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Metabolomics Center
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EDUCATION

Ph.D. Wood Chemistry and Biochemistry, Department of Wood Science and Forest Products, and Fralin Biotechnology Center, Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, Virginia 24061, May 1997 – May 2002.

B.S. Forest Products Chemistry, Department of Forest Products Chemistry, Nanjing Forestry University, Nanjing, Jiangsu 210037, China, September 1982 – May 1986.

RESEARCH INTERESTS

Plant metabolomics and proteomics, biological mass spectrometry, LC-MS-SPE-NMR

EMPLOYMENT EXPERIENCE:

Jan 2016 - Present

Assistant Director, Metabolomics Center, University of Missouri, Columbia, MO 65211

- Manage MU Metabolomics Center daily activity

June 2006 – Dec 2015

Research Scientist, Biological Mass Spectrometry Laboratory, Plant Biology Division, the Samuel Roberts Noble Foundation (Ardmore, OK 73401).

- Metabolomics and proteomics, Metabolomics data processing and statistics analysis
- Responsible for daily operation and maintenance of nano LC- qTOF MS, MALDI-TOF MS, UPLC-TOF MS, UHPLC-QQQ MS, Agilent HUPLC-6430 QQQ MS
- Train new postdoctoral researchers and visiting scientists/scholars.

June 2005 – June 2006

Senior Research Associate II, Biological Mass Spectrometry Laboratory, Plant Biology Division, the Samuel Roberts Noble Foundation (Ardmore, OK 73401).

- Plant membrane proteomics. Cloning and expression of a laccase gene in *E. coli* and yeast.
- Proteomics core support and instrument maintenance.

June 2002 – June 2005

Postdoctoral Research Fellow, Biological Mass Spectrometry Laboratory, Plant Biology Division, the Samuel Roberts Noble Foundation (Ardmore, OK 73401).

- Comparative proteomics of *Medicago truncatula* in response to external elicitors.

May 1997- May 2002

Graduate Research Assistant, Department of Wood Science and Forest Products, and Fralin Biotechnology Center, Virginia Tech (Blacksburg, VA 24061).

- Ellagitannin biosynthesis related to heartwood formation in oaks. Large scale profiling of secondary metabolites and proteins in heartwood of oaks.

May 1988- May 1997

Research Associate, Institute of Chemical Industry of Forest Products, Chinese Academy of Forestry (Nanjing, Jiangsu 210037, China).

- Chemical modifications of pine rosins, tall oil and tannins to enhance the values of the commodities.

July 1986- May 1988

Research Assistant, Institute of Chemical Industry of Forest Products, Chinese Academy of Forestry (Nanjing, Jiangsu 210037, China).

- Chemical modifications of pine rosins, tall oil and tannins to enhance the values of the commodities.

Sept 1982-July 1986

Undergraduate Research Assistant, Department of Forest Products Chemistry, Nanjing Forestry University (Nanjing, Jiangsu 210037, China).

- Tannin extraction and quantification from tree bark and heartwood.

PROFESSIONAL ORGANIZATIONS:

- **2003-Present** Member of the American Society for Mass Spectrometry
- **1998-2002** Member of the American Chemical Society

SERVICES:

- Peer reviewer for the following journals:

BMC informatics,
Journal of Advanced Research,
Journal of Experimental Botany,
Journal of Proteome Research,
Journal of Separation Science,
Metabolomics,
Molecular Genetics and Genomics,
Natural Product Research,
Plant and Cell Physiology,
Plant Physiology and Biochemistry,
Planta,
Phytochemistry,

Phytopathology,
Plant Cell Report,
Proteome Science,
Proteomics

- External reviewer for grant proposal submitted to *European Research Area in Plant Genomics (ERA-PG)*, 2006 and 2008.
- External reviewer for grant proposals submitted for the Fiscal Year 2008 *Ohio Plant Biotechnology Consortium (OPBC) Grants Program*.
- Co-supervised visiting Ph.D. candidates: (1). Ms. Narumon Sawasdipuksa (from the Research Centre for Bioorganic Chemistry, Department of Chemistry, Faculty of Science, Chulalongkorn University, Bangkok, Thailand) on proteomics of seeds from Tamarind tree (*Pithecellobium dulce*) from July 2007 to June 2008. (2). Ms. Li Jing, Ph.D. candidate (from Southwest University, Chongqing, China from 2012-2013) on tandem mass spectral library construction and citrus essential oil analysis.
- Taught a one-week long plant proteomics workshop.
- Annual lab demo of plant proteomics to college students from Southeastern Oklahoma State University as part of the on-site training and demonstration of proteomic and metabolomic approaches for Instrumental Analysis (Course #: CHEM 3525, Southeastern Oklahoma State University) since 2003.
- Lecture and lab demo in a three day Plant Proteomics Workshop sponsored by the Noble Foundation, Virginia Bioinformatics Institute of Virginia Tech and NSF Plant Genome as part of Award #010973, August 4-6th, 2004, Ardmore, OK
- Lab demo of nano-LC/MS/MS to summer interns, the Noble Simmer Scholars and high school teachers in July 2005.
- Lab demo of plant proteomics in a three day, hands-on Integrated Functional Genomics Workshop sponsored by the Noble Foundation, Virginia Bioinformatics Institute of Virginia Tech and NSF Plant Genome as part of Award #010973, November 16-18th, 2005, Ardmore, OK.
- Organized plant proteomics and metabolomics tutorial to a group of summer interns and the Noble Summer Scholars in July 2006. The tutorial included lecture entitled “Weighing Molecules and the Large-Scale Biochemical Analysis of Plant Proteomes and Metabolomes”, and lab hands-on demonstrations.

SELECT PUBLICATIONS:

40. Qiu, F., Fine, D. D. Wherritt, D.J., **Lei, Z.** and Lloyd W. Sumner, L.W. (2016) PlantMAT: A Metabolomics Tool for Predicting the Metabolic Potential of a System and for Large-scale Metabolite Identifications. *Anal. Chem.* Submitted.
39. Zhang, W., **Lei, Z.**, Huhman, D., Sumner, L.W. and Zhao, P. X. (2015) MET-XAlign: A Metabolite Cross-alignment Tool for LC/MS-based Comparative Metabolomics. *Anal. Chem.* 87 (18), 9114–9119. DOI: 10.1021/acs.analchem.5b01324.
38. **Lei, Z.**, Jing, L., Qiu, F., Zhang, H., Huhman, D., Zhou, Q. and Sumner, L.W. (2015) Construction of a UHPLC-Tandem Mass Spectral Library of Plant Natural Products and Comparative Spectral Analyses. *Anal. Chem.* 87 (14), pp 7373–7381. DOI: 10.1021/acs.analchem.5b01559.

- 37 Jing, L., **Lei, Z.**, Zhang, G., Pilon, A.C., Huhman, D., Tawfall-Forthman, A., Xie, R., Xi, W., Li, L., Zhou, Z. and Sumner, L. W. (2015) Metabolite profiles of Chinese native Citrus species and their taxonomic implications. *Metabolomics*. 11(4), 952-963. DOI:10.1007/s11306-014-0751-x.
36. Sumner L.W., **Lei, Z.**, Nikolau, B.J., Saito, K., Roessner, U. and Trengove, R. (2014) Proposed quantitative and alphanumeric metabolite identification metrics. *Metabolomics*. 10:1047–1049. DOI: 10.1007/s11306-014-0739-6.
- 35 Sumner, L.W., **Lei, Z.**, Nikolau, B.J. and Saito, K. (2014) Modern plant metabolomics: advanced natural product gene discoveries, improved technologies, and future prospects. *Nat Prod Rep*. 32, 212-229. DOI: 10.1039/C4NP00072B.
- 34 Zhang, W., Chang, J., **Lei, Z.**, Huhman, D., Sumner, L.W., Zhao, P. X. (2014) MET-COFEA: a liquid chromatography/mass spectrometry data processing platform for metabolite compound feature extraction and annotation. *Anal. Chem*. Jul 1; 86(13):6245-53. DOI: 10.1021/ac501162k.
- 32 Jing, L., **Lei, Z.**, Li, L., Xie, R., Xi, W., Guan, Y., Sumner, L.W. and Zhou, Z. (2014) Antifungal activity of citrus essential oils. *J. Agric. Food Chem*. 62(14), 3011–3033. DOI: 10.1021/jf5006148.
- 31 Creek, D.J., Dunn, W.B., Fiehn, O. Griffin, J. L., Hall, R.D., **Lei, Z.**, Mistrik, R., Neumann, S., Schymanski, E.L., Sumner, L.W., Trengove, R. and Wolfender J.-L. (2014) Metabolite identification: are you sure? And how do your peers gauge your confidence? *Metabolomics* 10(3), 350-353. DOI 10.1007/s11306-014-0656-8.
- 30 Zhang, H., Sumner, L.W., **Lei, Z.**, Huhman, D., Watson, B. Fu, F. and Yu, J. (2013) Identification of antioxidants in methanol extracts from soymilk. *Modern Food Science and Technology* 29(8), 1999-2003.
- 29 Lee, J., **Lei, Z.**, Watson, B.S. and Sumner, L.W. (2013) Sub-cellular Proteomics of *Medicago truncatula*. *Front. Plant Sci*. 4:112. doi: 10.3389/fpls.2013.00112.
- 28 Bhat, S., Folimonova, S.Y., Cole, A. B., Ballard, K. D., **Lei, Z.**, Watson, B. S., Sumner, L. W. and Nelson, R. S. (2013) Influence of host chloroplast proteins on Tobacco mosaic virus accumulation and intercellular movement. *Plant Physiol*. 161(1):134-147.
- 27 Badri, D.V., De-la-Peña, C., **Lei, Z.**, Manter, D.K., Chaparro, J. M., Guimarães, R.L., Sumner, L.W. and Vivanco, J.M. (2012) Early biochemical events reveal that root secreted defense and stress-related proteins involved in plant-plant recognition. *PLoS ONE*, 7 (10), e46640 doi:10.1371/journal.pone.0046640.
- 26 **Lei, Z.**, Li, H., Chang, J., Zhao, P. X. and Sumner, L. W. (2012). MET-IDEA version 2.06; improved efficiency and additional functions for mass spectrometry-based metabolomics data processing. *Metabolomics* 8:S105–S110.
- 25 Shen, G., Huhman, D, **Lei, Z.**, Snyder, J., Sumner, L. W. and Dixon, R. A. (2012) Characterization of an isoflavonoid-specific prenyltransferase from *Lupinus albus*. *Plant Physiol*. 159(1), 70-80.
- 24 **Lei, Z.**, Huhman, D. and Sumner L. W. (2011) Mass Spectrometry Strategies in Metabolomics. *J. Biol. Chem*. 286, 25435-25442.

- 23 Ruiz-May, E., De-la-Peña, C., Galaz-Ávalos, R., **Lei, Z.**, Watson, B.S., Sumner, L.W., Loyola-Vargas, V. (2011) Methyl jasmonate induces ATP biosynthesis deficiency and accumulation of proteins related to secondary metabolism in *Catharanthus roseus* (L.) G. hairy roots. *Plant and Cell Physiol.* 52, 1401-1421.
- 22 **Lei, Z.**, Dai, X., Zhao, P.X. and Sumner L. W. (2011) A Legume Specific Protein Database and its Application in Legume Proteomics. *Phytochemistry.* 72, 1020-1027.
- 21 Sawasdipuksa, N., **Lei, Z.**, Sumner, L. W., Niyomploy, P. and Sangvanich, P. (2011) A Lysozyme with Antifungal Activity from *Pithecellobium dulce* Seeds. *Food Technol. Biotechnol.* 49 (4) 489–494.
- 20 **Lei, Z.**, Chen, F., Nagaraj, S., Watson, B. S., Elmer, A. M., Dixon, R. A. and Sumner, L. W. (2010) Comparative Proteomics of Yeast-Induced *Medicago truncatula* Cell Suspensions Revealed the Induction of Proteins Associated with Isoflavonoid Synthesis as well as Cell Wall Modifications. *J. Proteome Res.* 9, 6220-6231.
- 19 De-la-Peña, C., Badri, D.V., **Lei, Z.**, Watson, B.S., Brandão, M.M., Silva-Filho, M., Sumner, L.W. and Vivanco, J. M. (2010) Root Secretion of Defense-Related Proteins is Development-Dependent and Regulated by Flowering Time. *J. Biol. Chem.* 285, 30654-30665.
- 18 Brechenmacher, L., **Lei, Z.**, Libault, M., Findley, S., Sugawara, M., Sadowsky, M. J., Sumner, L.W. and Stacey, G. (2010) Soybean Metabolites Regulated in Root Hairs in Response to the Symbiotic Bacterium *Bradyrhizobium japonicum*. *Plant Physiol.* 153, 1808-1822.
- 17 Dobritsa, A. A., **Lei, Z.**, Nishikawa, S.-i., Urbanczyk-Wochniak, E., Huhman, D. V., Preuss, D. and Sumner, L.W. (2010) LAP5 and LAP6 Encode Anther-Specific Proteins with Similarity to Chalcone Synthase Essential for Pollen Exine Development in *Arabidopsis thaliana*. *Plant Physiol.* 153, 937-955.
- 16 Sawasdipuksa, N., Sumner, L.W., **Lei, Z.** and Sangvanich, P. (2009) Proteome analysis of *Pithecellobium dulce* seeds using two-dimensional gel electrophoresis and tandem mass spectrometry. *J. Sci. Food Agric.* 89, 1284-1291.
- 15 Tian, L., Peel, G.J., **Lei, Z.**, Aziz, N., Dai, X., He, J., Watson, B.S., Zhao, P.X., Sumner, L.W. and Dixon, R.A. (2009) Transcript and proteomic analysis of developing white lupin (*Lupinus albus* L.) roots. *BMC Plant Biology.* 9:1, doi:10.1186/1471-2229-9-1.
- 14 De-la-Peña, C., **Lei, Z.**, Watson, B.S., Sumner, L.W. and Vivanco, J. M. (2008) Root-Microbe Communication through Protein Secretion. *J. Biol. Chem.* 283, 25247 – 25255.
- 13 Nagaraj, S., **Lei, Z.**, Watson, B.W. and Sumner, L. W. (2008) Proteomics of Legume Plants. In *Plant Proteomics: Technologies, Strategies, and Applications*. Agrawal, G K and Rakwal, R. eds., John Wiley & Sons, Inc., New Jersey. pp 179-189.
- 12 **Lei, Z.**, Nagaraj, S., Watson, B.S. and Sumner, L.W. (2007) Proteomics of *Medicago truncatula*. In *Plant Proteomics*. Samaj, J and Thelen, J. eds., Springer-Verlag New York. pp 121-136.
- 11 Farag, M., Huhman, D., **Lei, Z.** and Sumner, L.W. (2007) Systematic Identification of Flavonoids and Isoflavonoids in *M. truncatula* using HPLC-UV-ESI-MS and GC-MS. *Phytochemistry* 68, 342-354.

- 10 Sumner, L. W., Huhman, D. V., Urbanczyk-Wochniak, E. and **Lei, Z.** (2007) Concepts, Methods, Applications, and Future Directions of Metabolic Profiling in Secondary Metabolism. In *Plant Systems Biology*. Fernie, A. and Baginsky, S. eds., Bierkenhauser-Verlag, Germany. pp.195-212.
 - 9 **Lei, Z.**, Anand, A., Mysore, K. S. and Sumner, L. W. (2006) Electroelution of Intact Proteins from SDS-PAGE Gels and Their Subsequent MALDI-TOFMS Analysis. In *Plant Proteomics: Methods and Protocols, Methods in Molecular Biology*. Thiellement, H., Mechin, V., Damerval, C. and Zivy, M. eds., Humana Press, USA. pp. 353-364.
 - 8 Nagaraj, S., **Lei, Z.**, Watson, B., Summer, L. W., K. Gallardo, E. Dumas-Gaudot, G. Recorbet, F. Robert, O. Thiery, B. Valot, U. Mathesius, E. Triplett (2006) Proteomics of *Medicago truncatula* Different Tissues. In *The Medicago truncatula Handbook*, online version November 2006. (<http://www.noble.org/MedicagoHandbook/>).
 - 7 **Lei, Z.**, Elmer, A. M., Watson, B. S., Dixon, R. A., Mendes, P. J. and Sumner, L. W. (2005). A Two-dimensional Electrophoresis Proteomic Reference Map and Systematic Identification of 1367 Proteins from a Cell Suspension Culture of the Model Legume *Medicago truncatula*. *Molecular & Cellular Proteomics* 4, 1812-1825.
 - 6 Anand, A., **Lei, Z.**, Sumner, L.W., Mysore, K.S., Arakane, Y., Bockus, W.W. and Muthukrishnan, S. (2004) Pathogenesis-Related Proteins from Apoplastic Fluid of a Transgenic Wheat Line Exhibit Combinatorial Antifungal Activity. *Molecular Plant-Microbe Interactions* 17, 1306-1317.
 - 5 Watson, B. S., **Lei, Z.**, Dixon, R. A. and Sumner, L.W. (2004) Proteomics of *Medicago sativa* Cell Walls. *Phytochemistry* 65, 1709 -1720.
 - 4 Elmer, A.M., Broeckling, C.D, Chen, F., Dixon, R.A., Donnelley, B.E., Duran, A.L., Huhman, D.V., Lei, Z., Watson, B.S. and L.W. Sumner. (2004) Potential of Integrated Functional Genomics in Biosafety Assessment. In *NATO Science Series: Genomics for Biosafety in Plant Biotechnology*, Nap, J.-P., Atanassov, A. and Stiekema, W. J. eds., IOS press, Netherlands, 359, 3-17.
 - 3 **Lei, Z.**, Jervis, J. and Helm, R. F. (2001) Use of Methanolysis for the Determination of Total Ellagic and Gallic Acid Contents of Wood and Food Products. *J. Agric. Food Chem.* 49, 1165-1168.
 - 2 **Lei, Z.**, Jervis, J. and Helm, R. F. (1999) C-Glycosidic Ellagitannins from White Oak Heartwood and Callus Tissues. *Phytochemistry* 51, 751-756.
 - 1 Helm, R. F., **Lei, Z.**, Ranatunga, T., Jervis, J. and Elder, T. (1999) Toward Understanding Monomeric Ellagitannin Biosynthesis. In *Plant Polyphenols 2: Chemistry, Biology, Pharmacology, Ecology*. Gross, G. G., Hemingway, R. W. and Yoshida, T. eds., Klumer Academic/Plenum Publishers, New York. 83 – 99.
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ORAL PRESENTATIONS

- 10 Metabolomics and its Applications in Plant Research. University of Missouri. Columbia, Missouri, April 7, 2015.
- 9 Integrated Metabolomics for Natural Product Gene Discover in *Medicago truncatula* (co-presented with Sumner, L.W.). University of Georgia, Athens, Georgia, Nov. 12, 2014.

- 8 Construction of a Plant Secondary Metabolite Tandem Mass Spectral Library using Triplequadrupole Mass Spectrometry. NSF-JST (National Science Foundation-Japan Science and Technology Agency) Minisymposium on Metabolomics, Ardmore, Oklahoma. Oct 19, 2012.
 - 7 Plant Metabolomics and its Application in Medicago Secondary Metabolism Research. Southwest University, Chongqing, China, June 22, 2012.
 - 6 Metabolomics Provides Fundamental Insights to Understanding *Medicago* Secondary Metabolism. 42nd Annual Meeting of the American Chemical Society Central Meeting. University of Indiana, Indianapolis, Indiana, June 10, 2011.
 - 5 Metabolomics and Integrated Functional Genomics Reveal Novel Information related to *Medicago* Secondary Metabolism. 55th Annual Pentasectional Meeting of the American Chemical Society. University of Oklahoma, Norman, Oklahoma. April 10, 2010.
 - 4 Metabolomics and Integrated Functional Genomics Reveal Novel Information related to *Medicago* Secondary Metabolism. M.D. Anderson Cancer Center, Houston, Texas. October 27, 2009
 - 3 Metabolomics of Soybean Roots Inoculated with *Bradyrhizobium japonicum*. Noble Metabolomics Minisymposium, Ardmore, Oklahoma, March 27, 2009.
 - 2 Systematic Identification of the Proteome of *Medicago truncatula* Suspension Cells using Two-Dimensional Electrophoresis and Tandem Spectrometry. NSF-VBI-NOBLE Plant Proteomics Workshop, Ardmore, Oklahoma, August 5, 2004
 - 1 Ellagitannin Biosynthesis in Hardwood Cell Suspension Cultures. 219th American Chemical Society Meeting, San Francisco, California. March 30, 2000.
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POSTER PRESENTATIONS

- 13 **Lei, Z.**, Henson, S., Huhman, D., Watson, B., and Sumner, L.W. Elucidation of the Biochemical Basis of Scab Resistance in Pecan using Metabolomics. 63rd American Society for Mass Spectrometry (ASMS) Annual Conference. Minneapolis, MN, May 31-June 4, 2015.
- 12 **Lei, Z.**, Watson, B., Huhman, D., Henson, S., and Sumner, L.W. Large-scale Metabolic Profiling of Saponins in *Medicago truncatula* Ecotypes. 62nd American Society for Mass Spectrometry (ASMS) Annual Conference. Baltimore, MD, June 15-19, 2014.
- 11 **Lei, Z.**, Jing, L, Zhang, H., Huhman, D., Zhou, Q. and Sumner, L.W. Construction of a Plant Natural Products Tandem Mass Spectral Library. 61st American Society for Mass Spectrometry (ASMS) Annual Conference. Minneapolis, MN, June 9-13, 2013.
- 10 **Lei, Z.**, Zhang, H., Huhman, D., Zhou, Q. and Sumner, L.W. Construction of a Plant Secondary Metabolite, Triple Quadrupole Tandem Mass Spectral Library. 60th American Society for Mass Spectrometry (ASMS) Annual Conference. Vancouver, Canada, May 20-24, 2012.
- 9 **Lei, Z.**, Bench, B.J., Huhman, D. and Sumner, L.W. Development of a Plant Secondary Metabolite, Tandem Mass Spectral Library Using a Triple Quadrupole LC-MS/MS. 59th American Society for Mass Spectrometry (ASMS) Annual Conference. Denver, Colorado. June 5-9, 2011.

- 8 **Lei, Z.**, Brechenmacher, L., Stacey, G. and Sumner, L.W. “Metabolomics of Soybean Roots” 58th American Society for Mass Spectrometry (ASMS) Annual Conference. Salt Lake City, Utah. May 23-27, 2010.
- 7 **Lei, Z.**, Brechenmacher, L., Findley, S., Libault, M., Stacey, G. and Sumner, L.W. “*Metabolomics of Soybean Root Hairs Inoculated with Bradyrhizobium japonicum*” 57th American Society for Mass Spectrometry (ASMS) Annual Conference. Philadelphia, Pennsylvania. May 31-June 4, 2009.
- 6 **Lei Z.**; Sawasdipuksa, N., Sangvanich, P. and Sumner L.W. “*Isolation and Proteomics Analysis of Vacuolar Membrane from Medicago truncatula*” 56th ASMS Conference on Mass Spectrometry, Denver, Colorado, May 31–June 5, 2008.
- 5 **Lei, Z.**, Dai, X., Bedair, M., Watson, B.S, Zhao, P. and Sumner, L.W. Proteomic of *Medicago truncatula* Tonoplast. American Society for Mass Spectrometry (ASMS) 55th Annual Conference. Indianapolis, Indiana, June 3–June 7, 2007.
- 4 **Lei, Z.**, Nagaraj, S., Watson, B.S., Huhman, D.V., Chen, F., Naoumkina, M., Dixon, R. and Sumner, L.W. Proteomic Analysis of Responses of *Medicago truncatula* to External Stimuli. American Society for Mass Spectrometry (ASMS) 54th Annual Conference. Seattle, Washington, May 28 – June 2, 2006.
- 3 **Lei, Z.**, Watson, B. S., Farag, M., Dixon, R. A. and Sumner, L. W. Comparative Proteomics of Yeast Elicited *Medicago truncatula* Suspension Cell Cultures. American Society for Mass Spectrometry (ASMS) 53rd Annual Conference. San Antonio, Texas, June 5–9, 2005.
- 2 **Lei, Z.**, Elmer, A. M. and Sumner, L. W. Systematic Identification of the Proteome of *Medicago truncatula* Suspension Cells using Two-Dimensional Electrophoresis and Tandem Mass Spectrometry. American Society for Mass Spectrometry (ASMS) 52nd Annual Conference. Nashville, Tennessee, May 23–27, 2004.
- 1 **Lei, Z.**, Elmer, A. M. and Sumner, L. W. Proteomic analysis of *Medicago truncatula* suspension cells using 2-DE and LC-MS/MS. Oklahoma Molecular Plant Biology Minisymposium, Stillwater, OK, March 20-21, 2003.