Department of Biosciences
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Professional Preparation

1998	Ph.D. in Biochemistry and Cell Biology	Dept. of Cell Biology, John Innes Centre, UK.
1994	M.Sc. By Research in Plant Pathology (Distinction)	Dept. of Applied Biology, Hull University, UK.
1992	B.Sc. (HONS) Special Biology	Dept. of Applied Biology, Hull University, UK.

Appointments

Minnesota State University Moorhead, MN, USA.
08/2019 – Present Tenured Associate Professor of Biosciences.
Minnesota State University Moorhead, MN, USA.
08/2010 – 05/2019 Tenured Assistant Professor of Biosciences.
Minnesota State University Moorhead, MN, USA.
08/2008 – 08/2010 Probationary tenure-tracked Assistant Professor of Biosciences.
Minnesota State University Moorhead, MN, USA.
08/2005 – 06/2008 Visiting Assistant Professor of Biosciences.
North Dakota State University, Fargo, ND, USA.
07/2005 – 08/2011 Adjunct Professor of Research working on surveying the microscopic autosporic coccoid green algae for distinctive features of the cell covering using Fourier Transformed Infrared (FT-IR) Spectroscopy.
North Dakota State University, Fargo, ND, USA.
01/2001 – 07/2005 Post-Doctoral Research Fellow working on cellulose biosynthesis in *Agrobacterium tumefaciens* and xyloglucan biosynthesis in *Pisum sativum*.
Glasgow University, Scotland.
12/1998 – 12/2000 Post-Doctoral Research Assistant using Electron Energy Loss Spectroscopy (EELS) for elemental imaging of the plant cell wall.
Wye College (University of London), UK.
07/1994 - 10/1995 Research Technician. Flower Development in *Rumex acetosa*

Teaching experience

The undergraduate Biology major courses I have taught in my time at MSUM include: Biotechniques I and II (BCBT 475 and 476), Biochemistry I (CHEM 405), Biochemistry II Lab (CHEM 410L), Plant Physiology (BIOL 341 and BIOL 341L), Genetics Lab (BIOL 347L), Plant Physiology (BIOL 349 and BIOL 349L) General Botany (BIOL 305 and BIOL 305L), Organismal Biology Lab (BIOL 115), Cell Biology Lab (BIOL 111). The non-major courses I have taught at MSUM include: An Ecological Perspective (BIOL 346), Human Biology (BIOL 104), Matter and Life (BIOL 102), and Biology Today (BIOL 109) along with its corresponding Lab (BIOL 109L), a course that I developed to fit the new overall University curriculum for non-science majors

As a post-doc at NDSU I had the opportunity to teach a section on ‘structural aspects of the plant cell wall’ to grad-students as part of their advanced cell biology course. In the two and a half years I worked at NDSU, I oversaw the supervision of two PhD. candidate students and was involved with their work on xyloglucan biosynthesis. This included discussion of experimental design, result analysis and the general day to day running

and management of the lab. I also supervised and guided two Governor School Students and two work-study students during my time in the lab.

Whilst working as a post-doc at the University of Glasgow, I taught a section on 'techniques for carbohydrate analyses,' and a section on 'plant cell wall carbohydrates' to third year students. I also became an advisor to a Ph.D. student, a co-supervisor to a fourth year project student and advised Ph.D. students with their experimental designs

As a research technician at Wye College (University of London) I taught molecular biology to 2nd year undergraduates and MSc students for one year. This involved teaching the theory of all modern molecular biology techniques. I was involved in the set up and co-demonstration of the practicals for the course. Furthermore, I was the project supervisor to two MSc students, whose projects involved novel approaches to plant transformation.

Education in detail

10/1995 - 10/1998 *Department of Cell Biology, John Innes Centre, Norwich, UK.*
Ph.D. in Biochemistry and Cell Biology. Date of conferral 07/1999.
Title: *Characterization of cell walls and extracted polysaccharides from* Beta vulgaris.

Summary My Ph.D. thesis consisted of five key areas of study involving the characterization of polymers, cell walls, structural proteins and enzymes from mature sugar beet.

1. Previous investigations using sugar beet have used pulp as the starting material. As the heat and pressure of pulping may modify the architecture of the cell wall, I adapted a relatively non-disruptive method to characterize cell wall material isolated directly from the sugar beet. I used a combination of Fourier Transform Infra-red (FTIR) microspectroscopy, immunogold labelling, Gas Chromatography-Mass Spectroscopy (GC-MS) and chemical analyses to provided new data on the composition of sugar beet cell walls. These data indicate that the sequential extraction is an efficient way of removing different populations of pectins from different locations within the wall and also that a hierarchy of cross-links exist within the cell walls of sugar beet. These data were backed up with data obtained whilst working at the University of Glasgow (Marry *et al*. 2006. *Physiologia Plantarum,* **126**, 243-256).

2. Fresh cell walls from mature sugar beet (*Beta vulgaris* L. Aztec) were sequentially extracted with imidazole and sodium carbonate to solubilize six pectic polysaccharide extracts and with potassium hydroxide to solubilize a hemicellulosic extract (predominantly xylan). Heterogeneity of the extracted pectins was indicated by differences in FTIR spectra, uronic acid content, % methyl etherification, % feruloylation, % acetylation, molecular weight distribution and neutral sugar composition. The highest proportion of feruloyl esters were found in polysaccharides solubilized by the second sodium carbonate extraction. Anion exchange chromatography of these polysaccharides gave three fractions, one of which contained most of the feruloyl ester. These results indicate that feruloyl esters are not randomly distributed among the different pectic polysaccharides in the sugar beet cell wall, and that etherification is likely to be dependent on the local sugar sequence or conformation. Furthermore, boiling the cell walls in methanol prior to extraction inactivated native hydrolytic enzymes (Marry *et al*., 2000. *Journal of the science of food and agriculture*, **80**, 17-28).

3. The use of monoclonal antibodies have provided increased insight into the distribution of cell wall polymers. However, they are limited to plant species with the same epitope conformation as the plant from which the antigen was taken. As some of the available monoclonal antibodies do not recognize epitopes within sugar beet walls, I raised a monoclonal antibody from the carbohydrate epitopes in the second sodium carbonate extract. This monoclonal antibody, which recognizes an acetylated region of RG-I, is the first example of a monoclonal product from this species.

4. Although never characterized, a small proportion of protein is associated with extracted pectic polysaccharides from sugar beet pulp. I isolated proteins from the cell wall's extracts and identified different AGPs and HPRGs from each extract.

5. Sugar beet cell walls contain significant levels of ferulic acid, found ester-linked to the arabinosyl and galactosyl residues. The identification and characterization of feruloyl esterases may find use in many areas including animal nutrition, the pulp and paper industry and may facilitate the extraction of plant material and the textural modification of food products. Such enzymes have been isolated with limited success from bacteria. However, I have isolated and partially characterized the first plant-encoded feruloyl esterase from untreated, fresh sugar beet cell walls.

08/1992 - 06/1994 *Department of Applied Biology, Hull University, UK.*
M.Sc. (By Research) in Plant Pathology. Date of conferral 12/1994.
Title: *The biotic and abiotic induction of systemic acquired resistance (SAR)* in plants.

Summary My M.Sc. thesis described an investigation of the biotic and abiotic induction of SAR by application of Salicylic acid (Sa), EDTA or a pathogen. This research showed that resistance in the first true leaf of cucumber (*Cucumis sativus* L. c.v perfection) to the pathogen *Colletotrichum lagenarium* or Cell Wall Degrading Enzymes (CWDE) was increased following treatment of the cotyledons with Sa, EDTA or *C. lagenarium*. This work also provided the first evidence that SAR was effectively reversed following the application of $Ca(NO_3)_2$ (10mM) 24 hours after inducer treatments (Marry *et al*., 1995. *Aspects of Applied Biology: Physiological Responses of Plant Pathogens*, **42**, 349-353).

Sa treatment of cucumber cotyledons was shown to induce two previously inactive anodic peroxidase isozymes in the first true leaf and enhance the activity of the three isozymes also present in control plants treated with sterile distilled water. Application of $Ca(NO_3)_2$ (10mM) 24 hours after Sa treatment prevented the expression of the two Sa induced isozymes and returned all other isozymes to near basal levels. Alterations in the polysaccharide fraction of cucumber first true leaf following treatment of the cotyledons with Sa, EDTA or *C. lagenarium* were observed as a decrease in degradation to CWDE. Application of $Ca(NO_3)_2$ (10mM) 24 hours after inducer treatments effectively reversed this cell wall alteration. $Ca(NO_3)_2$ applied alone to the cotyledons had no significant effect on the polysaccharide fraction.

I also conducted a comparative study that demonstrated that resistance in the first/upper leaves of tomato, broad bean, pepper, pea and tobacco to CWDE degradation was increased following treatment of the cotyledons/lower leaves with Sa or EDTA. Furthermore, I investigated the ability of the pathogens *Uromyces viciae-fabae* and *Pernospora pisi* as inducers for broad bean and pea respectively. I determined that resistance in the upper leaves of broad bean and pea to infection by *U. viciae-fabae* and *P. pisi* respectively was increased following treatment of the lower leaves with Sa, EDTA or the pathogen.

10/1989 - 6/1992 *Department of Applied Biology, Hull University, UK.*
B.Sc. (HONS) Special Biology.
Specialized in plant biotechnology and genetics.

Employment History in detail

01/2001 – 07/2005
North Dakota State University, USA.
Post-Doctoral Research Fellow working on cellulose biosynthesis in *Agrobacterium tumefaciens* and xyloglucan biosynthesis in *Pisum sativum*.

Summary My main research duty encompassed the genes required for cellulose synthesis in *Agrobacterium tumefaciens*. This work was conducted in collaboration with Ann Matthysse at the Department of Biology, University of North Carolina at Chapel Hill. Using a combination of FTIR microspectroscopy capillary electrophoresis (C.E.), specific hydrolytic digestion, and methylation analyses, I determined that these

accumulated oligosaccharides contain a mixture of β-(1,3)- and β-(1,4)- linked glucans, which is an indicator that CelC may have a proof reading function during cellulose biosynthesis.

I was also involved in the examination of the role of cellulose in the interactions of bacteria with surfaces. Our results suggested that cellulose production plays a major role in the bacterial interaction with both plant and inert surfaces and that production of cellulose may allow some bacteria, which would not otherwise bind to roots, to do so (Matthysse, *et al*., 2005. MPMI, **18 (9)**, 1002-1010). Lastly, I was involved in the biochemical analysis of the product from a functional cellulose synthase from ascidian epidermis (Smith, *et al*., 2005. PNAS, **101 (4)**, 986-991).

I also conducted research on xyloglucan biosynthesis in *Pisum sativum*. Specifically, I investigated the purification and characterization of the two main enzyme activities involved in the synthesis of the XXXG heptsaccharide repeat unit of xyloglucan within the Golgi network of plants: xyloglucan glucosyltransferase (XGT) and xyloglucan xylosyltransferase (XXT). I published a paper detailing the structural analysis of an array of oligo-xyloglucan fragments obtained from purified tamarind seed xyloglucan (Marry *et al*., 2003. *Carbohydrate Polymers*, **51 (3)**, 347-356).

In addition, I developed a novel assay to follow the activity of both XGT and XXT by the use of Fourier Transform Infra-red (FTIR) microspectroscopy. My preliminary data indicated that FT-IR identify the biosynthetic product of the *in vitro* activity of XGT.

In that time, our lab collaborated with Professor Ken Keegstra's research team at the Plant Research Laboratory at Michigan State University to conduct a combined proteomics and biochemical approach to unravel the biosynthesis, delivery, and assembly of xyloglucan polysaccharides in pea seedlings.

12/1998 – 12/2000
Glasgow University, Scotland.
Post-Doctoral Research Assistant using Electron Energy Loss Spectroscopy (EELS) for elemental imaging of the plant cell wall.

Summary My main duty was to develop the technique of EELS microscopy to be used routinely for high-resolution imaging of cross-linking and molecular architecture in plant cell walls. This was achieved by using EELS to localize calcium and boron at high resolution, thus allowing the cross-linking of pectin to be pinpointed. High-resolution imaging of protein, lipid and carbohydrate was achieved by the mapping ratios of carbon, oxygen and nitrogen within biological samples. This work involved the use of many different techniques of sample preparation, such as plunge-freezing, freeze-slamming and freeze-substitution as well as different variations of resin embedding. I also used atomic absorbance spectroscopy to quantify the proportion of these ions with the samples investigated.

I used many different plant species during the course of this research. The differences between the architecture of tomato cell walls isolated at various stages ripening were investigated and compared with immune-gold labeling data. I also studied the localization of calcium, carbon and nitrogen of potato cell walls during the development of stolon to tuber (Bush *et al*., 2001. *Planta*, **213**, 869-880). Both these studies have provided information on the end result of developmental biological alterations of the plant cell wall. Furthermore, I also studied the localization of boron within the secondary cell wall of flax fibres (His *et al*. In: *Boron analysis and imaging in biological materials*). In conjunction with work carried out during my Ph.D, I used EELS to localize calcium in the cell walls of sugar beet. These data indicate that, in the case of sugar beet, cell-cell adhesion is due to the additional presence of ester linked pectic polysaccharides in the middle lamella and not just calcium bridges (Marry *et al*. 2006. *Physiologia Plantarum*, **126**, 243-256).

I had a technician based in the John Innes Centre, as well as a technician based at the University of Glasgow. I was involved in the one-to-one supervision of final year undergraduate students and Ph.D. students. In addition, I introduced new techniques into the lab for the rapid identification of plant cell wall polymers during the isolation of celullosic fibres from grass species.

06/1994 - 10/1995
Wye College (University of London), UK.
Research Technician
Summary My main duty was to carry out research on flower development of *Rumex* species, mainly *R. acetosa*. This focused on three main areas. Firstly, I investigated possible differences between DNA & RNA hybridization in male and female flower tissue and also in structural tissue. Secondly, I carried out sense/antisense cloning and optimized different methods of transformation to produce transgenic lines of *R. acetosa*.

In conjunction with this research, I also lectured molecular biology to undergraduates and MSc students and supervised undergraduate practicals and MSc project work.

Technical Skills

During my scientific career, I gained good experience in many biological disciplines. I have designed and conducted glasshouse and contained-environment experiments and have developed the technique of EELS microscopy to study the plant cell wall. The molecular biology techniques I mastered include: DNA/RNA isolation & southern/northern analysis respectively, sequencing, PCR, plant transformation (using agrobacteria and particle gun), ligation and subcloning, electrotransformation, colony screening, CsCl- & Mini- preparation of DNA, differential display PCR, cDNA library screening and plaque lifting/purification. I also passed a workshop dedicated to the theory and application of microarray technology.

The biochemistry techniques I mastered. include: Fourier Transform Infra-Red (FTIR) microspectroscopy, sequential polysaccharide extraction, Gas Chromatography-Mass Spectroscopy (GC-MS), NMR Spectroscopy, electron microscopy, plunge-freezing, freeze-slamming, freeze substitution, resin embedding, sectioning & immunogold labelling, immuno-fluorescence, anion exchange chromatography, immunodot blots, sugar/ester group assays, SDS-PAGE, western blotting, monoclonal antibody production & isolation, native PAGE, the cell-disruptor bomb and the extraction of enzymes from cell walls and related assays, the induction of SAR by biotic & abiotic inoculation, isolation of protoplasts, extraction of pathogenesis related (PR)-proteins and extraction of Cell Wall Degrading Enzymes (CWDE) from pathogenic fungi, atomic absorbance spectroscopy, solubilization of active enzymes from membrane complexes, Rate-zonal and isopycnic ultracentrifugation, combined gas chromatography and radiogas proportional counting (RPC), high pH anion exchange-high performance liquid chromatography (HPAE-HPLC), gel filtration chromatography, and capillary electrophoresis (C.E.).

Publications

Yan, Peng, Brian M. Slator, Bradley Vender, Wei Jin, Matti Kariluoma, Otto Borchert, Guy Hokanson, Vaibhav Aggarwal, Bob Cosmano, Kathleen T. Cox, André Pilch, and **Andrew Mazz Marry** (2013). Intelligent Tutors in Immersive Virtual Environments, *Proceedings of Cognition and Exploratory Learning in a Digital Age*, pp 109-116.

Otto Borchert, Guy Hokanson, Brian M. Slator, Bradley Vender, Peng Yan, Vaibhav Aggarwal, Matti Karilouma, **Andrew Mazz Marry** and Bob Cosmano. (2013). A 3D Immersive Virtual Environment for Secondary Biology Education. *Proceedings of the Society for Information Technology & Teacher Education*, pp. 254-259.

Mazz Marry, Keith Roberts, I. Max Huxham, Julia Corsar, Michael C. Jarvis, Eion Robertson and Maureen C. McCann (2006) Cell-cell adhesion in sugar beet parenchyma tissue is mediated by ester cross-links. *Physiologia Plantarum*, **126**, 243-256.

David M. Cavalier, **Mazz Marry** and Alan R. White (2006) Novel methods to analyze the biosynthesis of xyloglucan. *In*: The Science and Lore of the Plant Cell Wall - Biosynthesis, Structure and Function (T. Hayash, ed); Universal Publishers: BrownWalker Press.

Ann G. Matthysse, **Mazz Marry**, Leonard Krall, Mitchell Kaye, Bronwyn E. Ramey, Clay Fuqua and Alan R. White (2005) The effect of cellulose overproduction on Binding and Biofilm Formation on Roots by *Agrobacterium tumefaciens. Molecular Plant Microbe Interactions*, **18 (9)**, 1002-1010.

William C. Smith, Ann G. Matthysse, **Mazz Marry** and Alan R. White (2004) A functional cellulose synthase from ascidian epidermis. *Proceedings of the National Academy of Science*, **101 (4)**, 986-991.

Mazz Marry, David M. Cavalier, Judy A. Schnurr, Jason Netland, Zhiyong Yang, Vida Pezeshk, William S. York, Marcus Pauly and Alan R. White (2003) Structural characterization of chemically and enzymatically derived standard oligosaccharides isolated from partially purified tamarind xyloglucan. *Carbohydrate Polymers*, **51 (3)**, 347-356.

Isabelle His, **Mazz Marry**, I. .Max Huxham, Laurence Tetley and Michael C. Jarvis (2001) EELS localisation of boron in flax fibres. *In* M. Thellier (ed) Boron analysis and imaging in biological materials.

Maxwell S. Bush, **Mazz Marry**, Michael C. Jarvis, I. Max Huxham and Maureen C. McCann. (2001) Developmental regulation of pectic epitopes during potato tuberisation. *Planta*, **213**, 869-880.

Mazz Marry, Maureen C. McCann, Frank Kolpak, Alan R. White, Nicola J. Stacey and Keith Roberts. (2000) Extraction of pectic polysaccharides from sugar beet cell walls. *Journal of the science of food and agriculture*, **80**, 17-28.

Mazz Marry, Philip N. Taylor and John Friend. (1995) Systemic acquired resistance in cucumber leaves is correlated with resistance of the leaves by cell wall-degrading enzymes. *Aspects of Applied Biology: Physiological Responses of Plant Pathogens*, **42**, 349-353.

A full listing of both Oral and Poster presentations is available upon request.

Synergistic Activities

- Higher Education Teaching Certificate (Awarded by Hull University, 1994).
- Attended an image analysis course for EsiVision in Munster, Germany. (2000)
- Microarray theory and workshop (Awarded by The University of York, UK, 2000).
- Review Grant proposals for the USDA and the BBSRC (since 2002).
- Attended 3-day professional grant writing workshop 2008.Moorhead, MN
- Grant writing presentation during the 2008 regional ASBMB meeting at MSUM.
- Attended various NSF-funded PKAL meetings 2008 to 2009.
- Presented POGAL workshop during MSUM facility development day 2008.
- Co-organized and taught projects at the 2009, 2010, 2011 and 2012 MSUM 7-9th grade Summer Discovery Camp.
- Taught outreach for the MSUM Biotechnology program in Fergus Falls, MN 2009.
- Academic consultant on the NDSU V-Cell 3-D educational *Cell Explorer* computer game 2011-2013.
- Member of the planning working group for the MSUM BS degree in Sustainability, focusing on the emphasis in Environmental Science (since 2011).
- Attended meetings addressing sustainability across the curriculum 2013.
- Taught at NDSU Governor's School during the summer of 2013.
- Faculty mentor and co-designer of two successful Aquaponic Systems at MSUM, housed in the Department of Biosciences' Greenhouse (since 2012).

Society Affiliations

Member of the Irish Research Scientists' Association (IRSA).
Member of the American Society of Plant Biologists.

Collaborators

During my scientific career, I have had the opportunity to collaborate with a number of established researchers in many different areas of plant cell biology. These researchers are:

Michael Jarvis, Agricultural, Food and Environmental Chemistry, University of Glasgow, Glasgow, G12-8QQ, Scotland.

Ann G. Matthysse, Department of Biology, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599-3280, USA.

William S. York, The Complex Carbohydrate Research Center. University of Georgia, Athens, GA 30602, USA.

Kenneth Keegstra, MSU-DOE Plant Research Laboratory, Michigan State University, East Lansing, MI 48824, USA.

Grants Funded:

MSUM 19A Grant. A continued investigation of adaptations to the structural and biophysical properties of both whole leaves and root tissue of broad bean and tomato seedlings grown in an aquaponics system relative to the same species grown in soil as a control. June 2018 -2019, $4000.00

MSUM 19A Grant, An investigation of the initial alterations to the plant cell wall matrix during the onset of abioticly induced systemic acquired resistance in cucumber seedlings June 2012- 2013, $3,000

MSUM 19A Grant, Biochemical analysis of the plant cell wall between plants grown in soil and an aquaponic system June 2014 – 2015, $4,000

Biotechnology and Biological Sciences Research Council, UK. *Cell-cell adhesion in higher plants*. Nov 200-Nov 2003. Co-advisor for PhD student at the University of Glasgow, Scotland. (Not Active).

Irish National Research Awards. *Sitka spruce as a renewable feedstock: The biotechnological production of value added products*. Jan 2002-Dec 2004 Co-advisor. (Not Active).

US Department of Agriculture, NRICPG, Plant Growth & Development: Growth and development effects of sildenafil citrate (Viagra) on *Pisum sativum* (pea) seedlings. July 2002 - June 2005. $466,112.

National Science Foundation: Division of Molecular and Cellular Biosciences. Isolation and purification of XGT and XXT from pea seedlings. Sept 2002 - Aug 2005. $494,862

References

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