Proceedings / Délibérations

The Canadian Society of Plant Physiologists

Founded in 1958

La Société Canadienne de Physiologie Végétale

Constituée en 1958

Eastern Regional Meeting 1999 Conférence Régionale de l'Est

Biosciences Complex, Queen's University at Kingston

December 11 – 13, 1999

Les 11 et 13 décembre 1999

Sponsored by / Parraine par

Queen's University
Department of Biology

BIOCAP
CANADA

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Canadian Society of Plant Physiologists

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Organizing Committee / Comité organisateur

Bill Plaxton (Chair), and David Layzell

Department of Biology, Queen's University

Meeting Coordinator

Mary Purcell

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Coffee Breaks and Poster Session Refreshments provided by:

Performance Plants Inc

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Saturday, 11 December

7:00 – 9:00 pm Registration and Mixer in Hospitality Suite (Room 216), Howard Johnson Confederation Place Hotel, 237 Ontario St., Kingston

Sunday, 12 December

8:30 – 9:30 am Registration, Coffee and Poster Setup (Atrium

9:30 – 9:45 am **Welcome and Opening Remarks** (Wm Plaxton and David Layzell)

Symposium: Plant Science for a Sustainable Future

Room **1103**, Biosciences Complex, 116 Barrie Street. (Chair: W. Plaxton)

9:45 – 10:30 am S1

PHYSIOLOGICAL AND ENVIRONMENTAL CONTROLS ON CARBON SEQUESTERING IN PLANTS AND SOILS LarryB. Flanagan*, P.J. Carlson, L.A. Wever, P. Rochette, E.G. Gregorich *Dept Biol. Sci., Univ. Lethbridge*

10:30 – 11:15 am S2

LIVING IN A HIGH CO_2 WORLD: BIOASSIMILATION STRATEGIES FOR FUN AND PROFIT Judith Jebanathirajah, Ming-De Deng, and John Coleman* *Department of Botany, U Toronto*

11:15 – 11:30 am **Coffee Break (in Atrium) – Courtesy of Qubit Systems Inc.**

11:30 – 12:15 pm S3

DECONSTRUCTING THE LIGNIN PATHWAY Brian Ellis* Biotechnology Lab / Agricultural Sciences, University of BC, Vancouver, BC

12:15 – 1:00 pm **Lunch (in Atrium, Biosciences Complex)**

Session 1A: Metabolism

Chair: Peter Summers (Rm. 1102)

1:00 – 1:15 pm 1A1

KINETIC PROFILES AND 3D MODELING OF ADENINE PHOSPHORIBOSYL-TRANSFERASE ISOFORMS FOUND IN *ARABIDOPSIS THALIANA*.
Michael Allen*, Wensheng Qin and Barbara Moffatt.
Dept. Biology, Univ. Waterloo.

1:15 – 1:30 pm 1A2

ADENOSINE KINASE IS INVOLVED IN MAINTAINING TRANSMETHYLATION ACTIVITIES IN PLANTS.
J Snider*, L Wang, Y Stevens, M Allen, L Pereira, K Alexander, L McCaffrey & B Moffatt
Department of Biology, University of Waterloo, ON, N2L 3G1

1:30 – 1:45 pm 1A3

ALTERNATIVE SPLICING OF A NOVEL DIACYLGLYCEROL KINASE IN TOMATO LEADS TO A CALMODULIN-BINDING ISOFORM.
Wayne A. Snedden* and Eduardo Blumwald
Dept Botany, University of Toronto, M5S3B2

1:45 – 2:00 pm 1A4

PURIFICATION AND CHARACTERIZATION OF BANANA FRUIT PYRUVATE KINASE
Will L. Turner*[1] & W.C. Plaxton[1,2], *Depts. of Biology[1] & Biochemistry[2], Queen's University.*

06
13
19

Session 1B: Development and Whole Plant Physiology

Chair: Susanne Kohalmi (Room 1103)

1:00 – 1:15 pm 1B1

THE FREQUENCY AND FUNCTION OF PLASMODESMATA IN ONION ROOTS
Fengshan Ma* and Carol A. Peterson
Dept Biology, U Waterloo, Waterloo, Ontario N2L 3E5

1:15 – 1:30 pm 1B2

PATHWAYS OF ION UPTAKE IN WOODY ROOTS DEDUCED BY ANATOMICAL STUDIES OF *Pi banksiana* (Lamb.).
Jeff H. Taylor* and Carol A. Peterson,
Department of Biology, University of Waterloo

1:30 – 1:45 pm 1B3

PROTEIN MODULES IN PLANTS: CHARACTERIZATION OF ATSH3P1, A NOVEL ARABIDOPSIS GENE ENCODING A PROTEIN WITH A SH3 PROTEIN INTERACTION DOMAIN.
Lam, C-H Bernard*, and Blumwald, Eduardo. *Dept. of Botany, UToronto, Toronto, Ontario, M5S 3B2.*

1:45 – 2:00 pm 1B4 ← 18

SESQUITERPENE LACTONES IN *TANACETUM PARTHENIUM* VARY ACCORDING TO DEVELOPMENTAL STAGE AND ARE INFLUENCED BY ENVIRONMENTAL FACTORS.
K. Usher*, P.A. Bowen, G.H.N. Towers
Botany Dept., University of BC, Vancouver

2:00 – 2:15 pm **1A5**
THE PHYSIOLOGICAL AND METABOLIC EFFECTS OF THE SLICING/AGING RESPONSE IN POTATO TUBERS
Tara Jowett*, Stephen Hunt, & William C. Plaxton,
Dept. of Biology, Queen's Univ.

2:00 – 2:15 pm **1B5**
A NON-INVASIVE MEASURE OF THE DYNAMICS AND SITE OF NITRATE REDUCTION IN SOYBEAN PLANTS
Yanping Cen* & David B. Layzell,
Dept. Biol., Queen's Univ, Kingston, Ont K7L 3N6

2:15 – 2:30 pm **1A6**
THE EFFECTS OF TEMPERATURE AND LIGHT ON PHOTOINHIBITION AND SUCROSE PHOSPHATE SYNTHASE (SPS) IN WINTER AND SPRING WHEAT.
T. Pocock*, V.M. Hurry, L. Savitch and N.P.A. Huner,
Dept Plant Sci., U Western Ontario, London

2:15 – 2:30 pm **1B6**
WHOLE PLANT GAS-EXCHANGE: ENVIRONMENTAL RESPONSES AND REGULATION.
LV Savitch[1]*, ED Leonardos[2], B Grodzinski[2], G Oquist[3], NPA Huner[1] [1] *UWOt, Plant Sci, London, ON,* [2] *U Guelph, Plant Agric, ON,* [3] *U Umea, Plant Physiology, Umea, Sweden*

2:30 – 2:45 pm Coffee Break (in Atrium) - Courtesy of Qubit Systems Inc.

Session 2A: Stress #1 Chair: Wayne Snedden (Rm 1102)

Session 2B: Plant-Envir. Interactions – Chair: Sheila Macfie (Rm 1103)

2:45 – 3:00 pm **2A1**
THE POTATO NUCLEAR FACTOR PBF-2 REPRESENTS A NOVEL SINGLE-STRANDED DNA BINDING FACTOR IMPLICATED IN *PR-10A* GENE ACTIVATION
Darrell Desveaux*, C. Després, A. Joyeux, R Subramaniam & N. Brisson. *Dept. Biochemistry, U Montreal, Montreal, Que.*

2:45 – 3:00 pm **2B1**
WHY DO LEGUME NODULES EVOLVE H_2 GAS?
Zhongmin Dong[1], Lishu Wu[2] & David Layzell[3]*
[1]*Biology, St. Mary's U, Halifax, NS;* [2]*Huazhong U, Wuhan, Hubei, PR China;* [3]*Biology, Queen's U, Kingston, Ont.*

3:00 – 3:15 pm **2A2**
CLONING OF A NOVEL, EVOLUTIONARY-CONSERVED, ssDNA-BINDING PROTEIN INVOLVED IN THE PLANT DEFENSE RESPONSE
Alexandre Joyeux*, C Després, D Desveaux, & N Brisson
Dept. Biochemistry, U Montreal, Montreal, Que.

3:00 – 3:15 pm **2B2**
BIOFILTRATION I: THE SORPTION OF INDOOR POLLUTANTS BY HIGHER PLANTS.
Jeffrey Mallany*, Alan Darlington and Michael Dixon,
Hort Sci, Dept Plant Agric, U Guelph, Ont.

3:15 – 3:30 pm **2A3**
AN EVALUATION OF THE F1 PROGENY OF TRANSGENIC ALFALFA GENOTYPES TRANSFORMED WITH GENES RELATED TO ABIOTIC STRESS TOLERANCE.
Karen Samis*, SR Bowley and BD McKersie
Plant Biotech Div., Dept Plant Agric, U Guelph, Ont.

3:15 – 3:30 pm **2B3**
BIOFILTRATION II: THE ROLE OF FUNGI IN AN INDOOR BIOFILTER
David Llewellyn*, Alan Darlington and Michael Dixon,
Hort Sci, Dept Plant Agric, U Guelph, Ont.

3:30 – 3:45 pm **2A4**
DETECTION OF PLANT GROWTH INHIBITION CAUSED BY NITROGEN AND SULFUR DEFICIENCIES IN CORN PLANTS BY LASER-INDUCED FLUORESCENCE
Guy Samson[1]*, L Dextraze[2], N Tremblay[2] & J Wollring[3],
[1]*CRH, Université Laval, QC;* [2]*CRDH Agric. Canada, St-Jean-sur-Richelieu QC;* [3]*Institutfür Pflanzener_hrung & Umweltforschung, HydroAgri Deutschland, Dülmen, Germany*

3:30 – 3:45 pm **2B4**
THE USE OF OZONE IN THE MAINTENANCE OF RECIRCULATING HYDROPONIC NUTRIENT SOLUTIONS: THE EFFECTS OF OZONATION ON MAJOR NUTRIENT IONS
G. Thomas Graham, Richard Côté and Michael A. Dixon
Controlled Environ Systems Facilities, Dept Plant Agric U Guelph, Ont

45 – 4:45 pm **Plenary Talk** Room 1103 (Chair: David Layzell)
AGRICULTURAL BIOTECHNOLOGY AND ITS ACCEPTANCE BY CANADIANS
eiss, Wm. *President, Royal Society of Canada and NSERC/SSHRC Industrial Research Chair in Risk ommunication and Public Policy, Department of Management, U. Calgary, Alberta*

6:30 pm **Poster Session (in the Atrium)** refreshments Courtesy of Performance Plants Inc.

7:30 pm **Buffet Dinner** (in the Atrium)

0:00 pm **Cash Bar and Music by 'Agent Blue'** (in the Atrium)

Monday, 13 December

Session 3A: Stress #2 Chair: Hargurdeep Saini (Rm 1102)	Session 3B: N_2 Fixation and Photosynthesis Chair: Guy Samson (Rm 1103)
9:00 – 9:15 am **3A1** INDUCTION OF TONOPLAST PROTON-PUMPING PYROPHOSPHATASE BY PHOSPHATE DEPRIVATION OF *BRASSICA NAPUS* SUSPENSION CELLS David A. Palma*[,1], E Blumwald[2], & WC. Plaxton[1,3] *Depts Biol[1] & Biochem[3], Queen's U; Dept Botany[2], U Toronto*	**9:00 – 9:15 am** **3B1** CULTIVARS OF SOYBEAN (*GLYCINE MAX*) RESPOND DIFFERENTIALLY TO LIPOCHITOOLIGO-SACCHARIDE NOD*BJ* V($C_{18:1}$, MEFEU) B.Prithiviraj, A. Solumenoev and D.L. Smith *Plant Sci Dept, Campus of McGill University, Ste-Anne-de-Bellevue, Quebec,*
9:15 – 9:30 am **3A2** PHOSPHITE DISRUPTS THE ACCLIMATION OF YEAST TO PHOSPHATE-STARVATION Allison E McDonald,[1*] JO Niere,[2] & WC Plaxton[1,3], *Depts. Biol[1] & Biochem[3], Queen's U.; *Royal Melb Instit Tech*	**9:15 – 9:30 am** **3B2** THE ROLE OF INTERORGANISMAL SIGNALING IN THE INHIBITION OF SOYBEAN NITROGEN FIXATION BY LOW PH AND SALINITY STRESSES. Miransari, M* & D Smith, *Plant Sci,f McGill U. Que*
9:30 – 9:45 am **3A3** INTERACTIONS OF CARBON DIOXIDE AND PHOSHORUS NUTRITION WITH PROTEOID ROOT FORMATION IN WHITE LUPIN (*Lupinus albus*) Catherine Campbell* and Rowan Sage, *Botany, U Toronto*	**9:30 – 9:45 am** **3B3** EVIDENCE FOR STEEP ADENYLATE GRADIENTS IN THE INFECTED CELLS OF LEGUME NODULES. Hui Wei* & David B. Layzell *Dept. of Biology, Queen's University, Kingston, Ont.*
9:45 – 10:00 am **3A4** EXPRESSION PATTERN OF WHEAT ANTHER INVERTASE GENES IN DIFFERENT TISSUES AND THEIR MODULATION BY WATER STRESS. Chantale Nunes*, Joginder Minhas and Hargurdeep Saini. *Inst. de recherche en biologie végétale, U Montréal, Qué*	**9:45 – 10:00 am** **3B4** **IS THE ANTARCTIC ALGA, *CHLAMYDOMONAS SUBCAUDATA* "LOCKED" IN STATE I?** R.M. Morgan*, A.G. Ivanov, N.P.A Huner *Dept Plant Sci, U Western Ont, London, Ont.*
10:00 – 10:15 am **3A5** SALT TOLERANCE CONFERRED BY OVEREXPRESSION OF A VACUOLAR NA+/H+ ANTIPORT IN ARABIDOPSIS. Maris P. Apse*1, Gilad S. Aharon1, Wayne A. Snedden and Eduardo Blumwald. *Department of Botany, University of Toronto.*	**10:00 – 10:15 am** **3B5** INTERACTIONS OF LIGHT, HYDRATION & PHOTOSYSTEM ACTIVITY IN LOBARIA: VARIATIONS IN THREE ECOLOGICALLY SIMILAR LICHENS. Tyler D. B. MacKenzie* and Douglas A. Campbell *Mount Allison U. Sackville, New Brunswick.*
10:15 – 10:30 am **3A6** GENETIC TRANSFORMATION AND EVALUATION OF PERENNIAL RYEGRASS (*Lolium perenne*) WITH AN ADDITIONAL SUPEROXIDE DISMUTASE GENE Alissa Devereaux*, SR Bowley and BD McKersie *Dept Plant Agric., Plant Biotech Div, U Guelph, Ont*	**10:15 – 10:30 am** **3B6** CARBON SUPPLEMENTATION AND LIGHT EFFECTS ON GROWTH AND PHOTOSYNTHESIS OF C_3 AND C_4 PLANTS. S.H. Begna*[1], L.M. Dwyer[2], D. Cloutier[1] & D.L. Smith[1] [1]*Plant Sci Dept, McGill U; [2]Agric & Agri-Food Can, Cent. Exp'tl Farm, Ottawa.*
10:30 – 10:50 am Coffee Break (in Atrium) **Courtesy of Qubit Systems Inc.**	**10:30 – 10:50 am Coffee Break (in Atrium)** **Courtesy of Qubit Systems Inc.**
10:50 – 11:15 am **Awards Ceremony and meeting wrap-up** (in Atrium, Biosciences complex)	
11:15 am **Departure**	

Poster Session

(Sunday, 7 Dec. 1999; 4:45 pm to 6:30 pm in Atrium)

P1. INCREASED NONPHOTOCHEMICAL QUENCHING ACCOMPANIES THE OXIDATIVE BURST AS PART OF THE HYPERSENSITIVE RESPONSE IN *ASPARAGUS SPRENGER* Julie Karner[1*], Kennaway MacGregor[2*], Alan Bown[2], and Doug Bruce [1] *Dept. of Physics, U Guelph [2] Dept. Biol Sci, Brock U*

P2. FEEDBACK REGULATION OF PHOTOSYNTHETIC ELECTRON TRANSPORT IN RESPONSE TO SUGAR ACCUMULATION IN TOMATO LEAVES Olfa Ayari *, Guy Samson, Martine Dorais (Greenhouse Crops Research Centre, AAFC, Harrow, Ontario) and André Gosselin *Horticultural Research Center, Laval U, Quebec, Qc,*

P3. DISTINCT NON-PHOTOCHEMICAL QUENCHING OF THE PHOTOCHEMICAL AND THE THERMAL PHASES OF VARIABLE CHLOROPHYLL-a FLUORESCENCE. Bouchra Yaakoubd[1*],Nicolai Bukhov[2], Yves Desjardins[1], Robert Carpentier[3] & Guy Samson[1 *] *[1]CRH, Université Laval, QC; [2]Timiriasev Institute of Plant Physiology, Russian Academy ofSciences, Moscow, Russia; [3] Groupe de Recherche enÉnergie et Information Biomoléculaires, Université du Québec ˆ Trois-Rivières, CP 500Trois-Rivières*

P4. LINEAR VERSUS PARALLEL PHOTOSYNTHETIC ELECTRON TRANSPORT IN *SYNECHOCOCCUS* SP. PCC 7942. A.G. Ivanov[1*], Y.-I. Park[3], E. Miskiewicz[1], N.P.A. Huner[1*], J.A. Raven[4], G. Öquist[2], *[1]Dept Plant Sci, U W Ont, London, Ont; [2]Dept of Plant Physiol., U of Umeå, Umeå S-901 87, Sweden, [3]Dept Biology, Chungnam National U, Taejon 305764, Korea; [4]Dept of Biol Sci, U Dundee, Dundee, Scotland*

P5. LIGHT-ACTIVATED CO_2 EFFLUX IN THE MARINE ALGA *NANNOCHLOROPSIS* Huertas, I.E.[*1], Brian Colman[1] & G.S. Espie[2] *[1]Dept Biology, York U, Toronto.; [2]Dept of Botany, U Toronto at Mississauga, Ont.*

P6. ACTIN MICROFILAMENTS AND MICROTUBULES REORGANIZE DURING PEA ROOT NODULE CELL DEVELOPMENT. A.L. Davidson* and W. Newcomb. *Dept. of Biology, Queen's University, Kingston ON.*

P7. IN VITRO TARGETING OF THE TOC36 COMPONENT OF THE CHLOROPLAST ENVELOPE PROTEIN IMPORT APPARATUS INVOLVES A COMPLEX SET OF INFORMATION Kenton Ko, Zdenka W. Ko. *Dept Biology, Queen's Univ, Kingston, Ont*

P8. TO WHAT EXTENT CAN Cd-TOXICITY BE CONFOUNDED BY P-DEFICIENCY? M.N. Sweeney* and S.M. Macfie. *Dept. of Plant Sciences, UWO, London, ON, N6A 5B7.*

P9. LOW TEMPERATURE EFFECT ON 32P ABSORPTION AND TRANSLOCATION TO HOST PLANTS BY GLOMUS INTRARADICES, AN ARBUSCULAR MYCORRHIZAL FUNGUS Wang B., Funakoshi DM, *Hamel C. *Nat. Res. Sciences Dept, McGill U, Ste- Anne-de-Bellevue (Qc)*

P10. THE RESPIRATION OF TRANSGENIC TOBACCO CELLS LACKING ALTERNATIVE OXIDASE CAN STILL SUPPORT HIGH RATES OF PHOSPHATE UPTAKE Justine Y.H. Yip and Greg C. Vanlerberghe. *Div. Life Science and Dept Botany, U Toronto at Scarborough, Scarborough, ON* Presenter- Sandi Ordog,

P11. DOES ALTERNATIVE OXIDASE PLAY A ROLE IN PLANT RESISTANCE RESPONSES TO PATHOGENS? Sandi H. Ordog*and Greg C. Vanlerberghe. *Div Life Sci and Dept Botany, U of Toronto Scarborough, Scarborough, ON*

2. GABA SYNTHESIS ACCOMPANIES THE OXIDATIVE BURST David Janzen* and Alan Bown *Biological Sciences Dept., Brock University, St. Catharines, Ontario*

P13. CHARACTERIZATION OF AN ACCELERATED SENESCENCE MUTANT IN ARABIDOPSIS THALIANA Andrea A. Gilpin* and John R. Coleman, *Department of Botany, Univ. of Toronto, M5S 3B2.*

P14. ISOLATION OF A SENESCENCE- AND RIPENING- INDUCED DEOXYHYPUSINE SYNTHASE GENE FROM TOMATO Tzann-Wei Wang*, Lily Dongen Lu, and John E. Thompson *Department of Biology, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1*

P15. OIL BODY-LIKE PARTICLES FROM WAX BEAN SEEDS DO NOT CONTAIN OLEOSIN. Carol Froese. Linda Nowack*, Ewa Cholewa, and John E. Thompson *Dept Biol, U Waterloo, Waterloo, Ont,*

P16. ANTISENSE SUPPRESSION OF AN *ARABIDOPSIS* LIPASE-LIKE GENE DELAYS DETACHMENT-INDUCED SENESCENCE OF LEAVES C. Taylor*, M. K.Y. Lo*, J.E. Thompson, *Department of Biology, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1*

P17. INDUCTION OF INORGANIC CARBON TRANSPORT AND EXTERNAL CARBONIC ANHYDRASE ARE NOT CORRELATED IN *CHLAMYDOMONAS* Bozzo, G*. & Brian Colman. *Dept Biol, York U, Toronto, ON*

P18. CARBONIC ANHYDRASE IN THREE MARINE MICROALGAE Bhatti, Shabana*, Eva Szabo & Brian Colman. *Department of Biology, York University, Toronto , Ont.*

P19. PURIFICATION AND CHARACTERIZATION OF PYRUVATE KINASE FROM THE CYANOBACTERIA, *SYNECHOCOCCUS LEOPOLIENSIS* V.L Knowles*, C.S. Smith, C.R. Smith & W.C. Plaxton, *Dept. of Biology, Queen's University*

P20. FEEDBACK REGULATION OF CYTOSOLIC PYRUVATE KINASE AND PHOSPHOENOL-PYRUVATE CARBOXYLASE BY ASPARTATE AND GLUTAMATE INTEGRATES C- & N-METABOLISM IN *BRASSICA NAPUS* SUSPENSION CELLS C.R. Smith*[,1], T. Moraes[1], & W.C. Plaxton[1,2], *Depts. of Biochemistry[1] & Biology[2], Queen's Univ.*

P21. MOLECULAR AND PROTEIN CHARACTERIZATION OF PLASTIDIC GLUCOSE-6-PHOSPHATE DEHYDROGENASE (G6PDH) IN CASTOR (*RICINUS COMMUNIS* L.). David T. Dennis and Ka-Yu Law* *Dept Biology, Queen's University, Kingston, Ont.*

P22. THE ACTIVE SITE OF PYROPHOSPHATE-DEPENDENT PHOSPHOFRUCTOKINASE BASED ON MOLECULAR MODELING Lehli M. Pour[1*], Zongchao Jia[2], David T. Dennis[3] *Departments of Biology[1,3] and Biochemistry[2], Queens University, Kingston, ON K7L 3N6*

P23. AN UNREGULATED GLYCOLYTIC ENZYME (PFP) RESULTS IN CHANGES IN SEED STORAGE LIPIDS IN *NICOTIANA TABACUM* (L.). Susan Wood* Steven King, Maryse Chalifoux, Monika Kuzma, David Dennis[2] William Newcomb, *Biology Dept., Queen's University; [2]Performance Plants Inc., Kingston;*

P24. MAINTAINING THE TRANSMETHYLATION CYCLE: THE INVOLVEMENT OF ADENOSINE KINASE. Barbara M. Moffatt[a], Martina Drebenstedt[b*], Kristin Alexander[a] Jamie Snider[a], Peter Summers[b] and Elizabeth A. Weretilnyk[b]. *[a]Biology Department, University of Waterloo. Waterloo, ON N2L 3G1 [b]Department of Biology, McMaster University, Hamilton ON L8S 4K1.*

P25. PURIFICATION AND PROPERTIES OF *S*-ADENOSYL-L-METHIONINE: PHOSPHOMONO-ETHANOLAMINE *N*-METHYLTRANSFERASE Thomas Burian*, Elizabeth Weretilnyk and Peter Summers, *Department of Biology, McMaster University, Hamilton, ON, L8S 4K1.*

P26. IDENTIFICATION AND PARTIAL CHARACTERIZATION OF LIPASE CLONES FROM *PHASEOLUS VULGARIS* LEAVES Matthew D. Smith*, A Padham*, and JE Thompson *Dept Biology, University of Waterloo, Waterloo, Ontario*

P27. MOLECULAR CLONING OF A GROUP OF THIOL METHYLTRANSFERASES, POTENTIALLY INVOLVED IN DETOXIFICATION IN RED CABBAGE Jihad Attieh[1*], Rose Djana[1], Salvatore A. Sparace[2] & Hargurdeep S. Saini[1], *[1]IRBV, Université de Montréal, Montréal. [2]Plant Science Department, McGill University, Ste-Anne-de-bellevue.*

P28. HUNTING FOR AN AGL24 MUTANTOF ARABIDOPSIS THALIANA Hayden, D.S. and Kolhami, S. E.* *Dept. Plant Sci, U Western Ont, London, Ont, N6A 5B7*

P29. PHOTOSYNTHETIC ACCLIMATION PROCESSES IN THE CYANOBACTERIA OF BEAVERSKIN LAKE, NOVA SCOTIA D. Campbell*, M. DiQuinzio, J. Ackman, S. Roy+, S. Purcell-MacDonal, P. Morton, T. Clair#. *Dept Biol, Mount Allison U, Sackville, NB +U Québec à Rimouski; #Environment Canada, Atlantic Division, Sackville, NB*

P30. (Abstract only) PURIFICATION AND CHARACTERIZATION OF A TRANSALDOLASE FROM LEUCOPLASTS OF DEVELOPING CASTOR BEAN ENDOSPERM Fayek B. Negm, David H. Turpin, and David T. Dennis *Dept Biology, Queens U, Kingston, ON*

Saturday, 11 December

7:00 – 9:00 pm Registration and Mixer in Hospitality Suite (Room 216), Howard Johnson Confederation place Hotel, 237 Ontario St., Kingston

Sunday, 12 December

8:30 – 9:30 am Registration, Coffee and Poster Setup (Atrium, Biosciences Complex)

9:30 – 9:45 am **Welcome and Opening Remarks** (Wm Plaxton and David Layzell)

Symposium: Plant Science for a Sustainable Future

Room 1103 (Chair: W. Plaxton)

9:45 – 10:30 am S1

PHYSIOLOGICAL AND ENVIRONMENTAL CONTROLS ON CARBON SEQUESTRATION IN PLANTS & SOILS

Larry B. Flanagan*, P.J. Carlson, L.A. Wever, P. Rochette, E.G. Gregorich *Biol Sci, U Lethbridge; & AAFC*

Recently a number of independent techniques (atmospheric inversions, eddy covariance, forest inventory data, modelling studies) have all indicated that the terrestrial biosphere is a significant sink for carbon dioxide released to the atmosphere by human activities. A major research challenge is to more accurately define the mechanisms and location of terrestrial sinks for atmospheric carbon dioxide, and how these sinks will respond to changes in climate, land use and management practices. Two case studies will be used to illustrate measurement approaches to these problems. The first case study involves ecosystem carbon dioxide exchange measurements made using the eddy covariance technique. Data will be presented to describe how carbon exchange and carbon storage in Canadian grassland and boreal forest ecosystems is currently affected by variation in climate on seasonal and annual time scales. A second case study involves a combination of gas exchange and stable isotope analyses to separate total soil respiration into its major components (plant root, soil and decomposing litter). Distinguishing these components of soil respiration may be a more sensitive way to resolve treatment effects than measurements of change in the total soil carbon pool. These case studies provide insights into the processes that control variation in carbon sequestration observed at the whole ecosystem level.

10:30 – 11:15 am S2

LIVING IN A HIGH CO_2 WORLD: BIOASSIMILATION STRATEGIES FOR FUN AND PROFIT

Judith Jebanathirajah, Ming-De Deng, and John Coleman* *Department of Botany, University of Toronto*

As atmospheric levels of CO_2 continue to increase, characterization of the response of photosynthetic organisms to this environmental change has become a priority for many research programs. In addition, the hypothesis that management of atmospheric CO_2 loading can be achieved through enhanced biomass generation has also been put forward. To address the response issue, we have developed a genetic approach to screen for mutants of Arabidopsis which display an aberrant phenotype when grown at elevated levels of CO_2. In this talk we will present data on the isolation and preliminary characterization of mutants which are insensitive to CO_2 concentrations which would normally induce stress responses in wild type plants. The idea that elevated levels of CO_2 are an exploitable resource is considered in the latter section of the talk. Data will be presented that describe the use of genetically modified cyanobacteria that have been engineered to divert fixed carbon into the biosynthesis of ethanol. The ability to couple photosynthetic CO_2 assimilation with the production of a biofuel has the potential to be used as a CO_2 remediation process as well as a renewable energy source.

11:15 – 11:30 am **Coffee Break** – Courtesy of Qubit Systems Inc.

11:30 – 12:15 pm S3

DECONSTRUCTING THE LIGNIN PATHWAY

Brian Ellis* *Biotechnology Lab / Agricultural Sciences, University of BC, Vancouver, BC*

Lignin is both a major biosphere carbon sink and a product of huge commercial significance. For these reasons, there is considerable interest in genetic engineering changes in the output of the lignin biosynthetic pathway. The basic pattern of reactions involved was established more than 20 years ago, but with the development of modified-lignin transgenics, it has become evident that the classical model for lignin's origins is far from accurate. Novel enzymes, unexpected substrate preferences and apparent role specialization have all been revealed through these experiments. On a larger scale, manipulation of lignin deposition in trees has been linked to reciprocal changes in cellulose metabolism. These outcomes demonstrate the ability of transgenic technology to illuminate complex biological processes, and also confirm the potential that exists for creation of tree and crop genotypes with more desirable wood and fibre properties.

12:15 – 1:00 pm **Lunch in Atrium**

Session 1A: Metabolism

(Rm 1102) Chair: Peter Summers

1:00 – 1:15 pm 1A1

KINETIC PROFILES AND 3D MODELING OF ADENINE PHOSPHORIBOSYL-TRANSFERASE ISOFORMS FOUND IN *ARABIDOPSIS THALIANA*.

Michael Allen*, Wensheng Qin and Barbara Moffatt.
Dept. Biology, Univ. Waterloo.

Organisms can maintain their adenine levels by *de novo* synthesis or salvage metabolism. Free adenine can be salvaged to AMP through two separate pathways: a one-step pathway involving adenine phosphoribosyltransferase (APT) or a two-step pathway involving nucleoside phosphorylase and adenosine kinase. Within plants, APT is a constitutively expressed enzyme, which has two functions: the interconversion of cytokinin bases to nucleotides, as well as the aforementioned salvage of adenine. Most organisms have a single form of APT, in *Arabidopsis thaliana*, however, four separate isoforms of APT have been found. We have cloned, overexpressed and compared the kinetic abilities of three of these isoforms. At a cytosolic pH (7.4) the k_{cat} of APT1 towards adenine is approximately 6300-fold greater than that of either APT2 or APT3. With respect to the three cytokinin substrates tested (benzyladenine, isopentenyladenine, and zeatin) APT1, 2, and 3 are quite similar in their metabolism, however, each shows individual substrate preferences. Each isoform has been modeled against the crystal structure of APT from *Leishmania donovani*, and structural differences in substrate specificity-determining domains have been found. We conclude that each APT isoform likely has a distinct catalytic activity towards adenine and cytokinins and may thus occupy a specific niche in plant metabolism.

1:15 – 1:30 pm 1A2

ADENOSINE KINASE IS INVOLVED IN MAINTAINING TRANSMETHYLATION ACTIVITIES IN PLANTS.

J Snider*, L Wang, Y Stevens, M Allen, L Pereira, K Alexander, L McCaffrey & B Moffatt *Department of Biology, University of Waterloo, ON, N2L 3G1*

We are studying the involvement of adenosine kinase (ADK) in plant metabolism and growth as part of a long-term investigation of adenine salvage activities in plants. ADK recycles adenosine to adenylate nucleotides and thus its activity lowers the cellular levels of adenosine and helps to maintain the energy charge of plant cells. We have found two very similar genes encoding ADK activity in the Arabidopsis genome and designated these *ADK1* and *ADK2*. Both genes are transcribed constitutively with the highest steady-state levels in roots and flowers. In vitro kinetic studies indicate the enzymes are active on adenosine and also utilize certain ribosides as substrates at lower efficiency. We have isolated mutants deficient in ADK activity by cosuppression and these mutants have distinctive developmental

Session 1B: Development & Whole Plant Physiology

(Rm 1103) Chair: S. Kohalmi

1:00 – 1:15 pm 1B1

THE FREQUENCY AND FUNCTION OF PLASMODESMATA IN ONION ROOTS

Fengshan Ma* and Carol A. Peterson
Dept Biology, U Waterloo, Waterloo, Ontario N2L 3E5

A complete assessment was performed for the distribution of plasmodesmatal in an old zone of onion roots (100 mm from the tip) where the exodermis is mature. Along the inward path, the frequencies (plasmodesmata number per μm^2 wall surface) at the interfaces of epidermis-short cells-central cortex-central cortex-endodermis-pericycle-stelar parenchyma were 0.21, 1.03, 1.59, 0.58, 0.70 and 0.12, respectively. This measure was converted into the numbers plasmodesmatal per mm root length, i.e. 8.96×10^4, 4.05×10^5, (?, unavailable, but postulated high), 5.13×10^5, 5.64×10^5 and 1.25×10^4, respectively, at a ratio of 7 : 32 : (?) : 41 : 45 : 1. This secondary measure was more meaningful for understanding ion transfer. The results implied that a constant symplastic transport was most likely from the exodermis up to the pericycle, less efficient from the epidermis to the exodermis, and even less efficient from the pericycle to the stelar parenchyma. Therefore, *i*) some transmembrane transport of ions was anticipated across the epidermis-exodermis (short cells) interface, and *ii*) the pericycle could directly, and not by way of the stelar parenchyma, load the xylem vessels. Inside and at the immediate periphery of the phloem, the metaphloem sieve element-companion cell interface had a much higher plasmodesmatal frequency than the rest of interfaces (which exhibited comparable frequencies). This observation was suggestive of a high and low symplastic transport at these two sets of interfaces, respectively. The high plasmodesmatal frequency on the pericylic radial walls lent support to the "annular collector-disperser" model, highlighting the possible role of the pericyle in facilitating inward and outward solute movement. Ultrastructural results indicated that the plasmodesmata in all cells were operational in transferring Cl^-, as demonstrated by precipitation with Ag^+.

1:15 – 1:30 pm 1B2

PATHWAYS OF ION UPTAKE IN WOODY ROOTS AS DEDUCED BY ANATOMICAL STUDIES OF Pinus banksiana (Lamb.).

Jeff H. Taylor* and Carol A. Peterson, *Department of Biology, University of Waterloo*

Woody roots are complex organs, with striking changes in their anatomy along their lengths. In the present study, we performed various anatomical studies on *Pinus banksiana* seedlings with the aim of determining the regions in which ion uptake occurs in the root system. First, we established the presence of four distinct root zones (white, ectomycorrhizal white, condensed tannin, and cork) in field-grown seedlings. For each root zone, the fraction of the average total root length it occupied, and the plasmalemmae surface that was available for ion uptake was determined. Second, we determined the surface permeability to ions of two root zones where the issue was contentious, i.e. the cork and mycorrhizal zones. The mycorrhizal mantle was proved to be impermeable to sulphate ions, while the cork zone was

phenotypes, the severity of which varies directly with the extent of ADK reduction. Our results indicate that in plants ADK plays a key role in lowering the level of adenosine that would otherwise inhibit most methylation activities. Analyses of methylation of pectin and DNA are underway as well as in situ hybridization studies of ADK transcript levels. Results of these experiments along with our model of how ADK activity affects methylation levels will be presented.

1:30 – 1:45 pm 1A3

ALTERNATIVE SPLICING OF A NOVEL DIACYLGLYCEROL KINASE IN TOMATO LEADS TO A CALMODULIN-BINDING ISOFORM.

Wayne A. Snedden*and Eduardo Blumwald
Dept Botany, University of Toronto, M5S3B2

Calmodulin is a regulatory protein activated during Ca2+ signaling in plant and animal cells. Using 35S-calmodulin to screen a tomato cDNA expression library for novel calmodulin targets we isolated a cDNA, designated LeCBDGK (Lycopersicon esculentum calmodulin-binding diacylglycerol kinase) with sequence similarity to diacylglycerol kinases from animals. Diacylglycerol kinases (DGKs) convert diacylglycerol to phosphatidic acid and are thought to play a signaling role in plant and animal cells. We delineated the calmodulin-binding domain to >>25 amino acids near the C-terminus of LeCBDGK. A second DGK cDNA was isolated, designated LeDGK1, and was shown to be identical to LeCBDGK, except that it lacks the calmodulin-binding domain. The same gene encodes both proteins, thus, alternative transcript splicing leads to calmodulin-binding and non-binding forms of DGKs in tomato. The recombinant enzymes were catalytically active in vitro. Anti-DGK antiserum was used to localize the two DGK forms subcellularly. Native CBDGK bound to calmodulin-agarose in the presence of Ca2+ and also co-immunoprecipitated with calmodulin from tomato cell lysates suggesting their interaction in vivo. In addition, calmodulin stimulated native LeCBDGK activity in vitro. Possible roles of DGKs in phospholipid signaling will be discussed.

1:45 – 2:00 pm 1A4

PURIFICATION AND CHARACTERIZATION OF BANANA FRUIT PYRUVATE KINASE

Will L. Turner*,[1] & W.C. Plaxton[1,2], *Depts. of Biology[1] & Biochemistry[2], Queen's University.*

Plant pyruvate kinase (PK) is a key glycolytic enzyme that exists as cytosolic (PK_c) and plastid (PK_p) isozymes that differ markedly in their respective physical, immunological and kinetic characteristics. Associated with the burst of CO_2 release at the onset of banana ripening (the 'respiratory climacteric') are marked decreases and increases in [PEP] & [pyruvate], respectively. Thus, activation of PK &/or PEP carboxylase (PEPC) is the initial response of glycolysis at the climacteric. As a first step to formulating a model for the regulation of the PEP branchpoint in climacteric fruit, we previously reported several novel physical and kinetic/regulatory properties for homogeneous banana PEPC (Law & Plaxton 1995 Biochem J 387, 807-816; 1997 Eur J Biochem 247: 642-651) . The aim of the present study was to purify and characterize the physical and kinetic/regulatory features of banana PK_c. The enzyme was purified 335-fold to a final Sp. Act. of 50.2 umol of pyruvate produced/min/mg protein and an overall recovery of 6%. Purification involved batch separation on DE-52, then Butyl-Sepharose, DEAE-Fractogel, ADP affinity, and Mono-Q chromatographies. Batch fractionation on DE-52 was necessary to quickly remove pectins that otherwise caused gelation of the crude sparingly permeable. Third, we assessed the vitality of the extramatrical hyphae and the permeability of their walls, and found that while the majority of the hyphae were alive, a large fraction was encased in walls impermeable to fluorescein. When the data was combined, a large fraction of the root system was found to be very poorly suited for ion acquisition, and it appears that the majority of ion uptake would be by means of the extramatrical hyphae, despite the impermeability of much of their length.

1:30 – 1:45 pm 1B3

PROTEIN MODULES IN PLANTS: CHARACTERIZATION OF ATSH3P1, A NOVEL ARABIDOPSIS GENE ENCODING A PROTEIN WITH A SH3 PROTEIN INTERACTION DOMAIN.

Lam, C-H Bernard*, and Blumwald, Eduardo. *Dept. of Botany, UToronto, Toronto, Ontario, M5S 3B2.*

An important aspect of signal transduction, and other cellular processes in general, is the physical interaction between proteins involved. Similar to animal signal transduction processes, there is increasing evidence in plant research that protein-protein interactions involve conserved and specialized domains. The main question being addressed in my research is: How do plant proteins interact? AtSH3P1 (Arabidopsis Thaliana SH3-containing Protein 1), a novel Arabidopsis gene was cloned and used to investigate whether the predicted N-terminal coiled-coil domain and C-terminal SH3 domain are involved in protein-protein interactions. Although the amino acid sequence of AtSH3P1 shows no significant homology to any known proteins, its domain arrangement is identical to human and yeast proteins that are involved in endocytosis or intracellular protein trafficking. In fact, subcellular localization studies indicated that AtSH3P1 associates with plasma membrane and golgi. Furthermore, protein expression studies showed high AtSH3P1 abundance in flowers, suggesting that its expression could be under developmental control. We are now determining the cellular function of AtSH3P1 by identifying the interacting partners of its SH3 domain using the yeast two-hybrid system. Also, yeast complementation studies are performed to see if AtSH3P1 could rescue the phenotypes associated with a yeast endocytosis mutant.

1:45 – 2:00 pm 1B4

SESQUITERPENE LACTONES IN *TANACETUM PARTHENIUM* VARY ACCORDING TO DEVELOPMENTAL STAGE AND ARE INFLUENCED BY ENVIRONMENTAL FACTORS.

K. Usher*, P.A. Bowen, G.H.N. Towers
Botany Dept., University of BC, Vancouver

Tanacetum parthenium (feverfew) is a common herbaceous plant in the Asteraceae and has been proven effective for the relief of migraine headache. Specific sesquiterpene lactones (SL) are considered to be the main pharmacological constituents for migraine prophylaxis. These 15 carbon compounds are found primarily in glandular trichomes present on leaf, stem, and flower epidermis. The most abundant sesquiterpene lactone, parthenolide, is pharmacologically active. More than 25 other SLs occur in this species. The SL content of feverfew changes quantitatively and qualitatively throughout development of the plant and can be altered by exposure to different growing conditions. The effects of environmental change and stage of development show high variability in SL content. The effect of harvesting and regeneration on SL content has also been studied. This research has resulted in a model system which can be used to study SL biosynthesis.

extract. A major protein staining band of 57 kDa that cross-reacted with anti-(*Brassica napus* PK_c) IgG was observed following SDS-PAGE of the final preparation. We are currently optimizing banana PK_c purification and examining the physical, immunological, and kinetic/regulatory properties of the homogeneous enzyme. Together with earlier data obtained with banana PEPC, this will allow a model to be developed for the *in vivo* control of PEP utilization in climacteric fruit.(Supported by NSERC).

2:00 – 2:15 pm 1A5

THE PHYSIOLOGICAL AND METABOLIC EFFECTS OF THE SLICING/AGING RESPONSE IN POTATO TUBERS

Tara Jowett*, Stephen Hunt, & William C. Plaxton,
Dept. of Biology, Queen's Univ.

The well documented increase in CO_2 evolution following wounding of potato tubers occurs in two phases. "Burst" respiration involves a rapid, transient, and previously uninvestigated increase in CO_2 evolution that peaks about 20 min after slicing. "Induced" respiration involves the subsequent slow, steady increase in CO_2 evolution over the next 24 to 48 h. Despite extensive research, metabolic control points leading to both burst and induced respiration have remained elusive. Potato tuber PPi-dependent phosphofructokinase (PFP), a heterooctamer consisting of distinct alpha (66 kDa) and beta (60 kDa) subunits, is an adaptive cytosolic enzyme catalyzing the reversible interconversion of Fru6P & PPi to Fru16P2 & Pi. PFP is allosterically activated by Fru26P2, a key cytosolic regulatory metabolite. A possible relationship between PFP and the wound-induced tuber respiration was investigated by monitoring the activity of PFP over a 72 h time course. Both burst (53.4 umol/min/gFW; t = 20 min) and induced (36.5 umol/min/g, t = 24 h) CO_2 evolution significantly exceeded dormant levels (1.7 umol/min/g, t = 0 h). Maximal extractable PFP activity increased from 0.39 units/gFW in dormant (O h) tissue to 0.69 units/gFW in 48 h aged tuber slices. Activation of PFP by 4 uM Fru2,6P2 also increased from about 4-fold at 0 h to 7-fold at 48 h. Immunoblots of extracts from dormant (0 h) and aged (48 h) potato tuber slices were probed with anti-(potato tuber PFP) immune serum and revealed that aging induces a marked increase in the ratio of immunoreactive alpha:beta subunits of PFP. Our results suggest that the large increase in respiration rate that occurs during aging of potato tuber slices may partially arise via increased expression of PFP's alpha (regulatory) subunit leading to elevated sensitivity of the enzyme to its allosteric activator, Fru2,6P2. (Supported by NSERC)

2:00 – 2:15 pm 1B5

A NON-INVASIVE MEASURE OF THE DYNAMICS AND SITE OF NITRATE REDUCTION IN SOYBEAN PLANTS

Yanping Cen*& David B. Layzell,
Dept. Biol., Queen's Univ, Kingston, Ont K7L 3N6

In soybeans, nitrate reduction is known to occur in roots and shoots, but the relative importance of each has been both the subject of controversy and a measurement challenge. A gas analysis method was developed to determine the site of NO_3^- reduction and quantify changes with light and dark. The difference between CO_2 (CER) and O_2 (OER) exchange of intact roots, leaves and stems + petioles was used to calculate the diverted reductant utilization rate (DRUR = 4*(CER+OER), units of moles e^- min^{-1})) in the presence and absence of NO_3^-. In the absence of N, DRUR of roots declined steadily compared to +N controls in both the light and the dark periods. After 24 to 48 hr of N removal, a large decline was also measured in leaf DRUR in the light (but not in the dark) and in stem + petiole DRUR (measured only in dark). Resupply of NO_3^- resulted in an increase in DRUR in all tissues. The difference in DRUR of plant tissues + and - N was combined with plant growth data to calculate the rate of NO_3^- reduction in various parts of the plant during the light and dark periods. Roots accounted for 40% of whole plant NO_3^- assimilation in the light period, and 72% in the dark period. In contrast, leaves accounted for 52% and 9% in the light and dark periods, respectively, and stems and petioles made up the difference. This gas analysis measure of NO_3^- assimilation agreed with the N increment (+N plants) over the experimental period, supporting the validity of this assay method and the potential to use it to study the environmental and physiological factors affecting NO_3^- assimilation.

2:15 – 2:30 pm 1A6

THE EFFECTS OF TEMPERATURE AND LIGHT ON PHOTOINHIBITION AND SUCROSE PHOSPHATE SYNTHASE (SPS) IN WINTER AND SPRING WHEAT.

T. Pocock*, V.M. Hurry, L. Savitch and N.P.A. Huner,
Dept Plant Sci., U Western Ontario, London

Cold-acclimation occurs in winter cereals grown at low temperatures. Five arbitrarily chosen winter and spring wheat cultivars of unknown freezing tolerance were grown at 20°C and 250 µmol photons $m^{-2}s^{-1}$ (20/250), 20/800, 5/250 and 5/50. Susceptibility to low temperature photoinhibition (Fv/Fm), relative amounts of SPS and freezing tolerance (LT_{50}) were determined. Winter wheat cultivars grown under cold-acclimation or high light conditions were less susceptible to low temperature photoinhibition than spring wheat cultivars despite the variation between cultivars. Previous studies have demonstrated that the decreased susceptibility to photoinhibition in winter wheat is attributed to the increased ability to keep Q_A oxidized through an increased capacity for assimilation resulting from the up-regulation of some of

2:15 – 2:30 pm 1B6

WHOLE PLANT GAS-EXCHANGE: ENVIRONMENTAL RESPONSES AND REGULATION.

LV Savitch[1]*, ED Leonardos[2], B Grodzinski[2], G Oquist[3], NPA Huner[1]
[1]U Western Ont, Dept. Plant Sci, London, ON, [2] U Guelph, Dept. of Plant Agric, Guelph, ON , [3] U Umea, Dept. Plant Physiology, Umea, Sweden

Whole plant gas-exchange with respect to carbon partitioning has been studied on winter wheat (Monopol) plants grown at 20°C/250 PFD, 5°C/250 PFD or 20-5°C/250 PFD. Our results indicate that decreased CO_2 assimilation rates in cold-stressed plants was associated with decreased starch biosynthesis, and as a result, limited Triose-P utilization. During cold acclimation an adjustment of CO_2 assimilation rates was associated with an increased capacity for Triose-P utilization in sucrose and fructan biosynthesis in leaves and fructan biosynthesis in crowns. We show that cold stressed plants had similar the whole plant CO_2 gas-exchange rates to 20°C grown controls at growth irradiance, but not at the light-

the key regulatory enzymes. Relative to the controls, apparent SPS amounts were greater in all winter and spring wheat cultivars grown under cold-acclimation as well as high light conditions. Maximum freezing tolerance was only achieved in winter wheat cultivars grown under the cold-acclimation conditions of 5/250. Therefore, this study indicates that increased SPS amounts were not correlated to increased freezing tolerance. Second, susceptibility to photoinhibition and increased apparent amounts of SPS were the result of growth under high PSII excitation pressure rather than cold-acclimation conditions alone.

CO_2-saturated conditions. Our results indicate that plant gas-exchange of control and cold acclimated plants was similar when measured at growth temperature and either growth or saturated light irradiance. However, cold acclimated plants showed higher capacity to maintain the light- CO_2- saturated rates of CO_2 assimilation during the day than controls. This increased capacity for CO_2 assimilation in cold acclimated plants became negligible as a result of continuous (48 to 72h) illumination. The results are discussed with respect to the regulatory mechanisms of whole plant CO_2 gas-exchange, export capacity and sink-source relationship.

2:30 – 2:45 pm **Coffee Break**
Courtesy of Qubit Systems Inc.

2:30 – 2:45 pm **Coffee Break**
Courtesy of Qubit Systems Inc.

Session 2A: Stress #1

(Rm 1102) Chair: Wayne Snedden

Session 2B: Plant-Environment Interactions

(Rm 1103) Chair: Sheila Macfie

2:45 – 3:00 pm 2A1

THE POTATO NUCLEAR FACTOR PBF-2 REPRESENTS A NOVEL SINGLE-STRANDED DNA BINDING FACTOR IMPLICATED IN *PR-10A* GENE ACTIVATION

Darrell Desveaux*, C. Després, A. Joyeux, R Subramaniam & N. Brisson.

Dept. Biochemistry, U Montreal, Montreal, Que.

The pathogenesis-related (PR) genes present in both dicots and monocots, are among the best characterized genes induced by pathogens. Elicitor-induced activation of the potato pathogenesis-related gene *PR-10a* requires a 30 bp promoter sequence termed the elicitor response element (ERE). Previous studies have shown that binding of the nuclear factor PBF-2 to the ERE and activation of *PR-10a* are positively regulated by phosphorylation and involve a functional homologue of mammalian protein kinase C. In this study, PBF-2 has been purified to near homogeneity from elicited tubers using a combination of anion-exchange and DNA-affinity chromatography. Evidence provided demonstrates that PBF-2 is stored inactive in the nuclei of fresh tubers and becomes available for binding to the ERE upon elicitation. UV cross-linking indicates that PBF-2 is composed of a protein with an apparent molecular weight of 24 kD (p24) which interacts with the ERE. Antibodies against p24 are capable of interefering with PBF-2 binding to the ERE further supporting the DNA-binding role of p24. Binding studies demonstrate that PBF-2 binds specifically with high affinity to single-stranded coding (CS) and non-coding (NCS) strands of the ERE. The core PBF-2 binding site is shown to consist of an inverted repeated sequence 5'-TGACAnnnnTGTCA-3' which is also required for *PR-10a* expression in vivo, supporting the role of PBF-2 as a transcriptional regulator.

2:45 – 3:00 pm 2B1

WHY DO LEGUME NODULES EVOLVE H_2 GAS?

Zhongmin Dong[1], Lishu Wu[2] & David Layzell[3]*[1] *Biology, St. Mary's U, Halifax, NS; [2]Huazhong U, Wuhan, Hubei, PR China; [3]Biology, Queen's U, Kingston, Ont.*

H_2 gas is a major byproduct of N_2 fixation, consuming from 25% to 50% of the reducing power and ATP flowing through the nitrogenase enzyme. Most free-living diazotrophs and some symbiotic N_2 fixers have an uptake hydrogenase enzyme (HUP) that rapidly oxidizes the H_2, thereby recovering the reducing power. However, the nodules of most agricultural legumes lack HUP and the H_2 (equivalent to ~5% of net photosynthesis) diffuses into the soil. In studying why this occurs, we have shown that the H_2 is oxidized within a few cm of nodules where it alters soil microbiology and structure. In H_2 treated soils, 74% of the reducing power flows to O_2 and 10% to CO_2 (resulting in net chemoautotrophic CO_2 fixation). When soils were given an 8 week pretreatment with H_2 at an exposure rate similar to that adjacent to nodules, the soil stimulated the growth (after 4-5 weeks) of soybean, barley, canola and spring wheat by 10-30% relative to a control (air) treatment. The significance of these findings will be discussed, including the possibility that soil H_2 fertilization may account for much of the beneficial effects of legumes in crop rotation.

3:00 – 3:15 pm 2A2

CLONING OF A NOVEL, EVOLUTIONARY-CONSERVED, ssDNA-BINDING PROTEIN INVOLVED IN THE PLANT DEFENSE RESPONSE

Alexandre Joyeux*, C Després, D Desveaux, & N Brisson

Dept. Biochemistry, U Montreal, Montreal, Que.

Plant pathogen recognition induces a series of signal transduction cascades that lead to numerous responses, including the activation of pathogenesis-related (PR) genes. The potato *PR10a* gene is transcriptionally activated upon

3:00 – 3:15 pm 2B2

BIOFILTRATION I: THE SORPTION OF INDOOR POLLUTANTS BY HIGHER PLANTS.

Jeffrey Mallany*, Alan Darlington and Michael Dixon,

Hort Sci, Dept Plant Agric, U Guelph, Ont.

An investigation into the role of the foliage of plants in removing volatile organic compounds from indoor air was conducted in The Canada Life Environmental Room, a biofilter composed of a complex ecosystem of plants and microbes. It has been well documented that this system is able to remove volatile organic compounds (VOCs) from the

infection by *Phytophthora infestans* and elicitation with arachidonic acid. This activation correlates with the induced binding of PBF, a single-stranded DNA-binding factor, to a 30 bp elicitation-response element (ERE) in the promoter of *PR10a*. We report on the cloning of *p30*, a gene coding for a 30 kD DNA-binding protein component of the larger PBF complex, using a cDNA pooling approach. p30 represents a novel type of DNA-binding protein that is ubiquitous in the plant kingdom. Purification of PBF from elicited and fresh tubers as shown that this factor is stored inactive in the nuclei of fresh potato tubers, and is activated upon elicitation. This suggests that activation of *PR10a* by PBF does not require *de novo* protein synthesis. Consistent with this hypothesis, preliminary results show that *p30* mRNA production is not significantly induced after treatment with arachidonic acid. The parsley *PR10* gene is also regulated via an ERE-like sequence, bound by proteins of the WRKY family. However, transcription of the *WRKY* genes, in contrast to *p30*, is sharply induced following elicitation. It thus appears that p30 participates in the primary activation of *PR10*. Sustained activation may require WRKY proteins, though this has not yet been shown for the potato *PR10a* gene.

air stream. Some authors have suggested that the higher plants in the system may play a significant role in the removal of VOCs through sorptive processes on the leaf surface. It was found that although VOCs were being removed by the associated biofilter during the course of the experiment, only small levels of VOCs could be recovered from the leaf material itself. In most cases the concentration of VOC in the leaf material did not change with the concentration in the room. It is concluded that the foliage of plants represents a negligible sink for VOC in the indoor environment.

3:15 – 3:30 pm 2A3

AN EVALUATION OF THE F1 PROGENY OF TRANSGENIC ALFALFA GENOTYPES TRANSFORMED WITH GENES RELATED TO ABIOTIC STRESS TOLERANCE.

Karen Samis*, SR Bowley and BD McKersie
Plant Biotech Div., Dept Plant Agric, U Guelph, Ont.

A series of F1 families were generated through paired crosses between alfalfa genotypes transgenic for either Mn-SOD (mitochondrial or chloroplastic transit peptide), Fe-SOD or ADH in order to evaluate the effect of transgenes in combination. Southern hybridization analyses verified that selected parent plants had either one, two or three transgene insertion events. Goodness-of-fit tests indicated that the parental transgenes assorted independently and segregated in the F1 progeny following the expected ratios of 1:1 for single and linked insertion events, and 3:1 for unlinked insertion events. Analysis of SOD enzyme activity revealed that transgene expression levels within families were similar between parents and F1 progeny and also between F1 segregation classes within families. Analyses of dry matter accumulation in roots, crowns and shoots, in general, indicated that double SOD and ADH transgenic F1 progeny had accumulated more dry matter than single and non transgenic F1 genotypes, but that this difference was only significant for progeny from Mn-SOD (mitchondrial TP) or Fe-SOD and ADH crosses. Double SOD transgenes generally had no significant effect on increasing dry matter accumulation in the F1 families studied.

3:15 – 3:30 pm 2B3

BIOFILTRATION II: THE ROLE OF FUNGI IN AN INDOOR BIOFILTER

David Llewellyn*, Alan Darlington and Michael Dixon,
Hort Sci, Dept Plant Agric, U Guelph, Ont.

Living moss has been shown to be an adequate support medium for the biofiltration of low concentrations of airborne volatile organic compounds (VOCs) such as those typically found in indoor settings. The moss provides a suitable environment for the proliferation of microbial degraders while also maintaining favourable conditions for the exposure of airborne contaminants to the degrading population. Historically, bioreactors have focussed on prokaryotic communities, and, while fungi have been shown to consume various VOCs, their role in bioremediation has largely been ignored. Current studies have indicated that fungi may play a role in biofiltration. A biofilter actively removing toluene and MEK was treated with bacteriostatics (tetracycline, streptomycin and chloramphenicol). The biofilter responded with an almost complete cessation in toluene removal capacity but only a 50% reduction in MEK removal. The physical presence of fungi in the moss biofilter has been quantified. In addition, their role in consuming VOCs has been demonstrated. The ability of pure culture fungal isolates to consume VOCs will be discussed.

3:30 – 03:45 pm 2A4

DETECTION OF PLANT GROWTH INHIBITION CAUSED BY NITROGEN AND SULFURDEFICIENCIES IN CORNPLANTS BY LASER-INDUCED FLUORESCENCE

Guy Samson[1*], L Dextraze[2], N Tremblay[2] & J Wollring[3],
[1]CRH, Université Laval, QC;[2]CRDH Agric. Canada,St-Jean-sur-Richelieu QC; [3]Institutfür Pflanzener_hrung & Umweltforschung, HydroAgri Deutschland, Dülmen, Germany

The aim of this study was to determine the potential of laser-induced fuorescence (LIF) to detect precociously plant growth inhibition caused by nitrogen (N) and sulfur (S) deficiencies. LIF spectra were measured on excised leaves of corn plants grown in a greenhouse with different N and S levels with a FLS-PL compact multi-wavelength fluorescent lidar. Leaf

3:30 – 03:45 pm 2B4

THE USE OF OZONE IN THE MAINTENANCE OF RECIRCULATING HYDROPONIC NUTRIENT SOLUTIONS: THE EFFECTS OF OZONATION ON MAJOR NUTRIENT IONS

G. Thomas Graham*, Richard Côté and Michael A. Dixon
Controlled Environ Systems Facilities, Dept Plant Agric U Guelph, Ont

The strong oxidation potential of ozone makes it a prime candidate for the control of pathogens and organic compounds found in recirculating hydroponic solutions. The efficiency of ozone to destroy bacteria and other microorganisms, as well as its capacity to oxidise organic compounds, has been demonstrated in both the municipal and bottled water industries. Ozone is also known to facilitate reactions that cause transition metal ions, such as iron,

reflectance and leaf chlorophyll contents were also measured. Both N and S deficiencies caused significant growth inhibitions after 6 and 18 days respectively of treatments and afterward. Simultaneously to these plant growth inhibition, significant changes of the red to far-red (RF/FRF) fluorescence ratio and the R740/R540 reflectance ratio were observed in parallel to lower leaf Chl contents in N- and S-deficient plants. Interestingly, N and S deficiencies had distinct effects on the blue-green to chlorophyll fluorescence ratios (BGF/ChlF) induced by flashes of 360 nm: BGF/ChlF increased markedly in N-deficient leaves due a decreased transmitance of leaf epidermis to UV light. It is apparent from these results that LIF offers ground for early nutrient stress discrimination and a potential for solving the inherent limitation of remote sensing approaches to plant stress diagnosis based on reflectance measurements.

copper, zinc and manganese, to precipitate out of solution. What is unclear from the literature is the effects that ozone will have on ions that are, or carry, essential macronutrients. Using a prototype ozone delivery system, nutrient solutions of varying volumes were treated for 30hrs. Samples were then analysed for major nutrient cations (Na, NH_4, K, Mg, Ca) and anions (Cl, NO_2, NO_3, PO_4, SO_4). Early results indicate that the treatment had only minimal effects on the major nutrient ions. This is important from the standpoint that ozonation systems can be used to treat recirculating nutrient solutions without the need for costly supplemental nutrient addition to maintain a suitable ion balance for optimal plant growth.

Plenary Talk

Room 1103 - Chair: D. Layzell

3:45 – 4:45 pm **S4**

AGRICULTURAL BIOTECHNOLOGY AND ITS ACCEPTANCE BY CANADIANS

Leiss, Wm. *President, Royal Society of Canada and NSERC/SSHRC Industrial Research Chair in Risk Communication and Public Policy, Department of Management, U. Calgary, Alberta*

New thinking about the interplay between science and public policy is occurring in many different forums in Canada and elsewhere today, and especially in the area of risk management. In an earlier paper I sketched a new paradigm for this interplay, wherein governments manage health and environmental risks, and draw upon independent scientific bodies (such as expert panels) for the risk assessment expertise they need to do so; I argue that the strict institutional separation of science and policy is good for both of them. In this paper I use the example of the current, international risk controversy over food biotechnology to reaffirm that earlier position, arguing that the science/policy relation in all Western governments is in a state of crisis (an overworked but pertinent term here). One of the sources of this crisis is the failure to appreciate the crucial difference between *risk management* and *risk issue management*. An understanding of that difference, and its implications especially for government managers, is an essential first step towards overcoming our present difficulties.

Poster Session

4:45 – 6:30 pm **Poster Session** (in the Atrium)

- See Abstracts at the end of this book
- Refreshments Courtesy of *Performance Plants Inc*

6:30 – 7:30 pm **Buffet Dinner** (in the Atrium)

7:30 – 10:00 pm **Cash Bar and Music by 'Agent Blue'** (in the Atrium)

Monday, 13 December

Session 3A: Stress #2

(Rm 1102) Chair: Hargurdeep Saini

9:00 – 9:15 am **3A1**

INDUCTION OF TONOPLAST PROTON-PUMPING PYROPHOSPHATASE BY PHOSPHATE DEPRIVATION OF *BRASSICA NAPUS* SUSPENSION CELLS

David A. Palma[*,1], E Blumwald[2], & WC. Plaxton[1,3]

Depts Biol[1] & Biochem[3], Queen's U; Dept Botany[2], U Toronto

One fascinating feature of plant bioenergetics is that under conditions of depleted ATP (*e.g.* during Pi starvation or anoxia) PPi may serve as an autonomous energy donor for several alternative cytosolic reactions and ion pumps. Moreover, Pi or anoxia stress has been reported to induce various glycolytic 'bypass' enzymes including PPi-dependent phosphofructokinase. By examining pH-dependent fluorescence quenching of acridine orange, assays of ATP versus PPi hydrolysis, and immunoblotting of purified tonoplast vesicles we now provide evidence for a significant induction of tonoplast H^+-PPiase during Pi-starvation of *B. napus*. The ratio of PPi:ATP fluorescence quench magnitude and PPiase:ATPase specific activity was about 2-fold greater in tonoplast vesicles isolated from Pi-starved vs. Pi-sufficient *B. napus*. Furthermore, Pi stress caused a marked increase in the amount of a tonoplast 65 kDa anti-(H^+-PPiase) IgG immunoreactive polypeptide, whereas the amount of a 57 kDa anti-(H^+-ATPase) IgG immunoreactive polypeptide was unchanged. Together with the selective maintenance of cytosolic PPi pools, these data indicate that Pi-starved *B. napus* preferentially employ the tonoplast H^+-PPiase to maintain vacuolar acidity, thus conserving limited ATP. We also have preliminary fluorescence quench evidence for a tonoplast PEP translocator, which would facilitate the bypass of ADP-limited cytosolic pyruvate kinase during Pi-stress via a previously characterized Pi-starvation inducible vacuolar PEP phosphatase. (Supported by NSERC)

9:15 – 9:30 am **3A2**

PHOSPHITE DISRUPTS THE ACCLIMATION OF YEAST TO PHOSPHATE-STARVATION

Allison E McDonald,[1*] JO Niere,[2] & WC Plaxton[1,3],

Depts. Biol[1] and Biochem[3], Queen's U.; Dept. Applied Chem[2], Royal Melbourne Instit Technol.

Phosphite (Phi; HPO_3^{2-}), a reduced form of Pi in which -H replaces an -OH bonded to the P atom, is the active ingredient of an agricultural fungicide that is widely used to control crop infection by pathogenic *Phytophthora sp.* However, our recent studies of *Brassica sp.* revealed that by disrupting their Pi-starvation response, low Phi levels are quite toxic to Pi-starved plants. Here we report the influence of Phi on the Pi-starvation response of *Saccharomyces cerevisiae*. Evidence of an active Pi-stress response in this yeast was provided by Pi-repressible acid phosphatase (rAPase) whose activity was elevated 90-fold, 48 h following subculture of +Pi cells into -Pi liquid media. However, when +Pi yeast were subcultured into -Pi media + 0.1 mM Phi, rAPase derepression and cell growth were abolished. By contrast, Phi did not influence the rAPase activity or growth of +Pi cells, or protein concentration or activities of pyruvate kinase and alcohol dehydrogenase of +Pi or –Pi yeast. ^{31}P-NMR spectra obtained from PCA extracts revealed that: (i) Phi is assimilated and concentrated to significant levels by

Session 3B: N_2 fixation & Photosynthesis

(Rm 1103) Chair: Guy Samson

9:00 – 9:15 am **3B1**

CULTIVARS OF SOYBEAN (*GLYCINE MAX*) RESPOND DIFFERENTIALLY TO LIPO-CHITOOLIGOSACCHARIDE NOD*BJ* V($C_{18:1}$, MEFEU)

B.Prithiviraj*, A. Solumenoev and D.L. Smith

Plant Science Department, Macdonald Campus of McGill University, Ste-Anne-de-Bellevue, Quebec, Canada H9X 3V9

Lipo-chitooligosaccharides (LCOs) are bacteria-to-plant signal molecules essential for the establishment of rhizobia-legume symbiosis. LCOs invoke a number of physiological changes in the host plants, such as root hair deformation, cortical cell division and ontogeny of complete nodule structures. The response of six soybean cultivars to Nod*Bj* V($C_{18:1}$, MeFeu) isolated from *Bradyrhizobium japonicum* strain 532C was studied by a new technique. Two distinct types of root hair deformation were evident (i) bulging, in which root hairs were swollen at the tip or at the base depending on the cultivars and (ii) curling, that resulted in the curling of the root hairs. The nodulating capacity of *B. japonicum* 532C varied with the cultivars. Cultivars that produced a bulging reaction when treated with LCO had fewer nodules and the roots had low phenol contents while, the cultivars that produced curling had significantly higher number of nodules and the roots recorded higher amounts of phenol. Further, the roots of cultivars that showed root hair bulging were able to degrade LCO much faster than those cultivars with curling. The results of the present study establish a relationship between the type of LCO induced root hair deformation, LCO degrading ability with the nodulation capacity of the *B. japonicum*.

9:15 – 9:30 am **3B2**

THE ROLE OF INTERORGANISMAL SIGNALING IN THE INHIBITION OF SOYBEAN NITROGEN FIXATION BY LOW PH AND SALINITY STRESSES.

Miransari, M.*, and Donald Smith.

Department of Plant Science, Macdonald Campus of McGill University, Quebec

Signal exchange is necessary to initiate nitrogen fixation BY LEGUMES. Hence, any inhibition of this process CAN affect both plant growth and N2-fixation. The hypothesis of this study is: the inhibition of soybean nodulation and nitrogen fixation is due, at least in part, to disruption of the signal exchange process which occurs at the beginning of nodulation. The objectives are: 1) to determine the effects of stressful soil pH and salinity levels on the signal exchange process between soybean and B. japonicum, and 2) to determine whether or not the addition of signal molecules to B. japonicum can overcome at least part of the inhibition of nodulation caused by stressful soil pH and salinity levels. Four levels of pH and three levels of salinity as well as three levels of the signal molecule genistein have been tested. Genistein may partially or completely overcome pH and salinity stresses. The effects of genistein on soybean nodulation and growth under low pH conditions became greater with time. Significant pH*genistein (a=0.1) and

-Pi yeast cultured with 0.1 mM Phi, and (ii) the amounts of sugar-Ps, PPi, and particularly poly-P were significantly reduced in the Phi treated -Pi cells. It is hypothesized that one site of Phi action in *S. cerevisiae* is at the level of the signal transduction chain by which yeast detect and respond to alterations in cellular Pi pools at the molecular level. We are attempting to locate and identify the site(s) and mode(s) of Phi action by screening for Phi-resistance in -Pi yeast transformed with a cDNA library overexpressed under the control of a Gal promoter. (Supported by NSERC)

salinity*genistein (a=0.05) interactions showed that genistein can play a role in overcoming salinity and pH inhibitions of nodulation.

9:30 – 9:45 am 3A3

INTERACTIONS OF CARBON DIOXIDE AND PHOSPHORUS NUTRITION WITH PROTEOID ROOT FORMATION IN WHITE LUPIN (*Lupinus albus*)

Catherine Campbell* and Rowan Sage,
Dept. Botany, Univ Toronto

Rising atmospheric CO_2 is one of the most important components of global change, particularly with regard to plants. Nutrient acquisition strategies generally involve an investment of fixed carbon, and so should respond to changing atmospheric CO_2; one such strategy is the formation of proteoid roots. These are dense clusters of rootlets that secrete organic acids that in turn promote phosphorus solubility, facilitating its uptake by the plant. An increase in atmospheric CO_2 might lead to an increase in proteoid root formation, giving white lupin and plants like it an ecological advantage in the decades to come. In my thesis, I examined the change in proteoid root formation in white lupin (*Lupinus albus*) at varying levels of CO_2. I grew plants hydroponically, in solution with (+P) and without (-P) phosphorus, at three levels of CO_2: low (similar to those present during glaciation events), ambient and high (predicted levels in the next 50 years). Results showed that –P grown plants in all CO_2 treatments produced more proteoid roots than the controls at the same CO_2 level; the difference was most pronounced at high CO_2. The increase in atmospheric CO_2 at the end of the Pleistocene may have increased the importance of proteoid roots in nutrient acquisition, and this importance may grow further at high CO_2. In addition, because proteoid roots render phosphorus more available to both lupins and plants growing near them, changes in their production have the potential to change phosphorus cycling in an ecosystem.

9:30 – 9:45 am 3B3

EVIDENCE FOR STEEP ADENYLATE GRADIENTS IN THE INFECTED CELLS OF LEGUME NODULES.

Hui Wei* & David B. Layzell
Dept. of Biology, Queen's University, Kingston, Ont.

In metabolically-active legume nodules, the adenylate energy charge (AEC = [ATP + 0.5 ADP] /[ATP + ADP + AMP]) is low (0.73 ± 0.01) compared with other aerobic tissues (typically ≥ 0.80), due to a low AEC in the plant fraction (0.66 ± 0.04) and a high AEC in the bacteroids (0.76 ± 0.05). However, an O_2 limitation of nodule metabolism reduces the bacteroid AEC (to 0.56 ± 0.06) but has no effect on plant fraction AEC. Since the low plant AEC is not due to an O_2 limitation, a mathematical model was developed to test the hypothesis that bacteria-infected cells have a large gradient in ATP concentration from the mitochondria near the gas filled spaces, to the inner regions of the cell. The model supported this hypothesis, predicting that glutamine synthetase activity in the cytosol was largely responsible for generating a gradient in plant AEC of 0.84 near the space to 0.55 in the centre of the cell. The model was also used to simulate a nodule exposed to an atmosphere of Ar:O_2 (i.e. no N_2 fixation or NH_3 assimilation) and predicted that the average plant AEC would rise from 0.66 to 0.74. This prediction could explain why soybean nodules exposed to Ar:O_2 show no change in AEC, despite evidence that they experience a severe O_2 -limitation of metabolic activity.

9:45 – 10:00 am 3A4

EXPRESSION PATTERN OF WHEAT ANTHER INVERTASE GENES IN DIFFERENT TISSUES AND THEIR MODULATION BY WATER STRESS.

Chantale Nunes*, Joginder Minhas and Hargurdeep Saini.
Inst. de recherche en biologie végétale, U Montréal, Qué

Water stress imposed during microspore mother cell meiosis causes male sterility in wheat (*Triticum aestivum* L.), which reduces grain yield. Sterile pollen lacks starch grains, indicating a potential problem in carbohydrate metabolism. Meiotic-stage water stress causes a severe inhibition of the activities of vacuolar and cell wall invertases in anthers. Other key enzymes in carbohydrate metabolism are not affected. To study the regulation of this response at the level of the gene expression, we isolated three anther cDNA encoding invertase: IVR-1 (cell wall; accession number: AF030420), IVR-3 (cell wall; accession number: AF030421) and IVR-5 (vacuolar; accession number: AF069309). RNA blot analysis of anthers, pistils, glumes and leaves showed that the expression of the invertase genes changes throughout the development. Water stress does not affect the invertase gene expression, except in the glumes where a severe repression of IVR-5 was seen at meiosis. However, this expression was restored after addition of water. The role of invertase genes in

9:45 – 10:00 am 3B4

IS THE ANTARCTIC ALGA, *CHLAMYDOMONAS SUBCAUDATA* "LOCKED" IN STATE I?

R.M. Morgan*, A.G. Ivanov, N.P.A Huner
Dept Plant Sci, U Western Ont, London, Ont.

The ability of an Antarctic green alga, *Chlamydomonas subcaudata*, to reversibly redistribute light energy between photosystem II (PSII) and photosystem I (PSI) via state transitions was investigated. State I-State II transitions were monitored at the level of 77K Chl *a* fluorescence emission spectra as well as phosphorylation of major light harvesting (LHC II) polypeptides. As expected, the control species, *C. reinhardtii*, responded to conditions inducing state transitions by increasing PSI fluorescence emission relative to PSII fluorescence emission in conjunction with the phosphorylation of two LHCII polypeptides. In contrast, on the basis of 77K fluorescence emission, *C. subcaudata* did not exhibit the ability to undergo state transitions. While this phenomenon has been demonstrated in several *Chlamydomonas* mutants [Delsome et al (1996) Biochim Biophys Acta 1273:150], to our knowledge, this is the first example of this phenomenon in a natural variant. We suggest that the absence of state transitions in the Antarctic alga may be a consequence of a relatively oxidized plastoquinone (PQ) pool. This is

stress-induced male sterility will be discussed.

supported by (1) a reduced capacity for stromal electron donation to the PQ pool, (2) relatively high rates of cyclic electron transport around PSI and (3) a 2.5-fold higher level of cytochrome f in *C. subcaudata* in comparison with *C. reinhardtii*. The possibility that *C. subcaudata* is "locked" in State I will be discussed.

10:00 – 10:15 am 3A5

SALT TOLERANCE CONFERRED BY OVEREXPRESSION OF A VACUOLAR NA+/H+ ANTIPORT IN ARABIDOPSIS.

Maris P. Apse*1, Gilad S. Aharon1, Wayne A. Snedden and Eduardo Blumwald.
Department of Botany, University of Toronto.

Agricultural productivity is severely affected by soil salinity. One mechanism by which plants survive salt-stress could be to compartmentalize sodium ions away from the cytosol. The overexpression of a vacuolar Na+/H+ antiport from Arabidopsis thaliana promotes sustained growth and development in soil watered with up to 200 mM NaCl. This salinity tolerance was correlated with higher than normal levels of AtNHX1 transcripts, protein, and vacuolar Na+/H+ antiport activity. AtNHX1 belongs to a growing family of putative Na+/H+ antiport genes that have been identified in Arabidopsis and other plants. Initial studies on the other members of this family will also be presented.

10:00 – 10:15 am 3B5

INTERACTIONS OF LIGHT, HYDRATION & PHOTOSYSTEM ACTIVITY IN LOBARIA: VARIATIONS IN THREE ECOLOGICALLY SIMILAR LICHENS.

Tyler D. B. MacKenzie* and Douglas A. Campbell
Mount Allison U, Sackville, New Brunswic,

Photochemical yield of photosystem II electron transport (Φ_{PSII}), determined by chlorophyll fluorescence, was measured as a function of hydration in the photosynthetic symbionts (photobionts) of three species of the lichen genus Lobaria. Two of these species contain chlorophytes as photobionts, while the other contains a cyanobacterium. During drying Φ_{PSII} declines to half maximum in the chloro-lichens only once thalli reach about 20% hydration, whereas the same occurs once the cyano-lichen reaches 80% hydration. Amber light is preferrentially absorbed by the phycobilisomes, while blue light is absorbed by the photosystem cores, and also by the chlorophyte light harvesting antennae. During dehydration, amber-excited fluorescence declined proportionately more in cyano-lichens, while blue-excited fluorescence declined proportionately more in the chloro-lichens. These changes closely tracked changes in the proportion of reflected light from the lichen. We found no evidence to suggest decoupling of the phycobilisomes of the cyano-lichen during dehydration. Rather, we hypothesise that the optical properties of the fungal symbionts change during dehydration to specifically screen excess light from the particular antennae of the associated photobionts. If true, this represents a symbiotic photoprotective mechanism provided by the fungus.

10:15 – 10:30 am 3A6

GENETIC TRANSFORMATION AND EVALUATION OF PERENNIAL RYEGRASS (*Lolium perenne*) WITH AN ADDITIONAL SUPEROXIDE DISMUTASE GENE

Alissa Devereaux*, SR Bowley and BD McKersie
Dept Plant Agric., Plant Biotech Div, U Guelph, Ont

Genetic transformation of perennial ryegrass (var. Elite and Affinity) with a manganese superoxide dismutase gene (MnSOD) was carried out by particle bombardment and *Agrobacterium* mediated transformation. The evaluation of the transformants involved initial screening for the presence of the gene using Polymerase Chain Reaction (PCR). Southern hybridization analyses are being used to confirm integration of the gene into the plant genome and to determine gene copy number. Native SOD isozyme gel analyses are also being conducted to determine if an additional MnSOD enzyme is being expressed in the transgenic perennial ryegrass plants and will allow the level of activity to be estimated. Positive transgenic plants were transplanted to a field trial at the Elora Research station, Elora, Ontario in September 1999. The trial includes 201 genotypes in a replicated split plot design. This field trial will permit an assessment of the ability of the plants to endure a number of natural environmental stresses. Assessment of the plants will commence in the spring of 2000 when the performance of the transformed perennial ryegrass plants compared to the controls will be evaluated based on ratings of quality, colour, percent cover and greenup as specified by the National Turfgrass Evaluation Program.

10:15 – 10:30 am 3B6

CARBON SUPPLEMENTATION AND LIGHT EFFECTS ON GROWTH AND PHOTOSYNTHESIS OF C_3 AND C_4 PLANTS.

S.H. Begna*[1], L.M. Dwyer[2], D. Cloutier[1] & D.L. Smith[1]
[1]Plant Sci Dept, McGill U; [2]Agric & Agri-Food Can, E Cereal & Oilseed Res Cent, Cent. Exp'tl Farm, Ottawa.

If no other resource is limiting, the growth of a plant is proportional to the amount of light it intercepts. Reduced light levels result in reduced carbon assimilation, which results in reduced growth. Over the past ten years techniques have been developed that allow injection of concentrated solutions of growth affecting materials, such as sucrose, into plant. A greenhouse experiment was carried out to test the effects of sucrose injection and shading on three plant species. The light levels were full sun and 75 % shade. The solutions injected were 150 g sucrose L^{-1} and distilled water. The plant species were *Amaranthus retroflexus* L.- C_4, *Chenopodium album* L.- C_3, and *Abutilon theophrasti* Medic.- C_3. The overall average total sucrose uptake was 7.6 and 5.9 g for the 0 and 75 % shading levels, respectively, which represented an average of 47 % of the total dry weight of the plants. Photosynthetic activities were higher under unshaded than shaded conditions for all species, and higher values were recorded for distilled water injected and uninjected plants than plants injected with sucrose. Plants injected with sucrose under 75 % shade achieved dry weights not different from uninjected or distilled water injected plants in full sun. Injection of large amounts of sucrose over time periods long enough to have caused complete acclimation, into both C_3 and C_4 plants decreased photosynthesis mainly by reducing CO_2 uptake at the chloroplast, which led to reductions in stomatal aperture. The reduction in photosynthesis was

	greater when injection occurred in shade. Sucrose injection did not affect overall patterns of dry matter allocation and their response to shade suggesting that those effects are strictly due to light intensity and are not related to photosynthate availability.
10:30 – 10:50 am **Coffee Break** Courtesy of Qubit Systems Inc.	10:30 – 10:50 am **Coffee Break** Courtesy of Qubit Systems Inc.
10:50 – 11:15 am **Awards Ceremony and meeting wrap-up** (in Atrium)	
11:15 am **Departure**	

Poster Session (in Atrium)

Abstracts

P1.

INCREASED NONPHOTOCHEMICAL QUENCHING ACCOMPANIES THE OXIDATIVE BURST AS PART OF THE HYPERSENSITIVE RESPONSE IN *ASPARAGUS SPRENGERI*

Julie Karner[1*], Kennaway MacGregor[2*], Alan Bown[2], and Doug Bruce[2]

[1] *Dept. of Physics, University of Guelph* [2] *Dept. of Biological Sciences, Brock University*

The hypersensitive response is characterized by external alkalinization, internal acidification, Ca^{2+}, Cl^-, and K^+ ion fluxes, conversion of O_2 to O_2^- (the oxidative burst), and cell death. The G-protein activator mastoparan and its analogue Mas7 are known to elicit the oxidative burst, external alkalinization, and cell death, while also causing changes in photosynthetic parameters; a rapid increase in nonphotochemical quenching is followed by a slow release of photochemical quenching (Allen *et al.*, 1999, Plant Physiology 119: 1233-1241). It is not known whether these fluorescence changes are a part of the hypersensitive response. Butyric acid was used, in the absence of Mas7, to induce internal acidification, which led to the oxidative burst and the fluorescence changes. This suggests that these events are connected, and that the fluorescence changes are not due to a specific effect of Mas7. This notion is supported by the fact that the Ca^{2+} channel blocker lanthanum, which prevents the Mas7-induced oxidative burst and internal acidification, also blocks changes in fluorescence. It is unclear whether the fluorescence changes result directly from internal acidification or from an unknown signal that is part of the hypersensitive response (such as Ca^{2+} influx or loss of reductant). However, it is clear that the fluorescence changes are coincident with the oxidative burst, and both appear to be part of the hypersensitive response.

P2.

FEEDBACK REGULATION OF PHOTOSYNTHETIC ELECTRON TRANSPORT IN RESPONSE TO SUGAR ACCUMULATION IN TOMATO LEAVES

Olfa Ayari *, Guy Samson, Martine Dorais (Greenhouse Crops Research Centre, AAFC, Harrow, Ontario) and André Gosselin

Horticultural Research Center, Laval University, Quebec, Qc, Canada

In the present study, we investigated the effects of sugar accumulation in tomato leaves on the photosynthetic electron transport. Petioles of tomato leaves were immersed in water or in 50 mM glucose solution during 14 days. Glucose feeding caused large accumulation of sugars in leaves, accompanied by declines of the maximum photosynthetic rate (P_{max}) and leaf chlorosis. Glucose fed leaves showed lower Fv/Fm and $\Delta F/Fm'$, q_P and also higher q_N than control leaves. In dark-adapted leaves, ΦPSI was similar in both treatments. However, in light-adapted leaves, ΦPSI was lower in glucose fed leaves owing to a higher resistance of electron donation to P700 indicated by a slower kinetic of $P700^+$ reduction and a larger proportion of inactive $P700^+$.

Similar proportions of PSI inactive on their acceptor side in glucose- and water-fed leaves were observed indicating that the decrease of ΦPSI in glucose fed leaves originated from its donor side and not from its acceptor side. We conclude that 1) sugar accumulation in leaves induces a preferential loss of Fv/Fm relative to ΦPSI in dark-adapted leaves; and 2) in response to a decrease in overall photosynthetic capacity (P_{max}), there is a light-induced feedback regulation of photosynthetic electron transport involving a dissipation of excess energy as heat and a restriction of electron transport between the PQH_2 pool and the $Cytb_6f$ complex.

P3.

DISTINCT NON-PHOTOCHEMICAL QUENCHING OF THE PHOTOCHEMICAL AND THE THERMAL PHASES OF VARIABLE CHLOROPHYLL-a FLUORESCENCE

Bouchra Yaakoubd[1], Nicolai Bukhov[2], Yves Desjardins[1], Robert Carpentier[3] & Guy Samson[1*]

[1] *CRH, Université Laval, QC;* [2] *Timiriasev Institute of Plant Physiology, Russian Academy ofSciences, Moscow, Russia;* [3] *Groupe de Recherche enÉnergie et Information Biomoléculaires, Université du Québec ˚ Trois-Rivières, CP 500Trois-Rivières, G9A 5H7*

Variable chlorophyll-a fluorescence is composed of two distinct phases of similar amplitudes: a photochemical phase that can be obtained by a saturating single-turnover flash (Fsat) and a thermal phase which requires multiple PSII turnovers(Fm). Here, we compared the PSII photochemical yield (_PSII), the photochemical (qP) and non-photochemical(qN) fluorescence quenching coefficients based on Fsat or Fm measured in intact leaves of *in vitro* potato plantlets exposed to different PFD. Estimations of _PSII and qP made from Fsat were consistently lower but highly correlated(R^2>0.99) to those from Fm. However, the qN values from Fsat and Fm were markedly different: in contrast to Fm, Fsat remained unquenched at PFD < 200 $\mu Em^{-2}s^{-1}$. Parallel measurements of P_{700} redox state indicated thatat these low PFDs, _PSI decreased more than_PSII due to a limitation on its electron donor side. At higher PFD,_PSII and _PSI decreased linearly. We interpret these results by the presence of two concomitant processes, i.e. the removal at low PFD of a non-photochemical quenching caused by the reduction of PQ molecules, and the induction of the non-photochemical quenching related to the _pH and the accumulation of zeaxanthin.

P4.

LINEAR VERSUS PARALLEL PHOTOSYNTHETIC ELECTRON TRANSPORT IN *SYNECHOCOCCUS* SP. PCC 7942.

A.G. Ivanov[1*], Y.-I. Park[3], E. Miskiewicz[1], N.P.A. Huner[1*], J.A. Raven[4], G. Oquist[2].

[1]*Dept Plant Sci, U W Ont, London, Ont;* [2]*Dept of Plant Physiol., U of Umeå, Umeå S-901 87, Sweden,* [3]*Dept Biology, Chungnam National U, Taejon 305764, Korea;* [4]*Dept of Biol Sci, U Dundee, Dundee, Scotland.*

Exposure of *Synechococcus* sp. PCC 7942 to Fe-deficiency reduced the content of photosystem I (PSI) 2.7-fold and photosystem II (PSII) 1.6-fold which resulted in an increase in the ratio of PSII/PSI (0.90) compared to cells grown under control, Fe-sufficient conditions (0.53). Despite this change in photosystem stoichiometry, Fe-deficient cells showed growth rates that were only 12% lower than control cells coupled with rates of photosynthesis that were only 30% lower than Fe-sufficient cells. *In vivo* measurements of the redox status of P700 coupled with the use of photosynthetic electron transport inhibitors indicated a restriction in intersystem electron transport such that PSI reaction centers in Fe-stressed cells mainly operated in a cyclic mode generating ATP, while PSII contributed to the reduction of $NADP^+$. In contrast, electron transport through PSII and PSI were coupled through the intersystem electron transport chain as expected for Fe-sufficient cells. In support to this, Fe-sufficient cells exhibited a typical Emerson enhancement value for oxygen evolution of 1.3 whereas Fe-deficient cells exhibited no Emerson enhancement effect. We conclude that exposure of *Synechococcus* sp. PCC 7942 to iron stress restricts intersystem electron flow between PSII and PSI. As a consequence, the two photosystems are able to operate separately to a significant extent under iron deficiency rather than in series as normally observed under iron sufficient conditions.

P5.

LIGHT-ACTIVATED CO_2 EFFLUX IN THE MARINE ALGA *NANNOCHLOROPSIS*

Huertas, I.E.[*1], Brian Colman[1] & G.S. Espie[2]

[1]*Dept Biology, York U, Toronto. Ont.;* [2]*Dept of Botany, U Toronto at Mississauga, Ont.*

The occurrence of a light dependent bicarbonate transport system has been already demonstrated in the marine microalgae *Nannochloropsis gaditana*. This species possesses a rapid bicarbonate uptake system which causes the accumulation of high intracellular Ci levels. An internal carbonic anhydrase catalyzes the equilibration of bicarbonate and CO_2, and CO_2 is subsequently released to the external medium. Bicarbonate uptake is light-dependent but continues for periods up to 20 min. in the dark. The magnitude of dark CO_2 efflux is proportional to the light intensity to which the cells are exposed and to the length of the prior light period; dark efflux is saturated by a period of 3.0 min preillumination and both light and dark efflux are saturated at about 750 _mol _ photons _ m^{-2} _ s^{-1}. However, the magnitude of efflux in the light is lower at high light intensities than that in the dark since light energy is being used for both bicarbonate transport and CO_2 fixation. Growth of cells on 1.0 % CO_2 does not repress bicarbonate transport and cells grown under these conditions have the same rates of CO_2 efflux in light and dark.

P6.

ACTIN MICROFILAMENTS AND MICROTUBULES REORGANIZE DURING PEA ROOT NODULE CELL DEVELOPMENT.

A.L. Davidson* and W. Newcomb.

Dept. of Biology, Queen's University, Kingston ON.

Pea root nodules are cylindrical organs derived from the plant's inner root cortical cells and are infected by the diazotroph *Rhizobium*. A medial section from the longitudinal axis of the nodule reveals several stages of nodule cell development, including the uninfected nodule meristem cells at the nodule tip, young daughter cells adjacent to the meristem that have been infected by a small number of bacteria (symbiosomes), and older infected cells in the center of the nodule which are large and densely populated by symbiosomes. Using fluorescence and electron microscopy (EM) we have investigated the organization of the cytoskeleton in these cells, including microtubules (MTs) and actin microfilaments (MFs). Meristem cells contain MFs and MTs in random arrays in the cortex, in cytoplasmic strands and in association with the nucleus. The cytoskeleton of a recently infected cell is similar, but also contains a diffuse array of fragmented cytoplasmic MTs and MFs. In infected cells the MTs and MFs form extensive cytoplasmic and cortical networks. The cytoplasmic MFs are reticulated and multidirectional while the MTs are wavy and form a radial array. Cortical MTs are long and sometimes parallel while MFs are apparently randomly oriented. The extensive cytoplasmic networks suggest the cytoskeleton may pass near to or associate with the symbiosomes; EM confirms that MTs associate with the symbiosomes. Cytoskeletal-symbiosome associations may be necessary to position the symbiosomes and, possibly via vesicles, transfer metabolites to the symbiosomes.

P7.

IN VITRO TARGETING OF THE TOC36 COMPONENT OF THE CHLOROPLAST ENVELOPE PROTEIN IMPORT APPARATUS INVOLVES A COMPLEX SET OF INFORMATION

Kenton Ko, Zdenka W. Ko

Dept Biology, Queen's Univ, Kingston, Ont

Toc36 is a family of 44-kDa envelope polypeptides previously identified as components of the chloroplast protein import apparatus. Toc36 exists as multiple outer and inner envelope membrane forms. One member, Toc36B (formerly Bce44B), is targeted to the envelope without the typical maturation event. Targeting and assembly into the envelope is thus likely to involve a complex interplay of indigenous signals. These signals were examined by testing the effects of truncations and chimeric fusions on the targeting of Toc36B. The targeting ability of Toc36B appeared unaffected by carboxyl truncations of up to 80% of the protein, but was abolished by amino-terminal deletions. The N-terminal 39 residues of Toc36B conferred the same targeting profile to mouse dihydrofolate reductase as that displayed by unaltered Toc36B. However, removal of 18 residues from the carboxyl end of the N-terminal 39 amino acid segment abolished targeting to the chloroplast. Additional information in the remaining Toc36B segment was also apparent based on the import results of chimeric fusions between the transit peptide of the small subunit of ribulose-1,5-bisphosphate carboxylase and Toc36B. The targeting of Toc36B to various destinations in the chloroplast envelope

appears to be influenced by information from at least two segments of the protein.

P8.

TO WHAT EXTENT CAN Cd-TOXICITY BE CONFOUNDED BY P-DEFICIENCY?

M.N. Sweeney* and S.M. Macfie.
Dept. of Plant Sciences, UWO, London, ON, N6A 5B7.

In studies of metal-toxicity, it is important to monitor and control the pH of the growth medium. According to predictions made by GEOCHEM-PC, in Hoagland's nutrient solution at pH below 3.5, over 75% of the total Cd is ionic Cd^{2+}, which is thought to be the form that is most available to plants. Above pH 5, over 95% of the Cd in solution will form a solid precipitate with PO_4. If the pH of the culture system is not controlled, what is reported to be Cd-toxicity could actually be P-deficiency or a combination of toxicity and deficiency.

Zea mays was grown in sand supplemented with Hoagland's nutrient solution (+/- Cd) adjusted to pH 5. The acid-washed quartz sand solution remained at pH ~6, despite the use of buffers. To test the extent of Cd-induced P-deficiency, experimental pots were paired such that one set had a known concentration of Cd (0 - 2.4 mM) and the other set had reduced P (4 - 0.1 mM). The concentration of P was set to that amount predicted to be available in pots with Cd. Examination of plant responses will help to distinguish between the effects of metal-toxicity and metal-induced P-deficiency. Increasing Cd resulted in decreased dry weight of roots and leaves (down to ~40 % of control). However, reducing P to as low as 2.5 % of control had no effect on root or leaf weight. Surprisingly, increasing concentrations of Cd in the sand did not affect accumulation of P in leaves or roots. Reduced P in sand resulted in reduced accumulation of P in leaves but not in roots. Despite the predicted problems with pH 6, the effects of Cd on biomass did not seem to be confounded by Cd-induced P-deficiency.

P9.

LOW TEMPERATURE EFFECT ON 32P ABSORPTION AND TRANSLOCATION TO HOST PLANTS BY GLOMUS INTRARADICES, AN ARBUSCULAR MYCORRHIZAL FUNGUS

Wang B., Funakoshi DM, *Hamel C.
Nat. Res. Sciences Dept, McGill U, Ste- Anne-de-Bellevue (Qc)

Arbuscular mycorrhiza improves the uptake of nutrients of low mobility in soil, such as phosphorus (P). Previous studies had shown a detrimental effect of root zone temperatures on the process of mycorrhizae formation. An indoor experiment was conducted to investigate the effects of low root zone temperatures (0, 15 and 23oC) on pre-established mycorrhizae function. The uptake of soil-injected 32P by leek (Allium porrum L.) plants colonized by Glomus intraradices Schenck & Smith, was our assay system. Radioactive P activity was reduced by low temperature in both mycorrhizal and non-mycorrhizal systems. The mycorrhizal fungus increased 32P activity of leek leaves at a root zone temperature of 23oC, 7 days after injection of32P in the soil. Fourteen days after injection, mycorrhizal plant leaves had higher activity, both at 23 and 15oC. No difference between mycorrhizal plants and non-mycorrhizal plants was found at 0oC, 7 or 14 days after injection of 32P to the soil.

P10.

THE RESPIRATION OF TRANSGENIC TOBACCO CELLS LACKING ALTERNATIVE OXIDASE CAN STILL SUPPORT HIGH RATES OF PHOSPHATE UPTAKE

Justine Y.H. Yip and Greg C. Vanlerberghe.
Div. Life Science and Dept Botany, U Toronto at Scarborough, Scarborough, ON,

We recently showed that mitochondrial alternative oxidase (AOX) protein is dramatically induced in wt tobacco suspension cells growing under P-limitation and that antisense (AS8) cells unable to induce AOX under these conditions (due to the presence of an antisense transgene) have altered growth, morphology, cellular composition, patterns of respiratory carbon flow and rates of generation of active oxygen species (Parsons et al., Plant Physiol., Dec 99). Here, we have investigated whether the lack of AOX in AS8 might compromise the high rates of P uptake which occur when P-limited cells are resupplied with P. Such P uptake is often associated with dramatically increased rates of respiration and a report in the literature hypothesizes that AOX may contribute to this respiration (Sakano K, Plant Cell Physiol. 39, 467-473, 1998). We found that wt cells resupplied with P exhibited a 1.5-fold increase in respiration rate and that this stimulated respiration was sensitive to the AOX inhibitor n-propyl gallate (nPG). Alternatively, AS8 cells displayed only a 1.2-fold stimulation of respiration, which was insensitive to nPG. These observations suggest that AOX does contribute to the stimulated respiration of wt cells and that the lack of AOX in AS8 cells compromises respiration. However, while respiration was compromised in AS8, the rates of P uptake by AS8 were similar to the wt. Also, analyses of cell viability and growth responses to P-resupply showed a similar response by both the wt and AS8.

P11.

DOES ALTERNATIVE OXIDASE PLAY A ROLE IN PLANT RESISTANCE RESPONSES TO PATHOGENS?

Sandi H. Ordog* and Greg C. Vanlerberghe.
Div Life Sci and Dept Botany, U of Toronto Scarborough, Scarborough, ON

The plant mitochondrial electron transport chain is branched such that electrons flow via the cytochrome pathway or to alternative oxidase (AOX). The AOX pathway bypasses two of the three energy-conserving sites which generate ATP. Recent reports in the literature suggest that AOX may have an active (but ill-defined) role in plant defense responses to pathogen attack. For example, salicylic acid induced resistance responses of tobacco to TMV infection are sensitive to AOX inhibitors (Chivasa et al., Plant Cell 9, 547-557, 1997). However, studies to date must be interpreted with caution as they are based solely on pharmacological evidence. Hence, we are utilizing transgenic plants with increased and decreased levels of AOX protein (due to the introduction of sense or antisense transgenes of the nuclear gene which encodes AOX) to critically assess the role of AOX in plant resistance responses. Tobacco plants possessing the N gene exhibit a resistance response to TMV infection which includes a hypersensitive response and systemic acquired resistance. Susceptible plants (nn genotype) do not display such resistance responses but salicylic acid pretreatment of such plants can still dramatically reduce virus proliferation. We have generated transgenic

plants with increased and decreased levels of AOX protein and which either lack or possess the N gene. Such plants are being utilized to assess the role of AOX in both the salicylic acid-mediated and the N-gene mediated resistance responses of tobacco to TMV. Our preliminary results will be presented.

P12.

GABA SYNTHESIS ACCOMPANIES THE OXIDATIVE BURST

David Janzen* and Alan Bown

Biological Sciences Dept., Brock University, St. Catharines, Ontario

Rapid stress–stimulated GABA (_-aminobutyric acid) synthesis has been attributed to the stimulation of L–Glu decarboxylase (GAD), the enzyme synthesizing GABA. GAD is stimulated by increases in cytosolic levels of H^+ or Ca^{2+} (Bown and Shelp, Plant Physiol 1997, 15: 1–5). However, the role of GABA accumulation is not clear. Increases in the cytosolic levels of H^+ and Ca^{2+} are implicated in the oxidative burst. The synthesis and efflux of GABA in mesophyll cells during a G–protein activated oxidative burst was investigated to determine whether GABA is associated with the hypersensitive response. The oxidative burst was induced in mesophyll cells with the mastoparan analogue Mas 7, a G–protein activator. In the absence and presence of Ca^{2+}, GABA levels were 2.59±0.48 and 27.55±1.86 nmol GABA 10^6 $cells^{-1}$ (± SE) respectively after addition of Mas 7. The Ca^{2+} channel blocker La^{3+} inhibits cytosolic acidification, the oxidative burst and GABA synthesis. The data suggest that influx of H^+ and/or Ca^{2+} that accompanies the oxidative burst also stimulates GABA synthesis. Furthermore, extracellular GABA levels were significantly higher than intracellular GABA levels, suggesting a possible role for GABA in intercellular communication during the oxidative burst and the associated hypersensitive response.

P13.

CHARACTERIZATION OF AN ACCELERATED SENESCENCE MUTANT IN ARABIDOPSIS THALIANA

Andrea A. Gilpin* and John R. Coleman

Department of Botany, Univ. of Toronto, M5S 3B2.

In an attempt to elucidate the mechanisms of CO_2 mediated regulation of gene expression in plants, *Arabidopsis thaliana* plants were mutagenized using a T-DNA insertion approach and grown in continuous elevated CO_2 conditions of 3500 ppm (10 fold higher than ambient). Plants that deviated from the wild-type response in elevated CO_2 conditions were placed in two broad categories: insensitive and hypersensitive plants. One hypersensitive mutant, *esc1-1*, exhibits early senescence of its cotyledons, is dwarfed, and has small epinastic rosette leaves. The *esc1-1* mutant exhibits a total reversion to a wild-type phenotype when grown on sucrose, and a partial rescue of its phenotype when grown on glucose. These data suggest that sucrose transport or other aspects of carbon allocation may be altered in the mutant. The mutation was mapped to chromosome I using molecular markers and was subsequently cloned by screening a cosmid library. Sequence homology indicates that this is a novel gene. Complementation studies are underway, in which the wild-type copy of the putative gene has been introduced into the mutant *esc1-1* plant to determine if a normal phenotype can be restored. At the moment, the relationships between senescence, sucrose and CO_2 metabolism are uncertain. Key experiments such as antisense and over-expression studies will provide insight into how these processes are regulated by CO_2 in Arabidopsis.

P14.

ISOLATION OF A SENESCENCE- AND RIPENING-INDUCED DEOXYHYPUSINE SYNTHASE GENE FROM TOMATO

Tzann-Wei Wang*, Lily Dongen Lu, and John E. Thompson

Department of Biology, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1

Deoxyhypusine synthase (DHyS) is required for the first step in the post-translational modification of the eukaryotic initiation Factor 5A, which in turn plays a role in the initiation of protein synthesis. Specifically, DHyS activates Factor 5A by converting a lysine into the unusual amino acid, hypusine. Hypusine is only present in activated Factor 5A and is found in all eukaryotes and in some archaebacteria, but not in eubacteria. A cDNA clone encoding a DHyS expressed in response to osmotically (2-M sorbitol) induced senescence has been isolated by screening a cDNA expression library prepared from tomato leaves (*Lycopersicon esculentum*, cv Match). The cDNA contains 1,601 bp and encodes a 381 amino acid polypeptide with a calculated molecular mass of 42.1 kDa. The abundance of the DHyS mRNA increases in senescing flowers, ripened fruit, and chill-injured leaves of tomato. The increase in DHyS mRNA in chill-injured leaves correlates temporally with electrolyte leakage from the leaves. Thus there appears to be a DHyS gene in tomato that is induced in response to both natural senescence and prematurely induced senescence. Southern analysis of tomato genomic DNA has indicated that there may also be another isoform of the gene.

P15.

OIL BODY-LIKE PARTICLES FROM WAX BEAN SEEDS DO NOT CONTAIN OLEOSIN

Carol Froese, Linda Nowack*, Ewa Cholewa, and John E. Thompson

Department of Biology, University of Waterloo, Waterloo, Ontario, Canada

Oil bodies of oil-rich seeds consist of a core of triacylglycerol coated with a monolayer of phospholipid and proteins termed oleosins. These proteins are believed to prevent coalescence of the oil body lipid so the oil can be rapidly mobilized during seed germination. Although oil bodies from oil-rich seeds have been extensively studied, other seeds also contain varying amounts of oil. *Phaseolus vulgaris* (wax bean) is an example of a seed in which lipid is not the primary storage product. However, wax bean seeds contain low-density lipid particles (LDPs) analogous to oil bodies. In particular, these LDPs are highly enriched in triacylglycerol and rapidly disappear during seed germination. There are three major proteins associated with LDPs, two within the size range described for oleosins. The smallest of these is 17 kDa, but the amino acid composition is too hydrophilic for the protein to be an oleosin. The other, 23 kDa in size, appears to be a contaminant from protein bodies which presumably adheres to LDPs during their isolation. In addition, unlike oil bodies from oil-rich seeds, LDPs from wax bean seeds do not aggregate under acidic conditions. In a survey of 13 different legumes, only black-eyed peas,

mung beans and pinto beans shared this characteristic with wax beans. Thus, LDPs from wax bean seeds, and possibly those from black-eyed peas, mung beans and pinto beans, appear to be a unique type of oil body in that they do not contain oleosin.

P16.

ANTISENSE SUPPRESSION OF AN *ARABIDOPSIS* LIPASE-LIKE GENE DELAYS DETACHMENT-INDUCED SENESCENCE OF LEAVES

C. Taylor*, M. K.Y. Lo*, J.E. Thompson
Department of Biology, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1

Senescence is an active process accompanied by a loss in the functional and structural integrity of cellular membranes, which can be attributed to the accelerated metabolism of membrane lipids. In this study we investigated the role of an *Arabidopsis* lipase-like gene, 221D24, in senescence by introducing a 221D24 antisense cDNA fragment into *Arabidopsis*. The retardation of senescence of detached leaves was demonstrated by delayed leaf yellowing and increased chlorophyll content in 221D24 antisense leaves compared to those of wild-type. These results suggest that the 221D24 lipase-like gene plays an important role in the senescence of post-harvest leaves. The 221D24 antisense transgenic plants are stunted early in development indicating that this lipase-like gene is also important for early plant development.

P17.

INDUCTION OF INORGANIC CARBON TRANSPORT AND EXTERNAL CARBONIC ANHYDRASE ARE NOT CORRELATED IN *CHLAMYDOMONAS*

Bozzo, G*. & Brian Colman.
Department of Biology, York University, Toronto, Ont.

Chlamydomonas reinhardtii cells grown in 5% CO_2 were allowed to adapt to air levels of CO_2. Time courses of induction of dissolved inorganic carbon (DIC) transport and external carbonic anhydrase (CA_{ext}) activity were obtained. Photosynthetic oxygen evolution rates measured with a Clarke type electrode in the presence of 5 uM acetazolamide (AZA), a CA inhibitor, were compared with the maximum rate of spontaneous CO_2 production and revealed the induction of active bicarbonate transport over 2 h. The O_2 evolution on addition of bovine CA indicated the induction of CO_2 transport over the same time. A similar rate of induction of both transporters was seen in the dark. CA_{ext} activity was found to increase 10 to 15-fold in adapting cells, over 6 h in light, and a 6-fold in the dark. There are critical [CO_2] at which induction takes place. These results suggest that the during acclimation to low CO_2, the induction of DIC transport in *C. reinhardtii* is not correlated with an increase in CA_{ext} activity.

P18.

CARBONIC ANHYDRASE IN THREE MARINE MICROALGAE

Bhatti, Shabana*, Eva Szabo & Brian Colman.
Department of Biology, York University, Toronto , Ont.

Carbonic anhydrase (CA; EC 4.2.1.1) is a zinc-containing metalloenzyme that catalyzes the reversible interconversion of CO_2 and bicarbonate, has been found in various forms throughout the animal and plant kingdoms. The distribution of CA among three marine microalgal species: *Isochrysis galbana*, *Thalassiosira weissfloggi*, and *Phaeodactylum tricornutum* (B-31, UTEX-640, 10521A) has been examined. The CA activity of air-grown intact cells and cell homogenates was assayed potentiometrically by measuring the rate of change in pH after injection of a standard amount of CO_2-saturated distilled water. High external CA activity (CA_{ext}) was detected in *I. galbana*, low activity in *T. weissflogii* and *P. tricornutum* UTEX-640, and no CA_{ext} was not detected in strains B-31 and 10521A of *P. tricornutum*. Internal CA activity was detected in all three microalgal species. Cell extracts of *I. galbana* were analyzed using cellulose acetate electrophoresis. Separation of CAs using cellulose acetate plates followed by CA detection using bromocresol purple or phenol red revealed 4 bands in air-grown cells. Currently, cell extracts of *T. weissflogii* and strains of *P. tricornutum* are being investigated for variation in carbonic anhydrase.

P19.

PURIFICATION AND CHARACTERIZATION OF PYRUVATE KINASE FROM THE CYANOBACTERIA, *SYNECHOCOCCUS LEOPOLIENSIS*

V.L Knowles*, C.S. Smith, C.R. Smith & W.C. Plaxton,
Dept. of Biology, Queen's University

Pyruvate kinase (PK) is a key regulatory glycolytic enzyme that exists as cytosolic (PK_c) and plastid (PK_p) isozymes in higher plants and green algae. Here we report the first purification of a cyanobacterial PK. *S. leopoliensis* PK was purified 1800-fold to electrophoretic homogeneity and a final specific activity of 141 umol pyruvate produced/min/mg protein. Purification steps included Butyl Sepharose, DEAE-Fractogel, Blue-Dextran agarose, Superose 6, and Mono-Q chromatographies. SDS-PAGE and gel filtration analyses of the final preparation indicated that this PK exists as a 280 kDa homotetramer composed of 65 kDa subunits. Monospecific rabbit anti-(*S. leopoliensis* PK) immune serum effectively immunoprecipated the activity of the purified enzyme. Immunoblot studies using the anti-(*S. leopoliensis* PK) immune serum indicated that cyanobacterial PK is immunologically related to *Bacillus* and green algal PK_p, but not to plant PKs. Likewise, immunoblots of *S. leopoliensis* and *Bacillus* PK cross-reacted with anti-(green algal PK_p)-IgG suggesting structural homology. Similar to green algal and higher plant PK_ps, but not PK_cs, the *S. leopoliensis* PK was relatively heat labile and exhibited an alkaline pH-activity optima of about 7.9. Thus, cyanobacterial PK appears to be more closely related to plant PK_p than to PK_c, consistent with the notion that plant PK_p arose via endosymbiosis of a photosynthetic cyanobacteria. Studies are underway to thoroughly characterize the kinetic/regulatory features of the homogeneous *S. leopoliensis* PK. (Supported by NSERC)

P20.

FEEDBACK REGULATION OF CYTOSOLIC PYRUVATE KINASE AND PHOSPHOENOL-PYRUVATE CARBOXYLASE BY ASPARTATE AND GLUTAMATE INTEGRATES C- & N-METABOLISM IN *BRASSICA NAPUS* SUSPENSION CELLS

C.R. Smith*[,1], T. Moraes[1], & W.C. Plaxton[1,2],
Depts. of Biochemistry[1] & Biology[2], Queen's Univ.

Coordinate regulation of cytosolic PK (PK_c) & PEP carboxylase (PEPC) plays a critical role in the integration of C-partitioning with the generation of 2-oxoglutarate needed for N-assimilation by GS/GOGAT. PEPC has an additional

function to produce oxaloacetate for Asp production by Asp aminotransferase (AAT). PK_c & PEPC from heterotrophic *B. napus* (canola) suspension cells were purified to homogeneity and respective Sp. Act's. of 51 & 32 units/mg protein. The purified PK_c & PEPC are 220 and 420 kDa homotetramers that exhibited pH optima of pH 6.8 & 8.4, respectively. Glu, and the flavonoids rutin and quercetin were the most effective PK_c inhibitors (I_{50}'s=4, 0.07 & 0.1 mM, respectively). Asp functions as a PK_c activator (K_a=0.3 mM) by facilitating PEP binding while reversing Glu inhibition. Increasing levels of Glu enhanced PK_c's K_a(Asp) and fold-activation by Asp. PEPC was insensitive to metabolite effectors at pH 8.4, but was potently inhibited by Glu, Asp, and malate at pH 7.3 (I_{50}'s=5.1, 1.4 & 0.1 mM, respectively). Feedback inhibition of *B. napus* PK_c and PEPC by Glu provides a rationale for the known activation of these two enzymes that occurs *in vivo* during periods of enhanced N-assimilation (when [Glu] is reduced). Asp appears to perform a key role in the reciprocal regulation of PK_c (activator) and PEPC (inhibitor), thus providing a mechanism for decreasing flux from PEP to Asp (via PEPC & AAT), while promoting PK_c activity when cytosolic [Asp] is elevated. A model outlining the allosteric effector regulation of PK_c and PEPC during N-assimilation by *B. napus* suspension cells will be presented. (Supported by NSERC)

P21.

MOLECULAR AND PROTEIN CHARACTERIZATION OF PLASTIDIC GLUCOSE-6-PHOSPHATE DEHYDROGENASE (G6PDH) IN CASTOR (*RICINUS COMMUNIS* L.)

David T. Dennis and Ka-Yu Law*
Dept Biology, Queen's University, Kingston, Ont.

All plant cells contain plastids, organelles specialized to perform various biochemical processes including photosynthesis, starch and oil biosynthesis. The latter processes in oilseeds, occur in a plastid termed the leucoplast. In leucoplasts, anabolic metabolism including the production of fatty acids and oil, mevalonate and amino acids, is dependent on the availability of reductants such as NADPH. Glucose-6-phosphate dehydrogenase G6PDH is the first and a key control enzyme in the Oxidative Pentose Phosphate Pathway (OPPP) where NADPH is concomitantly produced from $NADP^+$ when G6PDH converts glucose-6-phosphate to 6-phosphogluconate. At least two compartment-specific isoforms of G6PDH, a cytosolic and a plastidic form exist in green plant tissues. This poster presentation will detail the study of G6PDH in castor oil seed (COS), a model system for the study of oil biosynthesis in plants. The work described here includes the isolation of a full-length clone of the plasidic isoform of this enzyme from a castor cDNA library using polyclonal plastidic G6PDH antiserum to potato plastidic G6PDH. A comparison of this gene to other higher plant G6PDH genes reveals interesting conserved regions that may be involved in the regulation of this enzyme. As well, overexpression of this gene in a GST vector has provided sufficient enzyme activity to gather preliminary data on certain aspects of the kinetics of this enzyme from overexpressed crude extracts.

P22.

THE ACTIVE SITE OF PYROPHOSPHATE-DEPENDENT PHOSPHOFRUCTOKINASE BASED ON MOLECULAR MODELING

Lehli M. Pour[1*], Zongchao Jia[2], David T. Dennis[3]
Departments of Biology[1,3] and Biochemistry[2], Queens University, Kingston, ON K7L 3N6

In the plant cytosol, phosphofructokinase (PFK) and pyrophosphate-dependent phosphofructo-kinase (PFP) catalyze the conversion of fructose-6-phosphate (F-6-P) to fructose-1,6-bisphosphate (F-1,6-P_2). PFK is present in almost all organisms and operates irreversibly in the glycolytic direction using ATP as its phosphoryl donor. PFP appears to be ubiquitous in higher plants and catalyzes a freely reversible reaction using pyrophosphate as the phosphoryl donor. PFP isolated from plants is activated by low levels of fructose-2,6-bisphosphate (F-2,6-P_2). A F-2,6-P_2 insensitive form of PFP is also found in bacteria and primitive protists. Although PFK and PFP are distinct proteins with little overall sequence homology, the regions which comprise the active site of *E. coli* PFK are highly conserved in both plant and microbial PFP. Using the crystal structure of *E. coli* PFK as a template, models of the active site of plant PFP and protist PFP were constructed. The active sites of PFK and PFP are very similar but have important differences. Arg154 of the β subunit of the plant enzyme is not in the same orientation as the Arg72 residue in *E. coli* nor the Arg142 residue in protist PFP. Site-directed mutagenesis studies indicate that Arg72 is a key residue in PFK catalysis and F-6-P binding. It is possible that the binding of F-2,6-P_2 to plant PFP causes a conformational change, shifting the Arg154 side chain into the active site, thereby stabilizing the transition state and decreasing the K_m (F-6-P/F-1,6-P_2).

P23.

AN UNREGULATED GLYCOLYTIC ENZYME (PFP) RESULTS IN CHANGES IN SEED STORAGE LIPIDS IN *NICOTIANA TABACUM* (L.).

Susan Wood* Steven King, Maryse Chalifoux, Monika Kuzma, David Dennis[2] William Newcomb,
Biology Dept., Queen's University; [2]Performance Plants Inc., Kingston;

The role of the enzyme pyrophosphate-dependent fructose 6-phosphate, 1-phosphotransferase (PFP) remains unclear, despite considerable research. In a novel approach, a gene for PFP derived from the protist *Giardia lamblia*, was inserted into the tobacco genome in the sense direction. The *Giardia* PFP was unregulated by the plant, which continued to produce the native plant PFP; the two forms of the enzyme were analyzed independently. Analysis of four transgenic lines revealed a number of changes which suggest that flux through the pathway in the glycolytic direction was enhanced. Of particular interest were alterations in the production of seed storage lipids, which could prove valuable to the oil-seed industry. Most noticeably, the onset of seed storage lipid deposition was hastened; consequently, the total lipid content in the early stages of embryogenesis (9 days after anthesis) was greater in the transgenics. The total lipid content of the mature seeds was not significantly different. As well, increased production of 18:2 fatty acids during the early stages of embryo development of the transgenic lines was observed. The significance of altered timing of seed storage lipid deposition and the role of PFP is discussed.

P24.

MAINTAINING THE TRANSMETHYLATION CYCLE: THE INVOLVEMENT OF ADENOSINE KINASE.

Barbara M. Moffatt[a], Martina Drebenstedt[b*], Kristin Alexander[a], Jamie Snider[a], Peter Summers[b], and Elizabeth A. Weretilnyk[b]. [a]*Biology Dept, U Waterloo. Waterloo, ON,* [b]*Dept of Biology, McMaster University, Hamilton ON .*

S-adenosyl-L-methionine (SAM) dependent methyltransferases synthesize or modify many compounds in plants including DNA, lignin, pectin and phosphatidylcholine. Upon transmethylation, *S*-adenosyl-L-homocysteine (SAH) is formed, a potent inhibitor of SAM-utilizing methyltransferases. SAH hydrolase catalyses a reversible reaction which favours SAH hydrolysis upon removal of the products adenosine and homocysteine. An enzyme that can metabolize adenosine is adenosine kinase (ADK). Arabidopisis mutants deficient in ADK activity have been isolated. These mutants display a phenotype consistent with abherrent transmethylation activities including reduced pectin methylation. Arabidopisis plants grown under short day conditions, a daylength that increases methylation demand due to enhanced secondary cell walls, have higher ADK activity, protein and transcripts relative to plants grown under long days. We have also salinized spinach, a treatment that increases the methylation of phosphobases for glycine betaine synthesis. In these plants, increased methylation demand elevated both SAH hydrolase and ADK activities and protein. We propose that ADK activity is essential to maintaining transmethylation reactions in plants by removing adenosine to promote SAH catabolism.

P25.

PURIFICATION AND PROPERTIES OF *S*-ADENOSYL-L-METHIONINE: PHOSPHOMONOETHANOLAMINE *N*-METHYLTRANSFERASE

Thomas Burian*, Elizabeth Weretilnyk and Peter Summers, *Department of Biology, McMaster University, Hamilton, ON, L8S 4K1.*

Many plants accumulate the compatible osmolyte glycine betaine when exposed to osmotic stress. In spinach (*Spinacea oleracea*), phosphocholine is an intermediate for glycine betaine production and its synthesis increases with osmotic stress. Phosphocholine is produced by three sequential *N*-methylations of phosphoethanolamine (PEA) involving two *S*-adenosyl-L-methionine (SAM)-dependent methyltransferases. While a single enzyme has been shown to methylate PEA to phosphocholine, here we report on a second enzyme that uses the methylated intermediate phosphomethylethanolamine (PMEA) but not PEA as a substrate. We have purified PMEA *N*-methyltransferase (PMEAMeT) over 500-fold using a six step purification strategy: ammonium sulfate fractionation

analysis shows several polypeptides are present. However, only one polypeptide of 28 kDa can be photoaffinity cross-linked to [^{3}H]SAM. Inclusion of PMEA but not PEA in the cross-linking reaction abolishes radiolabelling, showing that the 28 kDa band is associated with PMEAMeT activity.

P26.

IDENTIFICATION AND PARTIAL CHARACTERIZATION OF LIPASE CLONES FROM *PHASEOLUS VULGARIS* LEAVES

Matthew D. Smith*, A Padham, and JE Thompson
Dept Biology, University of Waterloo, Waterloo, Ontario

A lipase gene is up-regulated in the leaves of *Phaseolus vulgaris* as a function of age, as indicated by Northern blot analysis using a heterologous cDNA as a probe. A series of degenerate primers were designed based on the amino acid and nucleotide sequences of seven plant lipases, and used to amplify putative lipase transcripts from the primary leaves of 3-week-old seedlings by RT-PCR. Three partial clones were obtained, all of which corresponded to lipases as determined by comparison to protein databanks. Preliminary Northern blots indicate that two of the partial clones may correspond to the same lipase, which appears to be expressed in young tissue and down-regulated during natural senescence and has, therefore, been dubbed a "stress" lipase. Northern blots are currently being probed with the third partial lipase clone isolated from leaves. This lipase may correspond to the lipase that is up-regulated during the early stages of leaf senescence as identified by probing Northern blots with the carnation lipase clone. Collectively, these data indicate that there are a series of lipase-like enzymes in the leaves of *P. vulgaris*, which are expressed at different times during development. Lipases from *Phaseolus* leaves have been described on a biochemical level, but this is the first report on the isolation of genes for such enzymes.

P27.

MOLECULAR CLONING OF A GROUP OF THIOL METHYLTRANSFERASES, POTENTIALLY INVOLVED IN DETOXIFICATION IN RED CABBAGE

Jihad Attieh[1*], Rose Djana[1], Salvatore A. Sparace[2] & Hargurdeep S. Saini[1], [1]*IRBV, Université de Montréal, Montréal.* [2]*Plant Sci Dept, McGill U, Ste-Anne-de-bellevue*

We have recently reported the presence of a novel group of thiol methyltransferases (TMTs) in red cabbage and a number of other glucosinolate-containing plants. Preliminary evidence indicated that these enzymes may be involved in the methylation, and thus detoxification, of reactive thiol groups generated upon glucosinolate degradation. Five TMTs, with distinct molecular masses ranging from 26 to 31 kDa, were purified to homogeneity. They all methylated thiocyanate ion and the aromatic thiols thiophenol, 4,4'-thiobisbenzenethiol, and thiosalicylic acid. Three peptic digests of one of these proteins were microsequenced, and showed significant homology to an *Arabidopsis* EST of unknown function. This EST was used to screen a cabbage cDNA library and 2 clones, *cTMT-1* and *cTMT-2*, were isolated. The clones contained the sequences of all three microsequenced peptides. Each of these clones contained an open reading frame of 681 nucleotides, encoding putative polypeptides of 226 amino acids. The calculated molecular masses of the two deduced polypeptides were 25.129 and 25.019 kDa, respectively. The amino acid sequences showed significant similarity to the sequence of two unknown proteins from *Arabidopsis* and to a recently cloned methyl chloride transferase from the succulent halophyte *Batis maritima*. Further characterization of these clones is in progress. The physiological and environmental implications of these novel genes for plant-herbivore interactions will be discussed.

P28.

HUNTING FOR AN AGL24 MUTANT OF ARABIDOPSIS THALIANA.

Hayden, D.S. and Kohalmi, S.E.* *Dept. of Plant Sciences, University of Western Ontario, London, Ont*

Proteins carrying a MADS-box motif can be found in eukaryotic organisms as diverse as yeast and humans. AGL24 is one of the approximately 100 MADS-box proteins in Arabidopsis thaliana. Based on structural and sequence criteria, such proteins are putative transcription factors, able to bind DNA and interact with other proteins. In Arabidopsis only a few MADS box proteins, including several floral identity genes, have been characterized on a functional level. In situ hybridizations indicate that these genes have very specific spatial and temporal expression patterns suggesting diverse and distinct roles in developmental regulation. Most AGAMOUS-LIKE or AGL genes have been identified via nucleotide sequence similarity with AGAMOUS. More recently many of them have been isolated through various DNA sequence projects and yeast two-hybrid screens. Consequently, only very few (other than the original organ identity mutants) have a known mutant phenotype associated with them. However, phenotypic characterization of null mutants or mutants having only a partially functioning protein is an invaluable tool for the functional characterization of a gene and its product. To identify a null or partial mutant of AGL24, we have been screening plant lines in the hope to identify a T-DNA insertion within the promoter or coding region of AGL24 using a PCR-based approach. We will present a progress report and discuss problems of identifying random insertions in single genes in the context of large conserved protein families.

P29.

PHOTOSYNTHETIC ACCLIMATION PROCESSES IN THE CYANOBACTERIA OF BEAVERSKIN LAKE, NOVA SCOTIA

D. Campbell*, M. DiQuinzio, J. Ackman, S. Roy+, S. Purcell-MacDonal, P. Morton, T. Clair#, *Dept Biol, Mount Allison U, Sackville, NB +U Québec à Rimouski; #Environment Canada, Atlantic Division, Sackville, NB*

We filter sampled phytoplankton cells from Beaverskin Lake, a small, acidic, oligotrophic clear water lake in Kejimkujik National Park, Nova Scotia. Our samples on five dates in 1997 spanned the progression of a summer cyanobacterial bloom. Merismopedia sp. contributed up to 95% of the phytoplankton cells, but its contribution to total phytoplankton biovolume was much lower. We extracted hydrophobic pigments and analyzed them using HPLC, and extracted total phytoplankton proteins, followed by specific detection and quantitation of the cyanobacterial light-capture phycobiliproteins and the cyanobacterial carbon-fixation enzyme RUBISCO. Chlorophyll, Phycobiliproteins and RUBISCO measured per litre of lake water were relatively stable over the summer, and distinct from the rise and decline of cell numbers and biovolume over the summer. This shows there were large changes in the content of these macromolecules per phytoplankton cell and per unit biovolume over the course of the summer bloom. The growth of the cells over the summer was therefore not balanced, but rather the cellular concentrations of key macromolecules declined over time. Preliminary calculations show that in these phytoplankton cells RUBISCO was present in large excess over the enzymatic levels required to support measured carbon fixation rates. This implies RUBISCO functions as a reserve molecule, and is accumulated in excess of metabolic requirements. We are returning for more detailed sampling and productivity measures in 1999 & 2000, with the aim of learning how the phytoplankton population (re)allocates nitrogen resources over the course of blooms in an oligotrophic lake.

P30 (Abstract only)

PURIFICATION AND CHARACTERIZATION OF A TRANSALDOLASE FROM LEUCOPLASTS OF DEVELOPING CASTOR BEAN ENDOSPERM

Fayek B. Negm, David H. Turpin, and David T. Dennis
Dept Biology, Queens U, Kingston, ON

Transaldolase (EC 2.2.1.2) catalyzes the reversible transfer of a dihydoxyacetone moiety of fructose-6-phosphate (Fru-6-P) to erythrose-4-phosphate (Ery-4-P), forming sedoheptulose-7-phosphate (Sed-7-P) and releasing glyceraldehyde-3-phosphate (Ga-3-P). Developing castor bean leucoplasts contain 3 transaldolase isozymes that were separated by chromatography on a Mono Q anion exchange column. The isozyme of the highest activity was purified to near homogeniety as indicated by a single band on SDS-PAGE. The isozyme is a monomer with a molecular mass of 43,000 Da as determined by gel filtration on a Superose 12 column. Maximum activity occurs at pH 7.5. The K*m* for Ery-4-P and Fru-6-P are 43 uM and 980 uM, respectively. The specific activity of the purified enzyme is about 40 U/mg protein using Ery-4-P and Fru-6-P as substrates at 25°C. Transaldolase activity is reduced in Tris-HCl and phosphate buffers and is inhibited by D-arabinose-5-phosphate. This is the first report on the purification of a transaldolase from higher plants and its molecular mass and characteristics are quite distinct from yeast and bacterial transaldolases. Transaldolase might operate as another enzyme for Fru-6-P metabolism to bypass PFK step in glycolysis and generating substrates for fatty acid biosynthesis in leucoplasts.

CSPP EASTERN REGIONAL MEETING
Queen's University, Kingston, 1999

At Mtg	Name	Institution	Presentation O=oral, P=Poster S=Symposium	Abstract Number(s)
No	Ackman, J.	Mount Allison University		P29
No	Aharon, Gilad S.	University of Toronto		3A5
No	Alexander, K.	University of Waterloo		1A2, P24
Yes	Allen, Michael	University of Waterloo	O	1A1*, 1A2
Yes	Apse, Maris	University of Toronto	O	3A5*
Yes	Attieh, Jihad	Université de Montréal	P	P27*
Yes	Ayari, Olfa	Université Laval	P	P2*
Yes	Begna, S.H.	McGill University	O	3B6*
Yes	Bernal, Libby	University of Guelph		
Yes	Bhatti, Shabana	York University	P	P18*
Yes	Blumwald, Eduardo	University of Toronto		1A3, 1B3, 3A1, 3A5
No	Bowen, P.A.	University of British Columbia		1B4
No	Bowley, S.R.	University of Guelph		2A3, 3A6
Yes	Bown, Alan	Brock University		P1, P12
Yes	Bozzo, Gale	York University	P	P17*
No	Brisson, N.	Université de Montréal		2A1, 2A2
No	Bruce, Doug	University of Guelph		P1
No	Bukhov, Nicolai	Timiriasev Inst., Russia		P3
Yes	Burian, Thomas	McMaster University	P	P25*
Yes	Campbell, Catherine	University of Toronto	O	3A3*
Yes	Campbell, Douglas	Mount Allison University	P	3A5, P29*
No	Carlson, P.J.	University of Lethbridge		S1
No	Carpentier, Robert	Université du Québec		P3
Yes	Cen, Yanping	Queen's University	O	1B5*
No	Chalifoux, Maryse	Queen's University		P23
No	Cholewa, Ewa	University of Waterloo		P15
No	Clair, T.	Environment Canada, N.B.		P29
No	Cloutier, D.	McGill University		3B6
Yes	Coleman, John	University of Toronto	S	S2*, P13
Yes	Colman, Brian	York University		P5, P17, P18
Yes	Cot, Swan	University of Toronto		
Yes	Coté, Richard	University of Guelph		2B4
Yes	Crozier, Cheryl	University of Toronto		
Yes	Cummins, W. Raymond	University of Toronto		
Yes	Curtis, Jason	Queen's University		
Yes	Darlington, Alan	University of Guelph		2B2, 2B3
Yes	Davidson, Andrea	Queen's University	P	P6*
No	Deng, Ming-De	University of Toronto		S2
Yes	Dennis, David T.	Performance Plants Inc.		P21, P22, P23, P30
No	Desjardins, Yves	Université Laval		P3
No	Després, C.	Université de Montréal		2A1, 2A2
Yes	Desveaux, Darrell	Université de Montréal	O	2A1*, 2A2
Yes	Devereaux, Alissa	University of Guelph	O	3A6*
No	Dextraze, L.	Agriculture Canada		2A4
No	DiQuinzio, M.	Mount Allison University		P29
No	Dixon, Michael	University of Guelph		2B2, 2B3, 2B4
No	Djana, Rose	Université de Montréal		P27
No	Dong, Zhongmin	St. Mary's University		2B1
No	Dorais, Martine	Greenhouse Crops Rsch. Ctr.		P2

Author and Participant List

At Mtg	Name	Institution	Presentation O=oral, P=Poster S=Symposium	Abstract Number(s)
Yes	Drebenstedt, Martina	McMaster University	P	P24*
No	Dwyer, L.M.	Agriculture Canada		3B6
Yes	Ellis, Brian	University of British Columbia	S	S3*
Yes	Espie, George	University of Toronto		P5
Yes	Ferreira, Fernando	University of Toronto		
Yes	Flanagan, Larry	University of Lethbridge	S	S1*
No	Froese, Carol	University of Waterloo		P15
No	Funakoshi, D.M.	McGill University		P9
Yes	Gilpin, Andrea	University of Toronto	P	P13*
No	Gosselin, André	Université Laval		P2
Yes	Graham, Thomas	University of Guelph	O	2B4*
No	Gregorich, E. G.	University of Lethbridge		S1
No	Grodzinski, B.	University of Guelph		1B6
Yes	Hamel, Chantal	McGill University	P	P9*
No	Hayden, D.S.	University of Western Ontario		P28
Yes	Huertas, Emma	York University	P	P5*
Yes	Huner, Norman	University of Western Ontario		1A6, 1B6, 3B4, P4*
No	Hunt, Stephen	Queen's University		1A5
No	Hurry, V.M.	University of Western Ontario		1A6
No	Ivanov, Alexander	University of Western Ontario	P	3B4, P4
Yes	Janzen, David	Brock University	P	P12*
Yes	Jebanathirajah, Judith	University of Toronto		S2
No	Jia, Zongchao	Queen's University		P22
Yes	Jowett, Tara	Queen's University	O	1A5*
Yes	Joyeux, Alexandre	Université de Montréal		2A1, 2A2*
Yes	Karner, Julie	Brock University	P	P1*
Yes	Kaup, Marianne	University of Waterloo		
Yes	Kettlewell, Bubby	Queen's University		
No	King, Steven	Queen's University		P23
Yes	Knowles, Vicki	Queen's University	P	P19*
Yes	Ko, Kenton	Queen's University	P	P7*
No	Ko, Zdenka W.	Queen's University		P7
Yes	Kohalmi, Susanne	University of Western Ontario	P	P28*
Yes	Krol, Marianna	University of Western Ontario		
No	Kuzma, Monika	Queen's University		P23
Yes	Lam, Chi-Hang Bernard	University of Toronto	O	1B3*
Yes	Law, Ka-Yu	Queen's University	P	P21*
Yes	Layzell, David	Queen's University	O	1B5, 2B1*, 3B3
Yes	Leiss, Bill	University of Calgary	Plenary	S4
No	Leonardos, E.D.	University of Guelph		1B6
Yes	Llewellyn, David	University of Guelph	O	2B3*
Yes	Lo, Maisie	University of Waterloo	P	P16*
No	Lu, Lily Dongen	University of Waterloo		P14
Yes	Ma, Fengshan	University of Waterloo	O	1B1*
Yes	Macfie, Sheila	University of Western Ontario		P8
Yes	MacGregor, Kennaway	Brock University		P1*
Yes	MacKenzie, Tyler	Mount Allison University	O	3B5*
Yes	Madey, Ewa	University of Waterloo		
Yes	Mallany, Jeffrey	University of Guelph	O	2B2*
No	McCaffrey, L.	University of Waterloo		1A2
Yes	McDonald, Allison	Queen's University	O	3A2*
No	McKersie, B.D.	University of Guelph		2A3, 3A6
No	Minhas, Joginder	Université de Montréal		3A4
Yes	Miransari, M.	McGill University	O	3B2*

Author and Participant List

At Mtg	Name	Institution	Presentation O=oral, P=Poster S=Symposium	Abstract Number(s)
No	Miskiewicz, E.	University of Western Ontario		P4
Yes	Mitchell, Holly	BIOCAP		
No	Moffatt, Barbara	University of Waterloo		1A1, 1A2, P24
No	Moraes, T.	Queen's University		P20
Yes	Morgan, Rachael	University of Western Ontario	O	3B4*
No	Morton, P.	Mount Allison University		P29
Yes	Mykoo, Jeevan	Queen's University		
No	Negm, Fayek	Queen's University		P30
Yes	Newcomb, William	Queen's University		P6, P23
No	Niere, J.O.	Royal Melb Inst Tech		3A2
Yes	Nowack, Linda	University of Waterloo	P	P15*
Yes	Nozzolillo, Connie	University of Ottawa		
Yes	Nunes, Chantale	Université de Montréal	O	3A4*
Yes	Oaks, Ann	University of Guelph		
No	Oquist, G.	University of Umea, Sweden		1B6, P4
Yes	Ordog, Sandi	University of Toronto	P	P10*, P11*
Yes	Padham, Anita	University of Waterloo	P	P26*
Yes	Palma, Dave	Queen's University	O	3A1*
No	Park, Y.-I.	Chungnam Nat'l U., Korea		P4
No	Pereira, L.	University of Waterloo		1A2
Yes	Peterson, Carol	University of Waterloo		1B1, 1B2
Yes	Plaxton, Bill	Queen's University		1A4, 1A5, 3A1, 3A2, P19, P20
Yes	Pocock, Tessa	University of Western Ontario	O	1A6*
Yes	Pour, Lehli	Queen's University	P	P22*
Yes	Prithiviraj, B.	McGill University	O	3B1*
No	Purcell-MacDonal, S.	Mount Allison University		P29
No	Qin, Wensheng	University of Waterloo		1A1
No	Raven, J.A.	University of Dundee, Scot.		P4
No	Rochette, P.	University of Lethbridge		S1
No	Roy, S.	Mount Allison University		P29
No	Sage, Rowan	University of Toronto		3A3
Yes	Saini, Deep	Université de Montréal		3A4, P27
Yes	Samis, Karen	University of Guelph	O	2A3*
Yes	Samson, Guy	Université Laval	O	2A4*, P2, P3*
Yes	Savitch, Leonid	University of Western Ontario	O	1A6, 1B6*
Yes	Schade, Frank	University of Waterloo		
Yes	Shearer, Heather	Queen's University		
No	Smith, C. S.	Queen's University		P19
Yes	Smith, Chris R.	Queen's University	P	P19, P20*
Yes	Smith, Donald	McGill University		3B1, 3B2, 3B6
No	Smith, Matthew	University of Waterloo	P	P26
Yes	Snedden, Wayne	University of Toronto	O	1A3*, 3A5
Yes	Snider, Jamie	University of Waterloo	O	1A2*, P24
Yes	So, Tony	University of Toronto		
No	Solumenoev, A.	McGill University		3B1
No	Sparace, Salvatore A.	McGill University		P27
No	Stevens, Y.	University of Waterloo		1A2
No	Subramaniam, R.	Université de Montréal		2A1
Yes	Summers, Peter	McMaster University		P24, P25
Yes	Sweeney, Michelle	University of Western Ontario	P	P8*
Yes	Szabo, Eva	York University		P18
Yes	Taylor, Catherine	University of Waterloo	P	P16*
Yes	Taylor, Gregory	University of Alberta		

Author and Participant List

At Mtg	Name	Institution	Presentation O=oral, P=Poster S=Symposium	Abstract Number(s)
Yes	Taylor, Jeff	University of Waterloo	O	1B2*
No	Thompson, John E.	University of Waterloo		P14, P15, P16, P26
No	Towers, G. H. N.	University of British Columbia		1B4
No	Tremblay, N.	Agriculture Canada		2A4
Yes	Turner, William	Queen's University	O	1A4*
No	Turpin, David	Queen's University		P30
Yes	Usher, Kevin	University of British Columbia	O	1B4
No	Vanlerberghe, Greg	University of Toronto		P10, P11
No	Wang, B.	McGill University		P9
No	Wang, L.	University of Waterloo		1A2
Yes	Wang, Tzann-Wei	University of Waterloo	P	P14*
Yes	Wei, Hui	Queen's University	O	3B3*
No	Weretilnyk, Elizabeth	University of Waterloo		P24, P25
No	Wever, L. A.	University of Lethbridge		S1
No	Wollring, J.	Inst PflanzenerShrung, Ger		2A4
Yes	Wood, Susan	Queen's University	P	P23*
No	Wu, Lishu	Huazhong U. China		2B1
No	Yaakoubd, Bouchra	Université Laval	P	P3
No	Yip, Justine	University of Toronto	P	P10
Yes	Zacal, Natalie	University of Toronto		
Yes	Zhou, Yuanxiang	University of Toronto		

infection by *Phytophthora infestans* and elicitation with arachidonic acid. This activation correlates with the induced binding of PBF, a single-stranded DNA-binding factor, to a 30 bp elicitation-response element (ERE) in the promoter of *PR10a*. We report on the cloning of *p30*, a gene coding for a 30 kD DNA-binding protein component of the larger PBF complex, using a cDNA pooling approach. p30 represents a novel type of DNA-binding protein that is ubiquitous in the plant kingdom. Purification of PBF from elicited and fresh tubers as shown that this factor is stored inactive in the nuclei of fresh potato tubers, and is activated upon elicitation. This suggests that activation of *PR10a* by PBF does not require *de novo* protein synthesis. Consistent with this hypothesis, preliminary results show that *p30* mRNA production is not significantly induced after treatment with arachidonic acid. The parsley *PR10* gene is also regulated via an ERE-like sequence, bound by proteins of the WRKY family. However, transcription of the *WRKY* genes, in contrast to *p30*, is sharply induced following elicitation. It thus appears that p30 participates in the primary activation of *PR10*. Sustained activation may require WRKY proteins, though this has not yet been shown for the potato *PR10a* gene.

air stream. Some authors have suggested that the higher plants in the system may play a significant role in the removal of VOCs through sorptive processes on the leaf surface. It was found that although VOCs were being removed by the associated biofilter during the course of the experiment, only small levels of VOCs could be recovered from the leaf material itself. In most cases the concentration of VOC in the leaf material did not change with the concentration in the room. It is concluded that the foliage of plants represents a negligible sink for VOC in the indoor environment.

3:15 – 3:30 pm 2A3

AN EVALUATION OF THE F1 PROGENY OF TRANSGENIC ALFALFA GENOTYPES TRANSFORMED WITH GENES RELATED TO ABIOTIC STRESS TOLERANCE.

Karen Samis*, SR Bowley and BD McKersie
Plant Biotech Div., Dept Plant Agric, U Guelph, Ont.

A series of F1 families were generated through paired crosses between alfalfa genotypes transgenic for either Mn-SOD (mitochondrial or chloroplastic transit peptide), Fe-SOD or ADH in order to evaluate the effect of transgenes in combination. Southern hybridization analyses verified that selected parent plants had either one, two or three transgene insertion events. Goodness-of-fit tests indicated that the parental transgenes assorted independently and segregated in the F1 progeny following the expected ratios of 1:1 for single and linked insertion events, and 3:1 for unlinked insertion events. Analysis of SOD enzyme activity revealed that transgene expression levels within families were similar between parents and F1 progeny and also between F1 segregation classes within families. Analyses of dry matter accumulation in roots, crowns and shoots, in general, indicated that double SOD and ADH transgenic F1 progeny had accumulated more dry matter than single and non transgenic F1 genotypes, but that this difference was only significant for progeny from Mn-SOD (mitchondrial TP) or Fe-SOD and ADH crosses. Double SOD transgenes generally had no significant effect on increasing dry matter accumulation in the F1 families studied.

3:15 – 3:30 pm 2B3

BIOFILTRATION II: THE ROLE OF FUNGI IN AN INDOOR BIOFILTER

David Llewellyn*, Alan Darlington and Michael Dixon,
Hort Sci, Dept Plant Agric, U Guelph, Ont.

Living moss has been shown to be an adequate support medium for the biofiltration of low concentrations of airborne volatile organic compounds (VOCs) such as those typically found in indoor settings. The moss provides a suitable environment for the proliferation of microbial degraders while also maintaining favourable conditions for the exposure of airborne contaminants to the degrading population. Historically, bioreactors have focussed on prokaryotic communities, and, while fungi have been shown to consume various VOCs, their role in bioremediation has largely been ignored. Current studies have indicated that fungi may play a role in biofiltration. A biofilter actively removing toluene and MEK was treated with bacteriostatics (tetracycline, streptomycin and chloramphenicol). The biofilter responded with an almost complete cessation in toluene removal capacity but only a 50% reduction in MEK removal. The physical presence of fungi in the moss biofilter has been quantified. In addition, their role in consuming VOCs has been demonstrated. The ability of pure culture fungal isolates to consume VOCs will be discussed.

3:30 – 03:45 pm 2A4

DETECTION OF PLANT GROWTH INHIBITION CAUSED BY NITROGEN AND SULFURDEFICIENCIES IN CORNPLANTS BY LASER-INDUCED FLUORESCENCE

Guy Samson[1*], L Dextraze[2], N Tremblay[2] & J Wollring[3],
[1]CRH, Université Laval, QC;[2]CRDH Agric. Canada,St-Jean-sur-Richelieu QC; [3]Institutfür Pflanzener_hrung & Umweltforschung, HydroAgri Deutschland, Dülmen, Germany

The aim of this study was to determine the potential of laser-induced fuorescence (LIF) to detect precociously plant growth inhibition caused by nitrogen (N) and sulfur (S) deficiencies. LIF spectra were measured on excised leaves of corn plants grown in a greenhouse with different N and S levels with a FLS-PL compact multi-wavelength fluorescent lidar. Leaf

3:30 – 03:45 pm 2B4

THE USE OF OZONE IN THE MAINTENANCE OF RECIRCULATING HYDROPONIC NUTRIENT SOLUTIONS: THE EFFECTS OF OZONATION ON MAJOR NUTRIENT IONS

G. Thomas Graham*, Richard Côté and Michael A. Dixon
Controlled Environ Systems Facilities, Dept Plant Agric U Guelph, Ont

The strong oxidation potential of ozone makes it a prime candidate for the control of pathogens and organic compounds found in recirculating hydroponic solutions. The efficiency of ozone to destroy bacteria and other microorganisms, as well as its capacity to oxidise organic compounds, has been demonstrated in both the municipal and bottled water industries. Ozone is also known to facilitate reactions that cause transition metal ions, such as iron,

greater when injection occurred in shade. Sucrose injection did not affect overall patterns of dry matter allocation and their response to shade suggesting that those effects are strictly due to light intensity and are not related to photosynthate availability.

10:30 – 10:50 am **Coffee Break**
Courtesy of Qubit Systems Inc.

10:30 – 10:50 am **Coffee Break**
Courtesy of Qubit Systems Inc.

10:50 – 11:15 am **Awards Ceremony and meeting wrap-up** (in Atrium)

11:15 am **Departure**