12-21-07

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1. Education:

Degree	University	Field	Year
B.S.	University of California, Riverside	Plant Science	1970
M.S.	University of California, Riverside	Plant Science	1972
Ph.D.	University of California, Riverside	Botany	1976

2. Positions:

Assistant Professor, Horticulture Department, Purdue University	1977-1981
Associate Professor, Horticulture Department, Purdue University	1981-1985
Professor, Horticulture and Landscape Architecture Department, Purdue University	1985-2005
Bruno C. Moser Distinguished Professor, Horticulture and Landscape Architecture, Purdue University	2005-present

3. Awards and Honors:

The National Canners Association Award (American Society for Horticultural Science) – 1974
Wilson J. Popenoe Award (American Society for Horticultural Science) – 1980
Alex Laurie Award (American Society for Horticultural Science) – 1983
ISI (Institute for Scientific Information) Highly Cited Researcher – Plant and Animal Science – 2001-present
Bruno C. Moser Distinguished Professor – 2005

4. Membership in Professional Societies:

American Society of Plant Biologists

5. Courses:

Year/Semester	Course Number and Title	Credit No.	No. of Students
1978/Winter	HORT 690/Plant Cell, Tissue Culture	4	12
1979/Winter	HORT 690/Plant Cell, Tissue Culture	4	8
1981/Winter	HORT 690/Plant Cell, Tissue Culture	4	17
1982/Winter	HORT 650/Plant Cell, Tissue Culture	1	24
1984/Winter	HORT 650/Plant Cell, Tissue Culture	1	13
1986/Winter	HORT 650/Plant Cell, Tissue Culture	1	15
1988/Winter	HORT 650G/Plant Cell, Tissue Culture	1	17

1990/Fall	HORT 650G/Plant Environ Stress Physiol	1(4-lectures)	10
1992/Fall	HORT 551/Plant Physiology	3(2 lectures)	10
1993/Fall	HORT 650G/Plant Cell, Tissue Culture	1	14
1993/Fall	HORT 551/Plant Physiology	3(2 lectures)	17
1994/Winter	HORT 590M/*In situ* hybridization	0.5	9
1994/Fall	HORT 590M/Immunocytochemistry	0.5	4
1995/Fall	BIOL 551/Ion homeostasis	3(2 lectures)	7
1995/Fall	HORT 590M/Immunocytochemistry	0.5	7
1997/Winter	HORT 590H/Plant Cell, Tissue Culture	1	16
1997/Fall	HORT 601/Planning & Presenting Research	1	7
1998/Winter	HORT 590H/Plant Cell, Tissue Culture	1	14
1998/Fall	HORT 601/Planning & Presenting Research	1	7
1999/Winter	HORT 515/Plant Cell, Tissue Culture	1	9
2000/Winter	HORT 515/Plant Cell, Tissue Culture	1	11
2000/Fall	HORT 601/Planning & Presenting Research	1	10
2001/Winter	HORT 515/Plant Cell, Tissue Culture	1	7
2002/Winter	HORT 515/Plant Cell, Tissue Culture	1	9
2002/Fall	HORT 301/Plant Physiology	3(co-instructor)	60
2004/Winter	HORT 515/Plant Cell, Tissue Culture	1	10
2005/Winter	HORT 515/Plant Cell, Tissue Culture	1	7
2006/Winter	HORT 515/Plant Cell, Tissue Culture	1	2
2007/Fall	HORT 301/Plant Physiology	4	60

6. Publications:

A. Refereed Papers

Murashige T, Shabde MN, Hasegawa PM, Takatori FH, Jones JB (1972) Propagation of asparagus through shoot apex culture. I. Nutrient medium for formation of plantlets. J Amer Soc Hort Sci 97:158-161

Hasegawa PM, Murashige T, Takatori FH (1973) Propagation of asparagus through shoot apex culture. II. Light and temperature requirements, transplantability of plants, and cyto-histological characteristics. J Amer Soc Hort Sci 98:143-148

Hasegawa PM, Murashige T, Mudd JB (1977) The fate of L-tyrosine-UL ^{14}C in shoot forming tobacco callus. Physiol Plant 41:223-230

Pence VC, Hasegawa PM, Janick J (1979) Asexual embryogenesis in *Theobroma cacao* L. J Amer Soc Hort Sci 104:145-148

Hasegawa PM, Yasuda T, Cheng T-Y (1979) Effect of auxin and cytokinin on newly synthesized proteins of cultured Douglas fir cotyledons. Physiol Plant 46:211-217

Hasegawa PM (1979) *In vitro* propagation of rose. HortScience 14:610-612

Eichholtz DA, Robitaille HA, Hasegawa PM (1979) Adventive embryony in apple. HortScience 14:699-700

Yasuda T, Hasegawa PM, Cheng T-Y (1980) Analysis of newly synthesized proteins during differentiation of cultured Douglas fir cotyledons. Physiol Plant 48:83-87

Pence VC, Hasegawa PM, Janick J (1980) Initiation and development of asexual embryos of *Theobroma cacao* L. in vitro. Z Pflanzenphysiol 98:1-14

Hasegawa PM (1980) Factors affecting shoot and root initiation from cultured rose shoot tips. J Amer Soc Hort Sci 105:216-220

Jarret RL, Hasegawa PM, Erickson HT (1980) Factors affecting shoot initiation from tuber discs of potato. (*Solanum tuberosum* L.). Physiol Plant 49:177-183

Jarret RL, Hasegawa PM, Erickson HT (1980) Effects of medium components on shoot formation from cultured tuber discs of potato. J Amer Soc Hort Sci 105:238-242

Papachatzi M, Hammer PA, Hasegawa PM (1980) *In vitro* propagation of *Hosta plantaginea*. HortScience 15:506-507

Hasegawa PM, Bressan RA, Handa AK (1980) Growth characteristics of NaCl selected and nonselected cells of *Nicotiana tabacum* L. Plant and Cell Physiol 21:1347-1355

Papachatzi M, Hammer PA, Hasegawa PM (1981) Propagation of *Hosta decorata* 'Thomas Hogg' using cultured shoot tips. J Amer Soc Hort Sci 106:232-236

Bressan RA, Hasegawa PM, Handa AK (1981) Resistance of cultured higher plant cells to polyethylene glycol-induced water stress. Plant Sci Lett 21:23-30

Pence VC, Hasegawa PM, Janick J (1981) In vitro regulation of anthocyanin synthesis in zygotic and asexual embryos of *Theobroma cacao*. J Amer Soc Hort Sci 106:381-385

Frankenberger EA, Hasegawa PM, Tigchelaar EC (1981) Influence of environment and developmental state on the shoot-forming capacity of tomato genotypes. Z Pflanzenphysiol 102:221-232

Frankenberger EA, Hasegawa PM, Tigchelaar EC (1981) Diallel analysis of shoot-forming capacity among selected tomato genotypes. Z Pflanzenphysiol 102:233-242

Kim Y-J, Hasegawa PM, Bressan RA (1981) *In vitro* propagation of hyacinth. HortScience 16:645-647

Pence VC, Hasegawa PM, Janick J (1982) Sucrose- mediated regulation of fatty acid composition in asexual embryos of *Theobroma cacao*. Physiol Plant 53:378-384

Jarret RL, Hasegawa PM, Bressan RA (1982) Gibberellic acid regulation of adventitious shoot formation from tuber discs of potato. In Vitro 17:825-830

Eichholtz DA, Hasegawa PM, Robitaille HA (1982) Effects of gentamicin on growth and shoot initiation of cultured tobacco callus and salpiglossis leaf discs. In Vitro 18:12-14

Handa AK, Bressan RA, Handa S, Hasegawa PM (1982) Characteristics of cultured tomato cells after prolonged exposure to medium containing polyethylene glycol. Plant Physiol 69:514-521

Hyndman SE, Hasegawa PM, Bressan RA (1982) A basis for increased rooting from cultured shoots through the use of reduced mineral salts concentrations. HortScience 17:82-83

Hyndman SE, Hasegawa PM, Bressan RA (1982) The role of sucrose and nitrogen in adventitious root initiation on cultured rose shoots. Plant Cell Tissue Organ Culture 1:229-238

Bressan RA, Handa AK, Handa S, Hasegawa PM (1982) Growth and water relations characteristics of cultured tomato cells during adjustment to low external water potentials. Plant Physiol 70:1303-1309

Bressan PH, Kim Y-J, Hyndman SE, Hasegawa PM, Bressan RA (1982) Factors affecting *in vitro* propagation of rose. J Amer Soc Hort Sci 107:979-990

Handa AK, Bressan RA, Nicholson RL, Park M, Hasegawa PM (1982) The use of plant cell cultures to study production and phytotoxicity of *Alternaria solani* toxin. Physiol Plant Path 21:295-309

Wright DC, Park WD, Leopold NR, Hasegawa PM, Janick J (1982) Accumulation of lipids, proteins, alkaloids and anthocyanins during embryo development in vivo of *Theobroma cacao* L. J Amer Chem Soc 59:475-479

Handa AK, Bressan RA, Handa S, Hasegawa PM (1983) Clonal variation for tolerance to PEG-induced water stress in cultured tomato cells. Plant Physiol 72:645-653

Jayaswal RK, Bressan RA, Handa AK, Hasegawa PM (1983) Occurrence of cAMP in the phytopathogenic fungus *Alternaria solani*. Archives of Microbiology. 135:125-129

Handa S, Bressan RA, Handa AK, Carpita NC, Hasegawa PM (1983) Solutes contributing to osmotic adjustment in cultured plant cells adapted to water stress. Plant Physiol 73:834-843

Wright DC, Janick J, Hasegawa PM (1983) Temperature effects on *in vitro* lipid accumulation in asexual embryos of *Theobroma cacao* L. Lipids 18:863-867

Cherry JH, Bishop L, Leopold N, Pikaard C, Hasegawa PM (1984) Patterns of fatty acid deposition during development of soybean seed. Phytochem 23:2183-2186

LaRosa PC, Hasegawa PM, Bressan RA (1984) Photoautotrophic potato cells: Transition from heterotrophic to autotrophic growth. Physiol Plant 61:279-286

Suzich JA, Ranjeva R, Hasegawa PM, Herrmann KM (1984) Regulation of the shikimate pathway in carrot cell suspension culture. Plant Physiol 75:369-371

Pratt RC, Bressan RA, Hasegawa PM (1985) Genotypic diversity enhances recovery of hybrid and fertile backcrosses of *Phaseolus vulgaris* L. and *P. acutifolius* A. Gray. Euphytica 34:329-344

Cherry JH, Bishop L, Hasegawa PM, Leffler HR (1985) Differences in fatty acid composition of soybean seed in Northern and Southern areas of the USA. Phytochem 24:237-241

LaRosa PC, Handa AK, Hasegawa PM, Bressan RA (1985) Abscisic acid accelerates adaptation of cultured tobacco cells to NaCl. Plant Physiol 79:138-142

Binzel ML, Hasegawa PM, Bressan RA (1985) Adaptation of tobacco cells to NaCl. Plant Physiol 79:118-125

Singh NK, Handa AK, Hasegawa PM, Bressan RA (1985) Proteins associated with adaptation of cultured tobacco cells to NaCl. Plant Physiol 79:126-137

Charles DJ, Hasegawa PM, Cherry JH (1986) Characterization of acetyl-CoA carboxylase in the seed of two soybean genotypes. Phytochem 25:55-59

Handa S, Handa AK, Hasegawa PM, Bressan RA (1986) Proline accumulation and the adaptation of cultured plant cells to water stress. Plant Physiol 80:938-945

Singh NK, LaRosa PC, Handa AK, Hasegawa PM, Bressan RA (1987) Hormonal regulation of protein synthesis associated with salt tolerance. Proc Natl Acad Sci (USA) 84:739-743

LaRosa PC, Hasegawa PM, Rhodes D, Clithero JM, Watad AA, Bressan RA (1987) Abscisic acid stimulated osmotic adjustment and its involvement in adaptation of tobacco cells to NaCl. Plant Physiol 85:174-181

Binzel ML, Hasegawa PM, Rhodes D, Handa S, Handa AK, Bressan RA (1987) Solute accumulation in tobacco cells adapted to NaCl. Plant Physiol 84:1408-1415

Singh NK, Bracker CA, Hasegawa PM, Handa AK, Buckel S, Hermodson MA, Pfankoch E, Regnier FE, Bressan RA (1987) Characterization of osmotin. A thaumatin-like protein associated with osmotic adaptation in plant cells. Plant Physiol 85:529-536

Binzel ML, Hess FD, Bressan RA, Hasegawa PM (1988) Intracellular compartmentation of ions in salt adapted tobacco cells. Plant Physiol 86:607-614

Iraki NM, Bressan RA, Hasegawa PM, Carpita NC (1989) Alteration of the physical and chemical structure of the primary cell wall of growth-limited plant cells adapted to osmotic stress. Plant Physiol 91:39-47

Singh NK, Nelson DE, Kuhn DN, Hasegawa PM, Bressan RA (1989) Abscisic acid and low water potential regulate the expression of osmotin. Plant Physiol 90:1096-1101

LaRosa PC, Singh NK, Hasegawa PM, Bressan RA (1989) Stable NaCl tolerance of tobacco cells is associated with enhanced accumulation of osmotin. Plant Physiol 91:855-861

Singh NK, Nelson D, Kuhn D, Hasegawa PM, Bressan RA (1989) Molecular cloning of osmotin cDNA and regulation of its expression by adaptation to low water potential. Plant Physiol. 90:1096-1101

Kononowicz AK, Floryanowicz-Czekalska K, Hasegawa PM, Bressan RA (1990) Chromosome number and DNA content of tobacco cells adapted to NaCl. Plant Cell Reports 8:672-675

Kononowicz AK, Floryanowicz-Czekalska K, Hasegawa PM, Bressan RA (1990) Chromosome number and nuclear DNA content of plants regenerated from salt adapted plant cells. Plant Cell Reports 8:676-679

Schnapp SR, Bressan RA, Hasegawa PM (1990) Carbon use efficiency in tobacco cells adapted to NaCl. Plant Physiol 93:384-388

Reuveni MR, Bennett AB, Bressan RA, Hasegawa PM (1990) Enhanced H^+ transport capacity and ATP hydrolysis activity of the tonoplast H^+-ATPase after NaCl adaptation. Plant Physiol 94:524-530

Casas A, Bressan RA, Hasegawa PM (1991) Cell growth and water relations of the halophyte, *Atriplex nummularia* in response to NaCl. Plant Cell Rep 10:81-84

Watad AA, Reuveni M, Bressan RA, Hasegawa PM (1991) Enhanced net K^+ uptake capacity of NaCl adapted cells. Plant Physiol 95:1265-1269

Schnapp SR, Curtis WR, Bressan RA, Hasegawa PM (1991) Growth yields and maintenance coefficients of unadapted and NaCl adapted tobacco cells grown in semi-continuous culture. Plant Physiol 96:1289-1293

Schnapp SR, Curtis WR, Bressan RA, Hasegawa PM (1991) Estimation of growth yield and maintenance coefficient of plant cell suspensions. Biotechnol Bioeng 38:1131-1136

Westgate PJ, Emery AH, Hasegawa PM, Heinstein PF (1991) Growth of *Cephalotaxus harringtonia* plant cell cultures. Appl Microbiol Biotechnol 34:798-803

Westgate PJ, Curtis WR, Emery AH, Hasegawa PM, Heinstein PF (1991) Substrate-limited growth of *Cephalotaxus harringtonia* plant cell cultures. Biotechnol Bioeng 38:241-246

Narasimhan ML, Binzel ML, Perez-Prat E, Chen Z, Nelson DE, Singh NK, Bressan RA, Hasegawa PM (1991) NaCl regulation of tonoplast ATPase 70-kilodalton subunit mRNA in tobacco cells. Plant Physiol 97:567-568

Curtis WR, Hasegawa PM, Emery AH (1991) Modeling linear variable growth in phosphate limited suspension cultures of opium poppy. Biotechnol Bioeng 38:371-378

Rietveld RC, Bressan RA, Hasegawa PM (1991) Somaclonal variation in tuber disc-derived populations of potato. I. Evidence of genetic stability across tuber generations and diverse locations. Theor Appl Genet 82:430-440

Watad AA, Swartzberg D, Bressan RA, Izhar S, Hasegawa PM (1991) Stability of salt tolerance at the cell level after regeneration of plants from salt tolerant tobacco cell line. Physiol Plant 83:307-313

Kononowicz AK, Hasegawa PM, Bressan RA (1991) Cell cycle duration in tobacco cells adapted to NaCl. Environ Exptl Bot 32:1-9

Casas AM, Nelson DE, Raghothama KG, Paino D'Urzo M, Singh NK, Bressan RA, Hasegawa PM (1992) Expression of osmotin-like genes in the halophyte *Atriplex nummularia*. Plant Physiol 99:329-337

LaRosa PC, Chen Z, Nelson DE, Singh NK, Hasegawa PM, Bressan RA (1992) Developmental, hormonal and environmental factors that affect transcriptional and post-transcriptional regulation of the osmotin gene. Plant Physiol 100:409-415

Nelson DE, Raghothama KG, Singh NK, Hasegawa PM, Bressan RA (1992) Analysis of structure and transcriptional activation of an osmotin gene. Plant Mol Biol 19:577-588

Reitveld RC, Bressan RA, Hasegawa PM (1993) Somaclonal variation in tuber disc-derived populations of potato: II. Differential effect of genotype. Theor Appl Genet 87:305-313

Kononowicz AK, Nelson DE, Singh NK, Hasegawa PM, Bressan RA (1992) Regulation of the osmotin gene promoter. Plant Cell 4:513-524

Zhu J-K, Bressan RA, Hasegawa PM (1992) An *Atriplex nummularia* cDNA with sequence homology to the algal caltractin gene. Plant Physiol 99:1734-1735

Perez-Prat E, Narasimhan ML, Binzel ML, Botella MA, Chen Z, Valpuesta V, Bressan RA, Hasegawa PM (1992) Induction of a putative Ca^{2+}-ATPase mRNA in NaCl adapted cells. Plant Physiol 100:1471-1478

Zhu J-K, Shi J, Bressan RA, Hasegawa PM (1993) Expression of an *Atriplex nummularia* gene encoding a protein homologous to the bacterial molecular chaperone DnaJ. Plant Cell 5:341-349

Reuveni M, Bressan RA, Hasegawa PM (1993) Modification of proton transport kinetics of the plasma membrane H^+-ATpase after adaptation of tobacco cells to NaCl. J Plant Physiol 142:312-318

Zhu J-K, Shi J, Singh U, Wyatt SE, Bressan RA, Hasegawa PM, Carpita NC (1993) Enrichment of vitronectin- and fibronectin-like proteins in NaCl-adapted plant cells and evidence for their involvement in plasma membrane-cell wall adhesion. Plant J 3:637-646

Niu X, Zhu J-K, Narasimhan ML, Bressan RA, Hasegawa PM (1993) Plasma-membrane H^+-ATPase gene expression is regulated by NaCl in cells of the halophyte *Atriplex nummularia*. Planta 190:433-438

Zhu J-K, Bressan RA, Hasegawa PM (1993) Loss of arabinogalactin-protein from the plasma membrane of NaCl-adapted cells. Planta 190:221-226

Smeda RJ, Hasegawa PM, Goldsbrough PB, Singh NK, Weller SC (1993) A serine to threonine substitution in Q_B protein in potato cells results in atrazine resistance without impairing productivity. Plant Physiol 103:911-914

Casas AM, Kononowicz AK, Zehr UB, Tomes DT, Axtell JD, Butler LG, Bressan RA, Hasegawa PM (1993) Transgenic sorghum plants via microprojectile bombardment. Proc Natl Acad Sci (USA) 90:11212-11216

Niu X, Narasimhan ML, Salzman RA, Bressan RA, Hasegawa PM (1993) NaCl regulation of plasma membrane H^+-ATPase gene expression in a glycophyte and a halophyte. Plant Physiol 103:713-718

Raghothama KG, Liu D, Nelson DE, Hasegawa PM, Bressan RA (1993) Analysis of an osmotically regulated pathogenesis-related osmotin gene promoter. Plant Mol Biol 23:1117-1128

Zhu J-K, Bressan RA, Hasegawa PM (1993) Isoprenylation of the plant molecular chaperone ANJ1 facilitates membrane association and function at high temperature. Proc Natl Acad Sci (USA) 90:8557-8561

Chang P-F, Narasimhan ML, Hasegawa PM, Bressan RA (1993) Quantitative mRNA-PCR for expression analysis of low-abundance transcripts. Plant Mol Biol Rept 11:237-248

Zhu J-K, Damsz B, Kononowicz AK, Bressan RA, Hasegawa PM (1994) A higher plant extracellular vitronectin-like adhesion protein is related to the translational elongation factor-1α. Plant Cell 6:393:404

Niu X, Wang H, Bressan RA, Hasegawa PM (1994) Molecular cloning and expression of a glyceraldehyde-3-phosphate dehydrogenase gene in a desert halophyte, *Atriplex nummularia* L. Plant Physiol 104:1105-1106

Botella MA, Quesada MA, Hasegawa PM, Valpuesta V (1993) Nucleotide sequences of two peroxidase genes from tomato (*Lycopersicon esculentum*). Plant Physiol 103:665-666

Perez-Prat E, Narasimhan ML, Niu X, Botella MA, Bressan RA, Valpuesta V, Hasegawa PM, Binzel ML (1994) Growth cycle stage-dependent NaCl induction of plasma membrane H^+-ATPase mRNA accumulation in de-adapted tobacco cells. Plant, Cell Environ 17:327-333

Liu D, Raghothama KG, Hasegawa PM, Bressan RA (1994) Osmotin overexpression in potato delays development of disease symptoms. Proc Natl Acad Sci (USA) 91:1888-1892

Xu Y, Narasimhan M, Chang PF(L), Raghothama KG, Hasegawa PM, Bressan RA (1994) Plant defense genes are synergistically induced by ethylene and methyl jasmonate. Plant Cell 6:1077-1085

Chen Z, Fu H, Liu D, Chang LP-F, Narasimhan M, Ferl R, Hasegawa PM, Bressan RA (1994) A NaCl-regulated plant gene encoding a brain protein homologue that activates ADP ribosyltransferase and inhibits protein kinase C. Plant J 6:729-740

Botella MA, Quesada MA, Kononowicz AK, Bressan RA, Pliego F, Hasegawa PM, Valpuesta V (1994) Characterization and *in situ* localization of a salt-induced tomato peroxidase mRNA. Plant Mol Biol 25:105-114

Grillo S, Leone A, Xu Y, Tucci M, Francione R, Hasegawa PM, Monti L, Bressan RA (1995) Control of osmotin gene expression by ABA and osmotic stress. Physiol Plant 93:498-504

Zhu J-K, Hasegawa PM, Bressan RA, Niu X (1996) Multiple transcripts of a novel plant calcium-binding protein gene are differentially regulated by developmental and environmental stimuli. Physiol Plant 97:499-506

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Mitchell C, Sherman L, Nielsen S, Nelson P, Trumbo P, Hodges T, Hasegawa P, Bressan R, Ladisch M, Auslander D (1996) Earth benefits of interdisciplinary CELSS-related research by the NSCORT in bioregenerative life support. Adv Space Res 18:4/5:23-31

Zhu K., Heusing J, Shade R, Bressan R, Hasegawa PM, Murdock L (1996) An insecticidal N-acetylaglucosamine-specific lectin gene from *Griffonia simplicifolia* (Legumónosae). Plant Physiol 110:195-202

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Salzman RA, Bressan RA, Hasegawa PM, Ashworth EN, Bordelon BP (1996) Programmed accumulation of LEA-like proteins during desiccation and cold acclimation of overwintering grape buds. Plant Cell Environ 19:713-720

Zhao Y, Botella MA, Subramanian L, Niu X, Nielsen S, Bressan RA, Hasegawa PM (1996) Wound-inducible soybean cysteine proteinase inhibitors have greater insect digestive proteinase inhibitory activities than constitutive homologues. Plant Physiol 111:1299-1306

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Prieto R, Pardo JM, Niu X, Bressan RA, Hasegawa PM (1996) Salt sensitive mutants of *Chlamydomonas reinhardtii* isolated after insertional tagging. Plant Physiol 112:99-104

Mendoza I, Quintero FJ, Bressan RA, Hasegawa PM, Pardo JM (1996) Activated calcineurin confers high tolerance to ion stress and alters the budding pattern and cell morphology of yeast cells. J Biol Chem 271:23061-23067

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Zhu K, Bressan RA, Hasegawa PM, Murdock LL (1996) Identification of N-acetylglucosamine binding residues in *Griffonia simplicifolia* lectin II. FEBS Lett 390:271-274

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Botella MA, Xu Y, Prabha TN, Zhao Y, Narasimhan ML, Wilson KA, Nielsen SS, Bressan RA, Hasegawa PM (1996) Differential expression of soybean cysteine proteinase inhibitor genes during development and in response to wounding and methyl jasmonate. Plant Physiol 112:1201-1210

Maggio A, Paino D'Urzo M, Abad LR, Takeda S, Hasegawa PM, Bressan RA (1996) Large quantities of recombinant PR-5 proteins from the extracellular matrix of tobacco: Rapid production of microbial-recalcitrant proteins. Plant Mol Biol Rep 14:249-260

Maggio A, Bressan RA, Hasegawa PM, Locy RD (1997) Moderately increased constitutive proline does not alter osmotic stress tolerance. Physiol Plant 101:240-246

Ping X, Watad A, Yun D-J, Hasegawa PM, Bressan RA (1997) An expedient and reliable method to identify gene constructs in *Agrobacterium* vectors. Plant Tissue Culture and Biotechnology 3:37-40

Raghothama KG, Maggio A, Narasimhan ML, Kononowicz AK, Wang G, Paino D'Urzo M, Hasegawa PM, Bressan RA (1997) Tissue specific activation of the osmotin gene by ABA, C_2H_4 and NaCl involves the same promoter region. Plant Mol Biol 34:393-402

Yun D-J, Zhao Y, Pardo JM, Narasimhan ML, Damsz B, Lee H, Abad LR, D'Urzo MP, Hasegawa PM, Bressan RA (1997) Stress proteins on the yeast cell surface determine resistance to osmotin, a plant antifungal protein. Proc Natl Acad Sci (USA) 94:7082-7087

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Niu X, Lin K, Hasegawa PM, Bressan RA, Weller SC (1998) Transgenic peppermint (*Mentha x piperita* L.) plants obtained by co-cultivation with *Agrobacterium tumefaciens.* Plant Cell Rep 17:165-171

Watad AA, Yun D-J, Matsumoto T, Niu X, Wu Y, Kononowicz AK, Bressan RA, Hasegawa PM (1998) Microprojectile bombardment-mediated transformation of *Lilium longiflorum*. Plant Cell Rep 17:262-267

Koiwa H, Shade RE, Zhu-Salzman K, Subramanian L, Murdock LL, Nielsen SS, Bressan RA, Hasegawa PM (1997) Phage display selection can differentiate insecticidal activity of soybean cystatins. Plant J 14:371-379

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7. Invited Presentations, Lectures, etc.:

Metabolic phenomena associated with initiation-of organized structures in vitro. Tissue Culture Association, 28th Annual Meeting, 1977

Propagation of woody plants by tissue culture techniques. Iowa State University 20th Annual Shade Tree Short Course, 1977

Tissue culture today and in the future. International Plant Propagator's Society, Inc. Southern Region, 3rd Annual Meeting, December, 1978

Shoot tip excision and culture to plants. Workshop on practical tissue culture techniques and problems. ASHS Annual Meeting, 1980

Plant tissue culture. Stauffer Chemical Company, Richmond, CA, February 13, 1980

Plant tissue culture and crop productivity. The Alpha Zeta-Gamma Delta Sigma Faculty Discussion Series, Purdue University, April 8, 1981

The involvement of plant growth regulators in growth and differentiation in vitro. U. S. - Taiwan Seminar on Plant Growth Regulators, NSF/NSC, June 22-24, 1981

Regulation of morphogenesis in vitro. Oregon Graduate Center, Beaverton, OR, July 13, 1981

Application of tissue culture to horticultural crops. Molecular Genetics, Inc., Minneapolis, MN, August 24, 1981

Morphogenesis in vitro. Native Plants, Salt Lake City, UT, September 22, 1981

Plant tissue culture research at Purdue University. Calgene, Inc., Davis, CA, October 15, 1981

Regulation of morphogenesis in vitro. Department of Pomology, University of California, Davis, CA, November 12, 1981

Tissue culture. Minicourse on plant cell and molecular biology. University of Utah, Salt Lake City, UT, February 24-27, 1983

Salt and drought stress tolerance in cultured higher plant cells. University of Chapingo, Chapingo Mexico, May 12, 1983.

Salt tolerance in cultured plant cells. Biological responses to stress in plants. Tissue Culture Association, 34th Annual Meeting, June 14, 1983

Tolerance to water stress in higher plant cells. Symposium on: Somatic cells genetics: Prospects for development of stress tolerance. ASHS, 80th Annual Meeting, October 19, 1983

Mechanisms of tolerance to salt in cultured cells. Plant Breeding and Genetics Program, Michigan State University, East Lansing, MI, February 24, 1984

Utilizing cell cultures to study cellular mechanisms of salinity and water stress tolerance in plants. Symposium on: Biotechnologies to unlock resources of arid land plants. AAAS Annual Meeting, New York, NY, May 24-/29, 1984

Osmotic adjustment. Gordon Research Conference on Temperature Stress in Plants, Tilton Academy, NH, June 24-29, 1984

Cellular mechanisms of salinity tolerance. University of Illinois, Urbana, IL, February 18, 1985

Physiological and biochemical adaptations contributing to salinity tolerance. Department of Botany, The Hebrew University of Jerusalem, Jerusalem, Israel, March 28, 1986

Osmotic stress tolerance in plants through in vitro and molecular approaches. ECC Conference on Drought Resistance in Plants: Genetic and Physiological Aspects. Amalfi, Italy, October 20-23, 1986

Cellular mechanisms of salinity tolerance in cultured glycophyte cells. Israel Association of Plant Tissue Culture and Israel Society of Plant Molecular Biologists. Weizmann Institute of Science, Rehovot, Israel, November 20, 1986

Mechanisms of salinity tolerance of glycophyte cells in vitro, CIBA-Geigy Biotechnology Research, Research Triangle, NC, February 3, 1987

Biotechnology use on cowpea, IITA Workshop on "Host plant resistance to post-flowering pests of cowpea", Ibadan, Nigeria, September 5-11, 1987

Salt adaptation of cultured glycophyte cells, University of Granada, Granada, Spain, October 20, 1987

Stability of salt tolerance in adapted cells and regenerated plants, Moet-Hennessey conference on "Advanced selection strategies: Potential applications for the breeding of woody species", Versailles, France, September 18-20, 1988

Phenotypic stability of salt tolerance in cells and regenerated plants, Bio Symposium Tokyo '88, Tokyo, Japan, October 19-22, 1988

Interspecific hybridization for insect resistance. Cowpea Biotechnology Conference, Portici, Italy, June 14-16, 1989

Intracellular ion accumulation and compartmentation mechanisms contributing to salt adaptation. Horticulture Biotechnology Symposium, Davis, CA, August 20-23, 1989

Ion accumulation and compartmentation mechanisms contributing to osmotic adjustment required for salt adaptation of plant cells, Department of Botany and Microbiology, Auburn University, October 9, 1990

Osmotic regulation of ATPase genes. Joint Cowpea Biotechnology Workshop, Purdue University, July 16-20, 1990

Cowpea transformation systems for bioassaying insect resistance genes and to obtain transgenic plants. Joint Cowpea Biotechnology Workshop, Purdue University, July 16-20, 1990

Cereal regeneration. Biotechnology: Enhancing Research on Tropical Crops in Africa, Ibadan, Nigeria, November 26-30, 1990

Cowpea Biotechnology Workshop, University of Naples, June 24-26, 1991

Osmotic regulation of osmotin. March Foundation Conference, Madrid, Spain, November 11-13, 1991

Physiological and molecular mechanisms of ion accumulation and compartmentation contributing to salt adaptation. University of Malaga, May, 1991

NaCl regulation of plasma membrane and tonoplast ATPase gene expression in glycophytes and a halophyte during salt adaptation. Ninth International Workshop on Plant Molecular Biology, Monterey, CA, July 19-24, 1992

Callus feeding bioassay. Cowpea Biotechnology Workshop, Bari, Italy, June 29-July 1, 1992

Physiological and molecular mechanisms of salt adaptation. Symposium on Applications and Prospects of Biotechnology for Arid and Semi-Arid Lands. Lubbock, TX, November 5-7, 1992

Osmotin: regulation of gene expression and function. Plant Responses to Cellular Dehydration During Environmental Stress, 16th Annual Symposium on Plant Physiology, University of California-Riverside, January 28-30, 1993

ATPase gene expression during salt stress. Plant Molecular Biology Gordon Research Conference, Andover, NH, July 5-9, 1993

Genetic transformation of cowpea. Joint Cowpea Biotechnology Workshop, Purdue University, September 27 to 29, 1993

NaCl regulated gene expression. Gordon Conference - Salinity Tolerance in Plants, Tilton, NH, August 14 to 19, 1994

Osmotic regulation of plant ATPase gene expression. Fifth International Symposium-Genetics and Molecular Biology of Plant Nutrition, July 17 to 24, 1994

Developing a transformation system for cowpea (*Vigna unguiculata* L. Walp.). Second World Cowpea Research Conference, Ibadan, Nigeria, September 4 to 10, 1994

Osmotin mediated host plant phytopathogenic fungal resistance - Cucurbitaceae 94, South Padre Island, TX, November 1 to 4, 1994

Microprojectile transformation of sorghum - 19th Biennial Grain Sorghum Research and Utilization Conference, Lubbock, TX, March 1 to 7, 1995

Improvement of abiotic and biotic stress tolerance in plants by molecular genetic approaches - Department of Biology, Humboldt State University, September 14, 1995

Plant transformation; Plant Biotechnology - Department of Biology, Humboldt State University, September 3, 1996

Wheat PR-4 and trypsin inhibitor effectively inhibit *Aspergillus flavus*, Aflatoxin Elimination Workshop, Fresno, CA, October 28-29, 1996

Verticillium resistance in mint via plant biotechnology, Mint Industry Research Council, Scientific Affairs Committee, Las Vegas, January 22, 1997

Plant transformation (BIOL 542) - Department of Biological Sciences, Humboldt State University, Arcata, CA, October 5-21, 1997

Plant biotechnology - Department of Biological Sciences, Humboldt State University, Arcata, CA, October 15, 1997

Plant stress tolerance - Cell and molecular biology, Humboldt State University, Arcata, CA, October 16, 1997

Identification of plant osmotic stress tolerance determinants - Department of Biology, IUPUI, Indianapolis, IN, November 14, 1997

Crop improvement of mint through biotechnology, Mint Industry Research Council Annual Meeting, Las Vegas, NV, January 14, 1998

Identification of plant salt tolerance determinants, RITE International Workshop on Metabolic Engineering of Plants, Kyoto, Japan, June 5, 1997

Osmotic stress tolerance determinants, Symposium on Abiotic Stress Tolerance at the International Association of Plant Tissue Culture Meeting, Jerusalem, Israel, June, 1998

Abiotic stress tolerance of plants, Symposium at the Horticulture Society Meeting, Charlotte, NC, July, 1998

Salt regulated plant genes, Salinity and Water Stress Gordon Conference, Oxford, UK, August, 1998

Plant Transformation in Biotechnology (BIOL 542) - Department of Biological Sciences, Humboldt State University, Arcata, CA, October 21 to November 14, 1998

Plant Genomics, HLA Department, Purdue University, October, 1998

Molecular determinants of stress tolerance in plants, Colloquium on Linking Molecular Processes to Horticultural Performance, American Society for Horticultural Science Annual Meeting, Charlotte, NC, July, 12-15, 1998

Function of genes implicated in stress tolerance, Session on Ionic Relations, Salinity and Water Stress Gordon Conference, Oxford, UK, August, 16-21, 1998

Salt tolerance determinants of plants, Department of Botany and Microbiology, Auburn University, October 16, 1998

Salinity stress tolerance of plants, Institute of Cell and Molecular Biosciences, University of Tokyo, December 1, 1998

Production technology for environmental compatibility: Technology development for renewable industrial materials production by plants adapted to stressful environments, Plant Biotechnology in the 21st Century, Nara Institute of Science and Technology Workshop, December 2-3, 1998

Signal transduction and salinity tolerance, Mechanisms of Plant Responses to Salt and Drought Stresses, Japanese Ministry of Education, Science, Culture and Sports, Honolulu, HI, January 14-16, 1999

Crop improvement of mint through biotechnology, Mint Industry Research Council Annual Meeting, Las Vegas, NV, January 19-21, 1999

Salt tolerance determinants, Plant Tolerance to Abiotic Stresses in Agriculture: Role of Genetic Engineering, NATO ARW, Mrogowa, Poland, June 13-19, 1999

Plant tissue culture and biotechnology (BOT 520), Department of Biological Sciences, Humboldt State University, March 31-May 7, 1999

Directed molecular evolution of plant defensive proteins, Institute of Food Technologists Annual Meeting, July 24-28, 1999

Plant genomics, Department of Biological Sciences, Humboldt State University, Arcata, CA, November 5, 1999

Ca^{2+} signaling in the osmotic stress response. 6^{th} International Society of Plant Molecular Biology Meeting, Quebec, Canada, June 18-24, 2000

Searching for *Verticillium* resistance determinants - Mint Industry Research Council Annual Meeting, Las Vegas, NV, January 16-18, 2001

Osmotic signaling and plant stress adaptation, Department of Plant Sciences, University of Arizona, Tucson, AZ, February 5, 2001

Genetic approaches to identification of plant osmotic stress tolerance determinants, Department of Plant Biology, Arizona State University, Tempe, AZ, February 9, 2001

Plant osmotic stress tolerance determinants, Volcani Center, Bet Dagan, Israel, February 27, 2001

Arabidopsis and yeast as genetic models to dissect the plant response to salt, School of Biological Sciences, University of Sussex, March 1, 2001

AtHKT1 is a salt tolerance determinant that controls Na^+ entry into plant roots, 12^{th} International Workshop on Plant Membrane Biology, Madison, WI, August 11-16, 2001

Plant osmotic stress tolerance determinants by T-DNA tagging mutagenesis in Arabidopsis, Central Power Industries Research Institute, Abiko, Japan, October 25, 2001

Cellular and plant responses to salinity: Tolerance determinants identified by T-DNA tagging mutagenesis in Arabidopsis, Yamada Symposium, Kyoto, Japan, November 5-6, 2001

Physiological, biochemical and genetic analyses of ion homeostasis during salinity stress, Academia Sinica Symposium, Taipei, Taiwan, November 8-10, 2001

Plant osmotic stress tolerance determinants identified by T-DNA tagging in Arabidopsis, University of Tokyo, Japan, November 21, 2001

Genetic approaches to identify plant osmotic stress tolerance determinants, including effectors of ion homeostasis – Research Institute for Bioresources, Okayama University, Japan, December 11, 2001

Plant stress tolerance determinants identified by T-DNA insertional tagging in *Arabidopsis thaliana*, Hiroshima University, Japan, December 13, 2001

Signaling and effector determinants of salt tolerance, Tohoku University, Japan, December 20, 2001

Osmotic stress tolerance determinants identified by T-DNA mutagenesis of *Arabidopsis thaliana*, Agricultural Plant Research Center, Chonnam, Korea, January 14, 2002

Osmotic stress tolerance determinants identified by T-DNA mutagenesis of *Arabidopsis thaliana*, Agricultural Plant Research Center, Gyeosang University, Korea, January 15, 2002

Ion homeostasis mechanisms that contribute to plant stress tolerance, Nara Institute of Research and Technology, Japan, January 18, 2002

Plant salt stress tolerance determinants identified by insertional T-DNA tagging, XIIIth International Conference on Arabidopsis Research, Seville, Spain, June 28-July 2, 2002

Introduction by the Chair, Salt and Water Stress in Plants Gordon Research Conference, Oxford, UK, July 14-19, 2002

Plant salt stress tolerance determinants identified by T-DNA tagging, Abiotic Stress Workshop, Rockefeller Foundation and Shandong Teacher's University, Jinan, PRC, October 9-11, 2002

Plant stress tolerance determinants, Institute of Botany, Academia Sinica, Beijing, PRC, October 14, 2002

Salt stress tolerance in plants, Beijing Forestry University, Beijing, PRC, October 15, 2002

Plant salt stress adaptation determinants identified by T-DNA insertional tagging, Plant Breeding and Genetics Program, Michigan State University, East Lansing, MI, December 13, 2002

Plant stress adaptation determinants identified by T-DNA insertional tagging, Molecular and Cell Biology Division, NSF, Arlington, VA, December 20, 2002

Plant stress adaptation determinants identified by T-DNA insertional tagging, USDA Salinity Laboratory, Riverside, CA, January 29, 2003

Salt and freezing tolerance determinants of plants, Plant and Animal Genome Conference XII, Abiotic Stress Workshop, San Diego, CA, January 10 to 15, 2004

Forward genetic approaches for the identification of salt adaptation determinants, Keystone Symposium on Plant Responses to Abiotic Stresses, Santa Fe, NM, February 19 to 25, 2004

Cold and osmotic stress signaling determinants in Arabidopsis, 7th International Plant Cold Hardiness Seminar, Hokkaido University, Sapporo, Japan, July 10, 2004

Salt tolerance determinants identified by forward genetic approaches, First Annual Australian Center for Plant Functional Genomics Research Symposium and Project Review, Barossa, South Australia, October 5 to 9, 2004

Cross talk between temperature stress and other environmental stresses, Discussion Leader, Gordon Research Conference on Temperature Stress in Plants, Ventura, California, January 29 to February 4, 2005

Plant osmotic stress tolerance determinants, Research Coordination Meeting – Crop Tolerance to Salt and Drought for FAO/International Atomic Energy Agency, Vienna, Austria, March 14-18, 2005

Forward genetic approaches for identification of plant osmotic stress tolerance determinants, MEPS Symposium, Texas A&M University, College Station, Texas, March 6-9, 2005

Osmotic stress tolerance determinants of Arabidopsis, Plant salt tolerance and breeding (cellular and whole plant response), International Salinity Forum, University of California Water Resources Center, Riverside, California, April 25-27, 2005

Osmotic stress tolerance determinants identified by forward genetic approaches, Institute of Genetics, Beijing, China, April 30 to May 4, 2005

Sumoylation in phosphate signaling and stress tolerance of plants, Plant Stress Biology Symposium, Busan, Korea, May 4-7, 2005

Salt and osmotic stress tolerance determinants of Arabidopsis, Symposium on plant responses to salinity, Barcelona, Spain, July 9-15, 2005

Sumoylation in plant responses to abiotic stresses, Gordon Research Conference on Salt and Water Stress in Plants, Oxford, UK, September 3-8, 2006

Sumoylation regulates plant responses to abiotic stresses, Iwate Plant Science Symposium 2006, Morioka, Japan, October 17-21, 2006

Universidad de Malaga, Malaga, Spain, March 29, 2006

Estacion Experimeiintal del Zaidin, Granada, Spain March 30, 2006

Instituto de Recursos Naturales y Agrobiologia, Sevilla, Spain April 3, 2006

Universidad de Cordoba, Cordoba, Spain, April 5, 2006

INIA, Madrid, Spain, April 7, 2006

8. Graduate Students, Post Doctorates and Visiting Scientists:

A. Graduate Students (completed):

E. A. Frankenburger. Genetics of shoot-forming capacity in tomato. M.S. 1980.
P. C. LaRosa. Carbon metabolism in photoautotrophic cells of potato. M.S. 1982.
M. C. Lopez-Peralta. Tolerance of tomato genotypes to osmotic stress in vitro. Ph.D. 1984 (Co-major Professor with R. A. Bressan).
M. L. Binzel. Ion transport properties associated with adaptation to salt stress in tobacco cells. Ph.D. 1987.
S. R. Schnapp. Carbon use efficiency of salt adapted cells. Ph. D. 1988.
Jian-Kang Zhu. Plant cell surface adhesion proteins. Ph.D. 1993.
Xiaomu Nui. Regulation of the 70 kDa subunit tonoplast ATPase gene by NaCl. Ph.D. 1994.
Tracie Matsumoto. Molecular genetics of salt adaptation. Ph.D. 1999.
Altanbradt Sharkuu. Suppressors of the salt sensitive phenotype of *sos3*. M.S. 2002
Xiangqiang Zhan. Forward genetic approaches in the halophyte *Thellungiella*. Ph.D
Chan Yul Yoo. Calmodulin-dependent transcription factors. Ph.D.

B. Postdoctorate Associates/Visiting Scientists (including collaborations):

V.C. Pence 1977-1980
A.K. Handa 1979-1981
S. Handa 1980-1987
M. Jain 1981-1982
N.K. Singh 1982-1987
S.S. Singh 1984-1985
D. Charles 1985-1987
C. Orser 1985-1987
J. Kanabus 1985-1987
M. Reuveni 1985, 1987-1989, 1992-1993
M. Binzel 1987-1989
A. Casas 1988-1993
J. Hanquier 1988-1990
K.G. Raghothama 1990-1992
Chima Osuala 1991-1992
Sherry Schnapp 1989-1992

Yuan Zhao 1993-1995
S. Grillo 1991
Chris LaRosa 1991-1993
Meena Narasimhan 1992-2006
U. Zehr 1992-1994
Josef Kapusta 1993-1994
Laura Todd 1994-1995
Dae-Jin Yun 1994-1998
Miguel Angel Botella - 1991, 1993, 1994-1995
E. Perez-Pratt, University of Malaga, Spain - 1988-1990
A. Kononowicz, University of Lodz, Poland - 1985, 1990-1997
Y.-J. Kim, Korean Faculty of Agriculture - 1980-1982
Oyette Chamblis, Auburn University - 1990
M.P. D'Urzo, Faculture of Agriculture, Italy - 1991, 1993-
Jose M. Pardo, Natural Science and Agriculture Research Institute, Seville, Spain - 1992, 1993-1994, 1995-1997
Franco Saccardo, University of Tuscany, Viterbo, Italy - 1991
Tykal N. Prabha, India - 1992
Louis Jackai, IITA, 1991-92
Imelda M. Mendoza, Spain - 1993-1994, 1995-1997
Abd Watad, Volcani, Israel - 1994, 1995-1996
Kheng T. Cheah, Malaysia - 1994-1995
Rafael Prieto, University of Cordoba, Spain - 1994-1996
Yongquin Niu, Chinese Academy of Sciences, Beijing - 1994-1995
Barbara Damsz, University of Lodz, Poland - 1993-2001
Satomi Takeda, Osaka Womens University, Osaka - 1994-1995
Joaquin Espartero, University of Seville, Spain - 1994-1995, 1996
Ping Xu, Zhejiang Agriculture University, China - 1994-1996
Iraida Amaya, Spain - 1994-1995
Amir Zuker, Volcani, Israel - 1994
Mansi Wang, Nanjing University, China - 1994-1996
Lanying Zhang, South China Institute of Botany, China - 1994-1997
Xia Li, Hebei Teacher's University, China - 1996-2002
Zihong Fan, China - 1994-1995
Jiamin Li, Institute of Agriculture, Schijiazhuang, China - 1995
Mahmoud Hamoui, University of Damascus, Syria – 1995
Kui Lin - 1996-1997
Hisashi Koiwa - 1996-2002
Mupala Reddy, Salinity Research Institute, India - 1996-1997, 1999-2000
Maria Coca, Consejo Superior de Investigaciones Cientificas, Sevilla, Spain - 1997-2000
Ignacio Ibeas - 1996-2000
Keyan Zhu-Salzman - 1995-2000
Yoshikiyo Sakabibara, National Food Research Institute, Tskuba, Japan - - 1996
Bahagiawati Amirhusin, Indonesia - 1996-2000
Gabriele Chilosi, University of Tuscany - Italy, 1996
Carla Caruso, University of Tuscany - Italy, 1997
Paola Veronase, Rome, Italy - 1996-1997, 1998-2002

Gyung-Hye Huh - 1997-2000
Shuji Yokoi - 1999-2001
Ana Rus - 1998-2004
Zhizhong Gong - 1999-2000
Fang Li - 2000-2001
Tracie Matsumoto - 1998-2001
Fumiyuki Goto - 2001-2003
Yuko Nakagawa - 2001-2003
Kenji Muira – 2002-present
Dae-Jin Yun – 2003-present
Abel Rosado-Rey – 2003-2004
Jingbo Jin – 2004-present
Dong Won Baek – 2003-2004
Ziyi Cao – 2003-2004
Jael Cheol Jeong – 2003-2006
Yinhua Jin – 2004-present
Suk-Yoon Kim – 2004-present
Kuk-Yoon Kwon – 2004-present
Hyung Gon Mang – 2004-present
Yanmei Zhu – 2004-present
Chan Yul Yoo – 2004-2005
Xiangqiang Zhan – 2004-2005
Jianjun Zhu – 2005-present
Dong Ha Oh – 2005-present
Soon-Tae Kwon – 2005-present
Ji Young Lee – 2005-present

9. Research Grants/Support:

Selection of disease resistance in maize and potato through the use of tissue culture. AES Program Improvement Funds. January 1, 1979 - December 31, 1981. $180,000 (Hasegawa PM, Nicholson RL, Bressan RA).

In vitro production of cacao. Chocolate Manufacturers Association, April 1, 1980 - March 31, 1983, $570,000 (Janick J, Hasegawa PM)

Studies on the biochemical and genetic control of linolenic acid synthesis in developing soybean seeds. American Soybean Association, March 1, 1980 - February 28, 1985, $114,000 (Cherry J, Hasegawa PM)

Resistance to water and salt stress through somatic cell selection. BARD, October 1980 - October 1983, $105,000 to Horticulture. (Bressan RA, Hasegawa PM, Handa AK)

Plant cell and tissue culture research. AES Program Improvement Funds, July 1, 1981 - July 1, 1984, $90,000 (Hasegawa PM, Bressan RA, Handa AK)

Tissue culture propagation of rose. Michigan Bulb Company, November 1, 1981 - October 31, 1982, $5,500

Salt stress tolerance in plants. Native Plants, Inc., September, 1982, $10,000 (Handa AK, Bressan RA, Hasegawa PM)

Regulation of protein and mRNA metabolism in salt tolerant and intolerant cultured higher plant cells. DOE, 1983-1986, $240,000 (Bressan RA, Hasegawa PM, Handa AK)

Development of tissue culture systems to produce important plant secondary products. Showalter Trust Fund, April 1, 1983-June 30, 1984, $30,000 (Heinstein P, Bressan RA, Hasegawa PM, Handa AK)

Role of ion accumulation and compartmentation in salinity adaptation of cultured cells. USDA/NRICGP, August 1, 1985-July 31, 1988, $150,000 (Hasegawa PM, Hess FD)

Purchase of equipment for plant stress biology research. NSF, $75,000 (Bressan RA, Cherry JH, Handa AK, Mitchell CA, Weller SC, Hasegawa PM)

Membrane transport adaptations contributing to salinity tolerance. Cultured cells and regenerated plants. BARD, December 1, 1986-November 31, 1988, $100,000 (Hasegawa PM, Hess FD, Israeli collaborators)

Cowpea PSG/IPIA. July 1, 1987-June 30, 1989, $57,000 (Bressan RA, Hasegawa PM)

Incorporation of resistance to pod borer and pod bugs into cowpea. AID/USDA/CSRS Collaborative Research on Special Constraints at the IARC's, July 1, 1988-June30, 1991, $90,000 (Hasegawa PM, Bressan RA, Kitch L, Shade RE, Murdock L)

Interspecific hybridization of cowpea, cowpea transformation. IITA, January 1, 1989-December 30, 1992, $180,000 (Bressan RA, Hasegawa PM)

Mechanisms contributing to enhanced tonoplast ATPase activity during adaptation of plant cells to salinity. David Ross Grant, January 1, 1990-December 31, 1992, $16,000

Regulation of the plasma membrane and tonoplast H^+-ATPases in plants exposed to NaCl. Royal Society Guest Research Fellowship, January 1, 1990, $20,000

Alternatives to enhance cowpea as a source of protein nutrition, a component of the NSCORT project. NASA, November 1990-November 1994, $380,000 (for Hasegawa PM, Bressan RA)

Transfer of osmotically (drought and salt stress) regulated genes to rice. Rockefeller Foundation, 1990-1993, $30,000 (Hasegawa PM, Bressan RA)

Regulation of the plasma membrane and tonoplast H^+-ATPases in plants exposed to NaCl. NSF - Cooperative Science Program, 1991-1992, $14,000

Molecular cloning of soybean cysteine proteinase inhibitor for insect resistance. USDA/NCRIGP, September 9, 1991-August 31, 1995, $195,000 (Nielsen S, Hasegawa PM, Bressan RA)

Sorghum transformation. Pioneer Seed Company, January, 1992-September, 1994, $283,000, (Hasegawa PM, Bressan RA, Butler L, Axtell J)

Characterization of morphological, physiological and biochemical mechanisms associated with drought resistance in *Sorghum bicolor*. McKnight Foundation, July1, 1990-June 30, 1993, $62,000, renewal from January 1992-Janaury, 1995, $62,000 (to Hasegawa PM)

Regulation of H^+-ATPase genes in a glycophyte and a halophyte. USDA/NCRIGP, July 1, 1992-June 30, 1995, $120,000 (Hasegawa PM, Bressan RA)

The possible involvement of extracellular matrix proteins in cell wall/membrane adhesion and in Ca/calmodulin regulated metabolism of plant cells adapted to osmotic stress. USDA/NCRIGP, July 1, 1992-June 30, 1995, $120,000 (Bressan RA, Hasegawa PM)

Osmotin, a novel source of phytopathogenic fungal resistance. Midwest Plant Biotechnology Consortium (DOE), January 1, 1993-December 31, 1994, $200,000 (Hasegawa PM, Bressan RA)

Resistance to aflatoxin producing *A. flavus* group fungi in transgenic peanut plants overproducing osmotin and osmotin-like proteins. USDA Cooperative, 1993 to 1998 $101,000 (Bressan RA, Hasegawa PM)

Osmotin and osmotin-like proteins, novel sources of phytopathogenic fungal resistance for tomato, carnation and petunia. BARD, 1993-1995, $50,000 (Hasegawa PM, Bressan RA, Watad AA)

Functional analysis of ANJ1, a higher plant homolog of the bacterial heat shock protein and molecular chaperone DnaJ. PRF Grant, July, 1994-June, 1996, $20,400

Sorghum transformation. Pioneer Seed Company, October, 1994-September, 1997, $641,000 (Hasegawa PM, Bressan RA)

Co-ordinate regulation and function of osmotically-induced plant defense genes. USDA/NRICGP, 1994-1997, $149,000 (Bressan RA, Hasegawa PM)

Development of a sorghum transformation system. Consortium for Plant Biotechnology Research (DOE), January, 1994-December, 1995, $50,000 (Hasegawa PM, Bressan RA)

ANJ1 proteins, a novel class of plant DnaJ-like chaperones that are involved in thermal adaptation. USDA/NRICGP, 1995-1998, $170,000 (Hasegawa PM, Bressan RA)

Sorghum stem borer and root and stalk rot disease resistance through genetic transformation. Rockefeller Foundation - 1996-1997 - $60,000 (Hasegawa PM, Bressan RA)

Sorghum transformation. Pioneer Hi-Bred International - 1996-1997 - $240,000 (Hasegawa PM, Bressan RA)

Exploiting antifungal protein and commercial fungicide synergisms to reduce fungicide use. USDA Biotech program - 1996-98 - $150,000 (Bressan RA, Hasegawa PM, Narasimhan ML)

Utilization of cysteine proteinase inhibitors for host plant insect resistance. USDA Biotech program, 1996-1998, $90,000 to Hort (, Hasegawa PM, Bressan RA)

Osmotin and osmotin-like proteins, novel sources of phytopathogenic fungal resistance for tomato and carnation and petunia. BARD, 1996-1999, $300,000 ($150,000 to Hort) (Watad AA, Hasegawa PM, Bressan RA)

Salt tolerance of plants expressing calcineurin. USDA/NRICGP, 1997-1999, $110,000 (Hasegawa PM, Bressan RA, Pardo JM)

Improving commercial mint varieties through biotechnology. Mint Council - 1997-2000 - $366,000 (Weller SC, Bressan RA, Hasegawa PM)

Molecular evolution of cysteine proteinase inhibitors. PRF Grant, 1998-2000, $22,000

Tomato Genomics – NRICGP/ARP, Purdue University, 9-1998 - $162,000 (Bressan RA, Hasegawa PM)

Genes controlling cytotoxicity of osmotin, a plant defense protein. NSF MCB98-8551, 1998-2001, $300, 000 (Bressan RA, Hasegawa PM, Narasimhan ML).

Genomics of plant stress tolerance, NSF DBI-9813360, 1998-2003, $2,250,000 to Purdue University (Bressan RA, Hasegawa PM)

Improved Surimi processing through bioengineering of proteinase inhibitors, USDA/NRICGP, 1998 – 2000, $73,830 to Purdue University (Hasegawa PM, Bressan RA)

Isolation of wheat seed proteins with substantial antifungal activities against *Aspergillus flavus*. USDA - 1998 - $25,000 (Bressan RA, Hasegawa PM)

Enhanced SCN resistance through metabolic engineering of cysteine proteinase inhibitors – Indiana Soybean Board #98-210, 1998-2000, $173,000 (Hasegawa PM, Bressan RA)

Memorandum of Agreement, Stress tolerance genes and their use in transgenic crop plants, Futuragene, 5/20/2003-2/28/2005, $25,000 (Bressan RA, Hasegawa PM)

Thellungiela halophila (Salt Cress), a halophyte and cryophyte Arabidopsis relative as a genetic model to identify stress adaptation determinants – NSF, 2004-2007, $500,000 (Hasegawa PM, Bressan RA)

Genes controlling *SOS1* mRNA stability in response to abiotic stresses – USDA, 2004-2008, $400,000 (Hasegawa PM, Shi H, Bressan RA)

Collaborative Research: Arabidopsis 2010: Functional Analysis of Calcium/Calmodulin-mediated Transcriptional Networks in *Arabidopsis* – NSF, 2004-2007, $296,062 (Hasegawa PM, Bressan RA)

Unrestricted gift to the HLA Department in support of RA Bressan and PM Hasegawa research, Futuragene, 8-2004, $904,000

Enhanced cell tolerance in tomato – SBIR, May 15, 2004 to October 15, 2004, $25,000 (Hasegawa PM, Bressan RA)

Research Grants Pending:

Sumoylation is a focal control process in phosphate starvation signaling and adaptation – USDA/NRI, 2007-2010, $349,068 (Hasegawa PM, Bressan RA, Miura K)

10. Other Research and Scholarly Activities:

Steering Committee for Tissue Culture Working Group Workshop at the 1979 ASHS Annual Meeting.

Organizer and co-convener of Session in Depth on Somatic Cell Selection and Crop Productivity, Annual Meeting Tissue Culture Association, 1980.

Vice Chairman, Tissue Culture Working Group ASHS, 1980-1981.

Chairman of Program Committee of the Plant Division of the Tissue Culture Association, 1981-1982.

Chairman, Tissue Culture Working Group ASHS, 1981-1982.

Executive Board and Executive Council Member, Tissue Culture Association - 1982.

Chairman ASPP Election Committee, 1983.

USDA/CRGO Panel on Biotechnology: Genetic and Molecular Responses to Physical Stress in Plants, 1986 and 1987.

USDA Competitive Research Grant Panel - SBIR-Plant Production, 1988 and 1989.

USDA Competitive Research Grant Panel - SBIR - Plant Production - Topic Manager, 1989-1990.

NSF-Cellular Biosciences Research Grant Panel, September 9, 1988.

USAID-USDA-CSRS Research Constraints Grants - Review group for both preproposals and full proposals, 1988 and 1989.

Associate Editor for In Vitro Cellular and Developmental Biology, 1998-2002.

Editorial Board for the journal Plant Physiology, 1988-1991.

Editorial Board for Plant Cell, Tissue and Organ Culture**,** 2001-2002.

Reviewer for; Plant Physiology, Plant Cell, PNAS, Science, Plant Cell and Environment, Plant Cell Reports, Plant Molecular Biology, Plant Journal, Plant and Soil, J Biol Chem, SDA/NRICGP, DOE, NSF, J Plant Physiol, Plant Science, Annals of Botany, J Exp Bot, Trends Plant Sci.

Organizer and Convener of a symposium on "Mechanisms of plant adaptation to salt", NATO Workshop on "Biochemical and physiological mechanisms associated with environmental stress tolerance in plants", Norwich, UK, August 2-7, 1987.

Organizer and Convener of the session on "Salinity Stress", NATO Advanced Research Workshop, Mrogowa, Poland, June 12-19, 99.

Editorial Committee for Annual Review of Plant Physiology and Plant Molecular Biology, Volume 50, 1999.

Vice-chair Salinity and Water Stress Gordon Conference, Tilton NH, 2000.

Chair Salinity and Water Stress Gordon Conference, 2002.

Polar Research Board Participant, Frontiers in Polar Biology Workshop, National Academy of Sciences/NSF, Lake Tahoe, NV, September 9-11, 2002.

NSF-Eukaryotic Genetics Grant Panel, October 30-November 3, 2002.

NSF-Signal Transduction Grant Panel, October 29-31, 2003.

NSF-Signal Transduction Grant Panel, November 8-10, 2004.

Monitoring Editor for Plant Physiology, 2004-2009.

GHARDEN Proposal Planning Meeting with USAID, Washington, DC, August 10, 2004.

Tomato Genome Initiative, Madrid, Spain, December 2-4, 2004.

Discussion Leader, Temperature Stress in Plants Gordon Research Conference, January 30-February 4, 2005.

Research Coordination Meeting – Crop Tolerance to Salt and Drought for FAO/International Atomic Energy Agency, Vienna, Austrai, March 14-18, 2005

Judge for 2006 Intel International Science and Engineering Fair, Indianapolis, IN, May 10, 2006

Sumoylation in plant responses to abiotic stresses, Gordon Research Conference on Salt and Water Stress In Plants, Magdalen College, Oxford, UK, September 3-8, 2006

Invited Speaker – Iwate Plant Science Symposium, Morioka, Japan, October 16-24, 2006

FFA Agriscience Fair Judge, Indianapolis, IN, October 26, 2006

11. Current Project Statements

Ca^{2+}/Plant Calmodulin Regulation of Abiotic Stress Responses.
The proposed work pertains to the determination of gene function of the calcium/calmodulin-mediated transcriptional networks involved in stress signaling in *Arabidopsis*. The Ca^{2+} messenger system plays a critical role in the perception and transduction of external and internal stimuli. Calmodulin (CaM), a primary intracellular Ca^{2+} receptor, transduces Ca^{2+} signals by binding to and altering the activity of the target proteins. Genome-wide screening with CaM has revealed that the *Arabidopsis* has at least 12 signal-responsive CaM-binding transcription factors (CaMBTFs), which belong to two distinct families. These CaMBTFs include 6 AtSRs (with a CGCG-box DNA-binding domain) and 6 AtGT2s (with two tri-helix DNA-binding domains). It is estimated that about 6.7% of the total 25,498 genes in the *Arabidopsis* genome are putative transcription factors. However, less than 10% of these factors have been characterized and, in particular, the Ca^{2+}/CaM-modulated transcriptional networks are relatively undeciphered. We propose to study the *in planta* functional significance of the CaMBTFs using a collaborative approach involving scientists from Washington State University, Purdue University and Colorado State University. These investigators share a common interest in studying Ca^{2+}/CaM-mediated signaling and its role in plant response to biotic and abiotic stresses. It is hypothesized that Ca^{2+}/CaM plays an important role in plant response to biotic and abiotic stresses by regulating CaMBTFs. Specifically, we will study the following: (1) The functional significance of 12 CaMBTFs using loss-of-function genetic approaches; (2) The functional analysis of CaMBTFs using gain-of-function as well as site-directed mutants in the calmodulin-binding domain; and (3) Identify the *cis*-elements and downstream target genes by oligo screening and chromatin immunoprecipitation. A better understanding of the function(s) of these CaMBTFs will increase our knowledge of how plants respond to biotic and abiotic stresses, and help in the production of improved crop plants.

SIZ1 SUMO E3 Ligase Regulates Plant Innate Immunity.
Reversible modifications of proteins by small ubiquitin-related modifier (SUMO) proteins are involved in many cellular processes in yeasts and animals, yet little is known about the function of sumoylation in plants. Here, we show that the *SIZ1* gene, that encodes an Arabidopsis SUMO E3 ligase, regulates innate immunity. *siz1* plants exhibit constitutive systemic acquired resistance (SAR) that is characterized by

elevated accumulation of salicylic acid (SA), increased resistance to the bacterial pathogen *Pseudomonas syringae* pv. *tomato* (*Pst*) DC3000 and constitutive expression of pathogenesis-related (PR) genes. In *siz1* plants expressing the SA hydroxylase *nahG* (*nahG siz1-2*) disease resistance is linked to elevated SA amounts. In addition, accumulation of *PAD4*, *EDS1*, *EDS5* and *SID2* transcripts was increased, whereas the expression of *NDR1* and *NPR1* remained similar to wild-type**.** Studies with the double mutants, *npr1 siz1, pad4 siz1* and *ndr1 siz1* revealed that SIZ1 controls SA signaling. SIZ1 and PAD4 interact epistatically to regulate PR expression and disease resistance. Consistent with these observations, *siz1* mutant plants exhibited enhanced resistance to *Pst* DC3000 expressing *avrRps4*, a bacterial avirulence determinant that responds to the EDS1/PAD4-dependent TIR-NBS type *R* gene. In contrast, *siz1* plants were not resistant to *Pst* DC3000 expressing *avrRpm1*, a bacterial avirulence determinant that responds to the NDR1-dependent CC-NBS type *R* gene. Also, jasmonic acid (JA)-induced *PDF1.2* expression and susceptibility to *Botrytis cinerea* were unaltered in *siz1* plants. Taken together, our results demonstrate that SIZ1 is required for PAD4-mediated SA signaling, that in turn confers innate immunity in Arabidopsis.

Sumoylation in Plant Phosphate Starvation Signaling.
Phosphorus is the most limiting essential plant macronutrient because phosphate (Pi) is relatively unavailable or deficient in most soils. Plants sense low external Pi and initiate adaptations to access Pi. Our studies established that AtSIZ1 is a SUMO E3 ligase and a focal regulator of Pi starvation signaling that controls expression of genes and root development necessary to facilitate Pi acquisition and homeostasis. Research will dissect processes by which SIZ1 regulates Pi starvation-dependent gene expression and root remodeling, and provide evidence that a conserved cascade functions in rice. SIZ1 regulates Pi starvation-induced gene expression through the MYB transcription factor PHR1. Experimentation will establish how SIZ1-mediated sumoylation of PHR1 regulates *microRNA (miR)399* expression and, consequently, *PHO2/UBC24* silencing. *PHO2/UBC24* is a negative regulator of Pi transporters and Pi accumulation. Pi starvation-induced root remodeling is also regulated by SIZ1 perhaps because of effects on auxin accumulation and distribution in the root. Pharmacological and genetic interaction analyses are to determine if auxin facilitates Pi dependent root remodeling and identify the effectors that are regulated by SIZ1. Lastly, genetic gain- and loss-of-function, and complementation analyses will establish if orthologous rice SIZ proteins regulate an analogous Pi starvation cascade in rice, providing indication that the proposed research will have direct implication to cereals and perhaps other crop species. These experiments are focused to provide novel fundamental insight about Pi nutrient acquisition that will address NRI and CREES goal 1 “enhance economic opportunities of producers”.

Post-translational Modification Functions in Flowering Time Control.
Reversible conjugation of the small ubiquitin-related modifier (SUMO) peptide to proteins (sumoylation) occurs through an ordered series of biochemical steps that are similar to those of ubiquitination, although SUMO and proteins catalyzing the cycle are unique and biological consequences of sumoylation are very dissimilar. Sumoylation/desumoylation in animals and yeast is a transcriptional regulatory mechanism that facilitates chromatin modifications that are necessary for coordinated higher order gene expression required to facilitate developmental programs and appropriate responses to hormonal and environmental signals. SUMO conjugation/deconjugation in plants regulates biological processes such as flowering, abiotic stress and hormonal responses, and disease development; however, little is understood about sumoylation regulators, effectors, substrates, and outputs, or the transcriptional control processes that are involved. We determined that Arabidopsis AtSIZ1 is an ortholog of mammalian PIAS and yeast Siz SUMO E3 ligases, and like

these prototypes, is a transcriptional regulator (Miura *et al.*, 2005). *siz1* mutations cause substantial early flowering and evidence indicates that SIZ1 functions as a regulator of the autonomous pathway that controls *FLC* (*FLOWERING LOCUS C*) expression, a major determinant in floral suppression. SIZ1 mediated sumoylation of FLD (regulator of *FLC* expression) is associated with alterations in acetylation of histone 4 that is in nucleosomes of *FLC* chromatin. The project goal is to determine processes by which sumoylation regulates transcription in plants utilizing the molecular genetic platform of SIZ1 function in the modification of *FLC* chromatin and flowering time control. Specifically, **aim 1)** will identify regulators, substrates, and effectors of AtSIZ1 and genes expressed or silenced by AtSIZ1-dependent sumoylation; and **aim 2)** will establish how AtSIZ1 regulates FLD transcriptional activity FLD and *FLC* expression to control flowering time.

AtSIZ1 Regulates Responses to Temperature Extremes.
AtSIZ1 is a SUMO (*s*mall *u*biquitin *mo*difier) E3 ligase that facilitates SUMO conjugation to substrate target proteins (sumoylation) in Arabidopsis. *siz1* T-DNA mutations (*siz1-2* and *siz1-3*; Miura *et al*., 2005) cause basal, but not acquired, thermosensitivity that is associated with hyper-accumulation of SA. Expression of *NahG*, which encodes a salicylate hydroxylase, effectively reduces endogenous SA accumulation but enhances thermosensitivity resulting from *siz1-2*. High temperature induces SUMO1/2 conjugation to peptides in wild type but to a substantially lesser degree in *siz1* mutants. In other organisms, HSF sumoylation regulates DNA binding and activation of heat shock protein (HSP) gene expression that facilitates thermal adaptation. However, heat shock-induced expression of genes including *HSPs, APX1* and *APX2* is similar in *siz1* and wild -type seedlings further indicating that SIZ1 does not regulate acquired thermotolerance. Together, these results indicate that sumoylation through SIZ1 facilitates basal thermotolerance through processes that are SA independent and supersede negative regulation of SA accumulation by the E3 ligase.

SIZ1-Mediated Sumoylation of ICE1 Controls CBF3/DREB1A Expression and Freezing Tolerance in Arabidopsis
SIZ1 is a SUMO E3 ligase that facilitates conjugation of SUMO to protein substrates. *siz1-2* and *siz1-3* T-DNA insertion alleles that caused freezing and chilling sensitivities were complemented genetically by expressing *SIZ1*, indicating that the SIZ1 is a controller of low temperature adaptation in plants. Cold-induced expression of *CBF/DREB1*, particularly of *CBF3/DREB1A*, and of the regulon genes was repressed by *siz1*. *siz1* did not affect expression of *ICE1*, which encodes a MYC transcription factor that is a controller of CBF3/DREB1A. A K393R substitution in ICE1 [ICE1(K393R)] blocked SIZ1-mediated sumoylation in vitro and in protoplasts identifying the K393 residue as the principal site of SUMO conjugation. SIZ1-dependent sumoylation of ICE1 in protoplasts was moderately induced by cold. Sumoylation of recombinant ICE1 reduced polyubiquitination of the protein in vitro. ICE1(K393R) expression in wild-type plants repressed cold-induced CBF3/DREB1A expression and increased freezing sensitivity. Furthermore, expression of ICE1(K393R) induced transcript accumulation of MYB15, which encodes a MYB transcription factor that is a negative regulator of CBF/DREB1. SIZ1-dependent sumoylation of ICE1 may activate and/or stabilize the protein, facilitating expression of CBF3/DREB1A and repression of MYB15, leading to low temperature tolerance.

12. General Departmental Contributions:

Coordinator of departmental tissue culture facilities - 1977 to 1998
Numerous faculty search committees - 1978 to present
Primary Promotion Committee - 1985 to present
School of Agriculture Promotion Committee - 1992 to 1995
Department Head Search Committee co-chair – 1998
Graduate Committee Chair - 1997 to 2000
Department Head Search Committee – 2006
College of Agriculture Promotion Committee – 2006
Graduate Committee – 2006-present