Productivity, and Biofuel" Stage 1. (submitted 2/05/15). Funded $5,000.

Holbrook G. (Principal), Norbert Ziemer (Co-Principal) EPA P3 Proposal "Use of *Monoraphidium* algae for municipal waste water treatment and biodiesel production." (submitted 12/15/14)

Holbrook, G. (Principal), Norbert Ziemer (Co-principal). "Undergraduate engagement in biofuel research using algae growing in wastewater: environmental benefits, economic advantages, and educational opportunities." American Society of Plant Biologists Education Grant $19,900 8/01/13-7/31/14. Not funded.

Holbrook, G. (Co-Principal), Grayburn, S. (Principal), Grant, "Advances in Sustainable Algal Production (ASAP) Program. "Use of Effluent Water for Sustainable, Scalable Filamentous Algae Biomass Production.", USDA, Federal, $500,000.00, Not Funded. (sub: April 2012).

Barber, N. (Co-Principal), Sims, T. (Principal), Bujarski, J. (Co-Principal), Duvall, M. (Co-Principal), Holbrook, G. (Co-Principal), Miller, J. (Co-Principal), Stafstrom, J. (Co-Principal), von Ende, C. (Co-Principal), Lenczewski, M. (Co-Principal), Rigg, L. (Co-Principal), Scherer, R. (Co-Principal), Grant, "Integrated Research, Education and Outreach on Genetic Diversity and Potential for Adaptation to Climate Change in Midwest Agroecosystems", U.S. Department of Agriculture, Federal, $748,069.00, Not Funded

Holbrook, G. (Co-Principal), Pohlman, N. (Principal), Grayburn, S. (Co-Principal), Grant, "Biochar production and effect on Crops", NSF Basic Research to Enable Agricultural Development "BREAD"), Federal, $640,000.00, Not Funded. (start: June 2011, end: May 2014). Not funded.

Holbrook, G. (Principal), Grant, "“Effect of drought stress on impatiens”", American Floral Foundation, Private, $18,000.00. Not Funded. (start: April 2011, end: March 2013).

Holbrook, G. (Principal), Grant, "“Water Stress in ornamental plants”", Gloeckner Foundation, Private, $17,200.00, Not Funded. (start: March 2011, end: February 2013).

Holbrook, G., Tatara, R., Grayburn, S., Mirman, C., Grant, "DOE “Biofuels from Algae” through NIU College of Engineering and Engineering Technology Grant no. #DEE-EE0003975 and DE NT 000401 “Energy conservation projects to benefit the railroad industry", DOE, Federal, $90,000.00, **Funded**. (start: June 2009, end: July 2012).

Holbrook, G. (Co-Principal), Grayburn, S. (Principal), Grant, "Algae from Wastewater for Biofuel", NIU Venture Grant, Northern Illinois University, $10,000.00, **Funded**. (start: October 2010, end: May 2011).

Description of Research Projects.

1) Use of Algae use for biofuels and wastewater remediation

Freshwater algae are green aquatic plants that can use nutrients, sunlight and carbon dioxide for growth. Some species of algae produce significant amounts of oil and are being considered for the production of biodiesel. The starch and cellulose from algae may also be used for the production of cellulosic ethanol. Algae have major advantages over corn and soybeans which are presently the usual source of biomass for ethanol production. These include a longer growing season and a potential for faster growth. Algae do not compete with corn and soybean for human or livestock food. It may also be possible to use pyrolysis of dried algae to produce energy and biochar, which results in sequestration of carbon. Methane or `biogas' can also be a useful degradation product of algae, depending on digestion conditions.

In many cases the final stages of sewage treatment promote the growth of algae, due to the abundance of nutrients such as nitrogen and phosphorus in the water. It is beneficial to the environment to have these nutrients removed from treated water by the algae before the water is discharged from the treatment facility. Compared to current oil crops, there are a number of economic advantages when growing algae at wastewater treatment facilities. There is no cost for the nutrients. The outside tanks for growth are an integral part of the process with a throughput of millions of gallons per day. The water temperature is relatively constant throughout the year so there are no costs for growth chambers or heating. Light for photosynthesis is provided by the sun, supplemented by facilty lights at night.

The projects in the lab at NIU explore the use of algae indigenous to the region for the production of biofuels like biodiesel and ethanol. Advances in using these organisms as a sustainable source of energy will be applicable to municipal water treatment plants worldwide, and provide an alternative to petroleum based fossil fuels, whose supply is finite.

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2) Regulation of photosynthetic carbon metabolism via CA1P and CA1P phosphatase

2-carboxyarabinitol 1-phosphate (CA1P) is a phosphate ester synthesized in leaves of many agriculturally important plant species in response to decreased light intensity or darkness. Because of its

inhibitory interaction with the primary carbon-fixing enzyme, ribulose 1,5-bisphosphate carboxylase/oxygenase (Rubisco), CA1P is a component of the multiple mechanisms responsible for light-regulation of CO_2 fixation. Further characterization of this mode of control is necessary to facilitate development of strategies enhancing photosynthetic productivity, and ultimately producing higher yields of key crops. Fundamental information regarding the biochemical pathways responsible for the synthesis and degradation of CA1P is forthcoming, but the complete details have not been fully elucidated.

Ongoing research in my lab focuses on CA1P phosphatase, the chloroplast enzyme responsible for degrading CA1P in the light. Considering its potential importance in determining CA1P levels, we intend to examine the mechanisms controlling its activity. Past work in my lab indicates that CA1P phosphatase is susceptible to redox regulation, especially by ratios of reduced versus oxidized glutathione. Details of this regulation is being investigated with enzyme *in vitro*, and by addressing its physiological significance in leaves of bean and tobacco. These studies will be accompanied by cloning and sequencing of the CA1P phosphatase gene in tobacco plants. Further analysis of the regulation of this enzyme will then be accomplished by its expression in *E. coli* and site-directed mutagenesis of key cysteine residues. In addition, it should be possible to produce transgenic tobacco plants overexpressing and underexpressing CA1P phosphatase. This will provide important information about the role of CA1P in regulating Rubisco *in vivo*.

III. SERVICE TO THE UNIVERSITY, THE PROFESSION, AND THE PUBLIC

Department of Biological Sciences Service

Governance committee. (August 2010 - July 2012, Aug 2014 - present). Department service dealing with Personnel matters, Fund allocations, Merit evaluation, Administrative policies, and forward planning.

Graduate committee (2010-present) Assist with and evaluate M.S. and Ph.D. graduate student admissions in the Fall and Spring, allocation of student grants, scholarships and TA appointments, formulation of graduate policy and curriculum.

Greenhouse Committee, Committee Chair (2006-2013). Oversee running of NIU Greenhouses, including contact with full-time greenhouse staff, space allocation, equipment needs, maintenance and upgrades of facility. Also oversight of Growth Chamber facility containing Conviron Constant Environment Chambers.

PMBC Executive Committee, Committee Member. (July 2009 - 2013). Service position dealing with resource allocation, curricular matters, and Plant Molecular Biology center policies.

Seminar committee, Committee Member (July 2009 - Present). Organisation of Departmental seminar speakers, graduate colloquium, hosting and invitations.

University Service

NIU at Oxford Program, Coordinator CLAS. (1999 - Present). Ongoing annual organization, planning, student recruitment, on-site management and teaching in a five-week summer study-

abroad program involving four NIU faculty, one Oxford don, and 30-35 students at Oriel College, Oxford, England. Courses are in Biology, Anthropology, Geography, Political Science, English, History, Economics, and Sociology.
http://www.niu.edu/studyabroad/programs/NIU-admin/Program%20PDFs/Oxford%2013.pdf

Featured Speaker on International Education for NIU International Programs meeting Nov 15th 2010. See http://today.niu.edu/2010/11/09/international-education-week-begins-nov-15/

Award: "NIU Outstanding International Educator", NIU International Programs, Service, University, University. (November 2009) for significant contributions to International Education at NIU. Directing NIU Oxford program 2000- to present.

Appointed regularly to advisory panels and committee meetings to help college programs set up and maintain study abroad courses.

Membership and involvement in professional associations.

Society Memberships:

American Society for Plant Biology
American Society for Plant Biology , Midwest Section
Society for Experimental Biology
Phi Sigma
Phi Beta Delta (International Education)

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Rockford Bioenergy Days, Session Chair 2010. Rockford International Bioenergy Days Conference , Rockford, Illinois, Session Moderator and Faculty Facilitator 9/26/2010
http://www.ibed2010.com/

Chairman, American Society of Plant Biologists (ASPB) Midwest Section meeting, National. (June 1995 - May 1996). http://my.aspb.org/The American Society of Plant Biologists was founded in 1924 to promote the growth and development of plant biology, to encourage and publish research in plant biology, and to promote the interests and growth of plant scientists in general. Over the decades the Society has evolved and expanded to provide a forum for molecular and cellular biology as well as to serve the basic interests of plant science. It publishes the highly cited and respected journals Plant Physiology and The Plant Cell. Membership spans six continents, and our members work in such diverse areas as academia, government laboratories, and industrial and commercial environments. The Society also has a large student membership. ASPB plays a key role in uniting the international plant science disciplines.

Midwest ASPB section meeting (attend annually, most recently Chicago State University March 2013), I'm regularly a Poster Judging Official, Business meeting contributor.

Invited to and attended the Olga Nalbandov Symposium: " The Biology of Crop Response and adaptation to global atmospheric change" University of Illinois, Urbana 2001

Panel Member, Council on International Educational Exchange, Chicago Meeting, 2001

Professionally-oriented public service.

Consulting: a) Ball Seed Company, Aurora IL, Plant water Stress (June 2004 - July 2007).
b) Labline Instruments, Academic. (1995 - 1996). Growth Chamber and equipment design.
c) Amoco Research, Growth of transgenic plants (1990 - 1991).

Reviewer (ad hoc) for the following organizations and professional journals:

Journal of Biochemistry and Molecular Biology, New Phytologist, Planta, Photosynthesis Research Biochemical Journal, Journal of Plant Growth Regulation, Israel Science Foundation, Illinois Academy of Sciences, US Department of Energy

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