第一届国际植物电生理学与离子转运研讨会

会议手册

2021年10月

中国 · 开封 · 河南大学

会议日程

Calendar for The Conference

2021 年 10 月 21 日（星期四） 21th Oct, 2021 (Thu)		
全天 Full day	报到注册：开封中州国际饭店一楼 Register: Gourd floor in Kaifeng zhongzhou International Hotel	
2021 年 10 月 22 日（星期五） 21th Oct, 2021 (Fri)		
08:10-08:30	与会专家与领导介绍 Introduction	
	河南大学校长宋纯鹏教授致欢迎辞 Welcome address of Prof. Chunpeng Song	
8:30-11:35 第一部分 电压钳与膜片钳技术 **Session I.** **TECV and Patch-clamp**	主持人：安国勇 教授，龙雨 教授 Session Chair: Prof. Guoyong An and Prof. Yu Long	
	8:30-9:00	Prof. Julian I. Schroeder UC San Diego CO_2 Sensing and Signal Transduction in Stomatal Regulation.
	9:00-9:30	Prof. Matthew Gilliham University of Adelaide GABA signalling in guard cells acts as a 'stress memory' to optimise plant water loss.
	9:30-10:00	Prof. Zhong-Hua Chen University of Western Sydney Combining Voltage Clamp with Molecular Biological and Evolutionary analysis for Research in Plant Abiotic Stress
	10:00-10:20	茶歇和合影 **Tea Break and Group Photo**
	主持人：徐小冬 教授 Session Chair: Prof. Xiao-Dong Xu	

	10:20-10:45	Prof. Steve D. Tyerman University of Adelaide
		待定 Under Expectation
	10:45-11:15	田望 研究员 Wang Tian (Research Scholar) 北京大学 Peking University A calmodulin-gated calcium channel links pathogen patterns to calcium-dependent immunity in Arabidopsis.
	11:15-11:45	薛绍武 教授 Prof. Shao-Wu Xue 华中农业大学 Huazhong Agriculture University
		Insights into Hydrogen Sulfide (H_2S) Regulation of Stomatal Movements.
11:45-13:00		**午 餐 Lunch**
		主持人：赵翔 教授，张田教授 Session Chair: Prof. Xiang Zhao and Prof. Tian Zhang
13:00-14:45 第二部分 压力探针与非损伤微测技术 **Session II.** **Pressure Probe and MEFF (NMT)**	13:00-13:30	Prof. Sergey Shabala University of Tasmania Membrane transporters in sensing and signalling of soil salinity and hypoxia
	13:30-14:00	施卫明 研究员 Wei-Ming Shi (Research Scholar) 中科院南京土壤研究所 Institute of Soil Science, CAS, Nanjing
		Molecular physiological mechanism of root response to soil iron toxicity
	14:00-14:25	孙健 副教授 Associate Prof. Jian Sun 江苏师范大学 Jiangsu Normal University Carbon dots enhance plant environmental adaptability by activating cyclic nucleotide-gated ion channels.
	14:25-14:50	安锋 研究员 Feng An (Research Scholar)

		中国热带农业科学院橡胶研究所 Rubber Research Institute, Chinese Academy of Tropical Agricultural Sciences
		Plant pressure probe and its application in rubber trees.
14:50-15:05	**茶 歇 Tea Break**	
15:05-16:35 第三部分 表面电位与结构生物学 **Session III.** **Surface Potential and Structure Biology**	主持人：田望 研究员 Session Chair: Wang Tian (Research Scholar)	
	15:05-15:35	Prof. Edward E. Farmer Slow wave potential signalling during insect attack.
	15:35-16:05	陈宇航 研究员 Yu-Hang Chen (Research Scholar) 中科院遗传与发育研究所 Institute of genetics and development, CAS
		Cryo-EM structure and electrophysiological characterization of ALMT from Glycine max reveal a novel class of anion channels
	16:05-16:35	Prof. Colin Brownlee Marine Biological Association and University of Southampton Novel cation channels in marine photosynthetic unicells: signalling and evolution
16:35-17:55 第四部分 植物离子转运 **Session IV.** **Plant Ion Transport**	主持人：施卫明 研究员 Session Chair: Prof. Wei-ming Shi	
	16:35-17:00	王存 教授 Prof. Cun Wang 西北农林科技大学 Northwest Agriculture & Forestry University Manganese signal transduction in Plants.
	17:00-17:25	丁杨林 副教授 Associate Prof. Yang-Lin Ding

		中国农业大学 China Agricultural University
		Molecular mechanism of cold-induced Ca^{2+} signature generation, sensing and decoding in Arabidopsis.
	17:25-17:50	龙雨 教授 Prof. Yu Long 河南大学 Henan University MYB77 regulates high-affinity potassium uptake by promoting expression of *HAK5*
17:50-18:00	**闭幕 Closing Ceremony**	
2021 年 10 月 23 日 23th Oct, 2021 (Sat)		
离会 Departure		

河南大学简介

河南大学坐落在历史文化名城、八朝古都开封。这里曾是河南贡院的所在地，1903、1904 年最后两场全国会试在这里举行，上千年的科举制度在这里划上句号。1912 年，以林伯襄为代表的一批河南仁人先贤，在欧风美雨和辛亥革命胜利的曙光中创办了河南留学欧美预备学校，成为当时中国的三大留学培训基地之一。后历经中州大学、国立第五中山大学、省立河南大学等阶段，1942 年改为国立河南大学。新中国成立后，经院系调整，河南大学农学院、医学院、行政学院分别独立设置为河南农学院、河南医学院、河南行政学院，水利、财经等院系也先后调入武汉大学、中南财经政法大学等高校，校本部更名为河南师范学院。后又经开封师范学院、河南师范大学等阶段，1984 年恢复河南大学校名。2008 年 10 月 17 日，河南省人民政府和教育部签订共建协议，河南大学正式进入省部共建高校行列。2016 年 9 月，学校入选国家“111 计划”。2017 年 9 月河南大学生物学科入选国家“双一流”建设学科。

建校百余年来，河南大学严守“明德新民，止于至善”的校训，已培养了近 60 万名各类人才。目前已经成为一所拥有文、史、哲、经、管、法、理、工、医、农、教育、艺术等 12 个学科门类的综合性大学，97 个本科专业，43 个硕士学位授权一级学科，24 种硕士专业学位授权类别，20 个博士学位授权一级学科，15 个博士后科研流动站。现有教职工 4300 多人，其中专兼职院士 14 人，正副高级职称 1700 人。全日制在校生 5 万人，其中研究生近 1 万人，留学生 500 人。

作为一所具有厚重历史的高校，河南大学的建设一直受到各级政府和领导的重视。近年来，习近平、李克强、江泽民等领导同志先后莅校视察，对河南大学的发展寄予厚望。河南省委、省政府历来也十分重视河南大学的建设，一直把河南大学作为河南省重点建设高校给予重点扶持。2011 年，国务院《关于支持河南省加快建设中原经济区的指导意见》中明确提出“支持河南大学创建国内一流大学”，河南省人民政府也专门颁布了《百年名校河南大学振兴计划（2011—2020 年）》。

百年的风雨和磨砺，百年的奋斗与辉煌，河南大学正乘风扬帆，充满信心，朝着建设高水平大学的方向迈进。

受邀专家简介

Colin Brownlee, Senior Research Fellow and former Director. Colin's research addresses fundamental aspects of the biology of the marine organisms that are of critical importance in regulation of the Earth's climate, and which also provide ideal models for understanding fundamental aspects of cell biology. He has a primary focus on cellular transport, homeostasis and signalling in phytoplankton and multicellular algae. He studies environmentally important groups, such as the calcifying coccolithophores and adopts a multidisciplinary approach to understand the molecular mechanisms underlying major biogeochemical processes. A key strategic driver of much of this research is to provide a better understanding of how phytoplankton populations may respond or adapt to changing conditions in the oceans, including ocean acidification. Colin also uses model algal systems such as Fucus and Chlamydomonas to understand the molecular mechanisms underlying signalling in cells and flagella. Along with comparative physiological and genomic studies this research is shedding new light on the evolution of signalling mechanisms in eukaryotic organisms.

Edward E. Farmer, Edward E. Farmer is a professor in the Department of Plant Molecular Biology at the University of Lausanne where he leads an international research team focused on understanding leaf defence mechanisms. His work has led to the discovery of mechanisms that allow leaves to respond to attack and also allow damaged tissues communicate their health status to other parts of the plant. Professor Farmer has travelled widely to study the defence features of plants in tropical, desert and mountain habitats and has also focused attention on the often unique defence features of island floras.

Julian I. Schroeder, Julian I. Schroeder did his PhD research at the Max Planck Institute for Biophysical Chemistry with Erwin Neher and was a von Humboldt postdoctoral fellow at UCLA School of Medicine. He received awards, including the Presidential Young Investigator Award (NSF), the ASPB Charles Albert Shull Award

(1997), a DFG Heinz-Maier-Leibnitz Prize, the Blasker Award in Environmental Science, is Churchill Overseas Fellow at Cambridge University and with collaborators shared the Cozzarelli Prize from PNAS (2010) and a top 10 breakthrough of the year selected by Science (2009). He has served on several advisory boards, including Co-Director of the Food and Fuel for the 21st Century Center. He was von Humboldt Fellow at the MPI for Biochemistry, visiting Professor at the ETH Zurich and is a member of the U.S. National Academy of Sciences, a Fellow of AAAS and the German National Academy of Sciences – Leopoldina.

Matthew Gilliham, Matthew is Director of the Waite Research Institute, the University of Adelaide's flagship for agriculture, food and wine innovation. He is also Professor of Crop Molecular Physiology and program leader in the Australian Research Council Centre of Excellence in Plant Energy Biology.

Matthew's areas of research specialisation is crop plant nutrition and stress resilience with a focus on salinity and drought tolerance. Specifically, his group studies transport and signalling mechanisms underpinning these processes with the aim of having them applied through plant breeding to improve crop yield and quality in the field. His discoveries include mechanisms that enhance the salt tolerance of wheat, soybean and grapevine. He is a current Web of Science Highly Cited Author and a Monitoring Editor of the ASPB Journal Plant Physiology.

Matthew gained a BSc in Ecology from Lancaster University and a PhD in Plant Physiology from the University of Cambridge, UK. After a postdoc at Cambridge, he immigrated to Australia to run the Plant Transport and Signalling Laboratory at the Waite Campus, University of Adelaide.

Steve D. Tyerman, Professor Tyerman has researched nutrition, salinity and water relations in plants for some 25 years. In 2001 he obtained the Wine Industry Chair of Viticulture at the University of Adelaide. He has received several awards for his plant physiology research and was elected as a Fellow of the Australian Academy of Science in 2003. He is currently head of the Plant Physiology, Viticulture and Horticulture

Research Group within the School of Agriculture, Food and Wine, and a member of the Wine Innovation Cluster . He is a Chief Investigator in the Australian Research Council Centre of Excellence in Plant Energy Biology and runs a node of the Centre at the University of Adelaide.

安峰，研究员，中国热带农业科学院橡胶研究所抗逆栽培课题组组长、中国热带农业科学院作物栽培与耕作学重点学科负责人。长期从事橡胶树抗逆栽培生理与生态方面的研究，发表论文 40 余篇（SCI 论文 8 篇），主编专著 1 部、参编专著 1 部、获得实用新型专利 2 项、发明专利 1 项、获陕西省科技进步二等奖及陕西省林业科技进步特等奖各 1 项(第 6 完成人)。曾主持国家自然科学基金 3 项、公益性行业科技专项、海南省自然科学基金等项目 10 余项。获得的学术成绩包括：（1）将橡胶树的根系吸水、木质部输水、蒸腾等过程耗水等联系起来较为深入系统的研究了橡胶树的整体水分传输特性及其与抗旱间的关系，认为砧木抗旱性及其吸水能力在一定程度上决定了芽接树的抗旱能力；橡胶树木质部栓塞的发生与气孔行为间有一定关联，木质部栓塞程度是橡胶树节水抗旱、调节体内水分关系的一种水力信号，可作为预测橡胶树抗旱性的良好指标；率先在国际上克隆到了 2 个橡胶树水通道蛋白基因的全长 cDNA，并开展了水通道蛋白在促进橡胶树韧皮部水分平衡，促进产排胶中的作用的研究。（2）建立了一种能够准确、连续观测橡胶乳管膨压实时变化的橡胶树乳管膨压探针，发展了一种能够同时测定多个样品植物导水率的装置，建议利用高压液流计等测定砧木的整根吸水能力以筛选橡胶树抗旱砧木，并根据橡胶树乳管膨压的变化规律研究发现乳管膨压是橡胶树产胶潜力的一个评价指标，同时根据膨压变化规律提出了一些橡胶树割胶制度的优化方案。（3）从韧皮部水分平衡和乳管膨压变化方面系统研究了乙烯利刺激橡胶树增产的机理，证明乙烯利可以诱导橡胶树水通道蛋白的表达促进韧皮部水分平衡、尤其可以解除割线附近胶乳的局部升高，从而降低胶乳总固形物含量，降低胶乳粘度、延长排胶时间，促进橡胶树增产。（4）在限流耐旱机理方面做了深入、细致的研究，证明植物木质部栓塞是其节水抗旱的一种重要策略。

陈仲华，现任澳大利亚西悉尼大学科学与健康学院副院长（国际合作），农业学科负责人和博士生导师。曾获澳大利亚农业、渔业与林业部优秀青年科学家科学与

创新奖、农业、渔业与林业部部长奖和澳大利亚研究理事会探索青年科学家奖。在 PNAS, Trends in Plant Science, Plant Cell, eLife, Molecular Plant, New Phytologist, Plant Physiology, Plant Journal, Plant, Cell and Environment, Journal of Experimental Botany 等国际权威期刊发表多篇学术论文，总影响因子逾 300，总被引用超 3900 次（Google Scholar）。受德国科学基金会、瑞士国家科学基金会、荷兰科研基金会、澳大利亚科研理事会等多个国家的基金会邀请担任项目评审专家，担任国家基金重点项目和面上项目的评审专家。目前任 SCI 刊物 Plant Growth Regulation 主编

陈宇航，中国科学院遗传与发育生物学研究所研究员。2002 年，获清华大学生物物理理学博士；2002 年-2012 年，在哥伦比亚大学从事博士后研究。主要从事结构生物学领域的工作，综合运用蛋白质晶体学，单颗粒冷冻电镜和电生理学等多种手段来研究离子通道蛋白的结构与功能调控的分子机理。离子通道是一些能形成膜孔的跨膜蛋白分子，能被特异的生理性刺激所激活，选择性通透离子进或出细胞膜，进而在多种生命活动中发挥重要的作用。致力于在原子水平上研究离子通道的三维结构，以及调控的分子机理，为理解基本生命活动规律和揭示疾病致病机理提供重要信息，为疾病诊治等提供新的理论依据和思路。其研究成果以第一作者（或共同第一作者）身份发表在 Nature , Cell, Nat Biotechnology, PNAS, Nature Communications, PLoS Genetics 等国际权威学术期刊上。

丁杨林，中国农业大学副教授，2009 年在安徽农业大学获得理学学士学位，2015 年在中国农业大学获得理学博士学位。2015-2018 年在中国农业大学从事博士后研究。2018 年入选中国农业大学“高层次人才”引进计划。主要研究植物感知和响应低温胁迫的分子机理，为农业生产提供优异的基因资源。一方面以拟南芥为研究材料，系统研究蛋白激酶和蛋白磷酸酶调控植物抗冻性的生理及分子机制；另一方面以玉米为研究材料，通过正向遗传学，反向遗传学以及蛋白质组学等手段研究玉米抗高、低温的分子机理，构建玉米响应温度胁迫的遗传调控网络，为培育抗高温或者抗低温玉米新品种提供理论基础和基因资源。近年来在 Developmental Cell、EMBO Journal、Trends in Plant Science、Molecular Cell、Nature Communications、Plant Cell、New Phytologist 等国际杂志上发表研究论文十余篇。

龙雨，河南大学特聘教授。男，理学博士，教授，硕士生导师。2007 年于山东大学物理学专业获学士学位，2014 年于中国农业大学植物学专业获博士学位。2016.4-2019.12 在澳大利亚阿德莱德大学从事博士后研究工作，2020 年 1 月任职于河南大学作物逆境适应与改良国家重点实验室。主要研究方向：植物离子转运与植物逆境生物学。近年来在 Plant Cell、New Phytologist 等国际权威学术期刊发表研究论文十余篇，ESI 1%高被引用论文 1 篇，F1000 Prime 推荐论文 2 篇。

施卫明，中国科学院南京土壤研究所研究员（二级），博士生导师，农业面源污染治理技术研发中心主任，中国植物营养与肥料学会副监事长。1982 年毕业于浙江农业大学（现浙江大学）土壤农化系，获农学学士学位，1985 和 1989 年分别在中国科学院南京土壤研究所研究生毕业，获理学硕士和理学博士学位。先后在日本东京大学、名古屋大学和美国亚利桑那大学学习和工作。长期从事土壤-植物营养学方面的研究，应用植物营养学、植物生理学、分子生物学和环境科学等技术手段，研究农田面源氮磷排放规律和污染防控技术、氮磷循环过程与植物高效吸收利用机制等，为实现我国肥料利用率的提高和农业的可持续发展提供理论依据和实用技术。先后主持国家“十三五”重点研发计划项目、国家自然科学基金重点项目和重大国际合作项目等研究项目。获中科院青年科学家奖和中科院朱月李华优秀教师奖等荣誉称号。先后获省部级科技成果奖 3 项、中国土壤学会科技成果一等奖 1 项。合著学术专著 1 部，发表 SCI 论文共 90 多篇，包括，Nature Plants、Trends in Plant Science、New Phytologist、Plant Physiology、 Science of Total Environment、Field Crop Research、Agriculture Ecosystem and Environment 等。

孙健，江苏师范大学副教授，国家甘薯产业技术体系“细胞遗传与倍性有种技术”岗位科学家团队骨干成员，江苏省高校“青蓝工程”优秀青年骨干教师。主要研究方向包括：1. 甘薯生物技术与产业应用：开发前沿生物技术并应用于甘薯精准育种、高产栽培、病虫害防治、储藏保鲜等产业过程。2. 甘薯耐盐生理与分子机制：解析甘薯及近缘野生种耐盐生理机制，挖掘耐盐基因并鉴定功能，阐明甘薯耐盐性差异的分子机制。在 Plant Physiology、Plant Joumnal、Plant Cell and Environment 等期刊发表论文 40 余篇，所发论文已被引用近 1400 次（包括 ESI 高被引论文 1 篇）。

田望，北京大学研究员，博士生导师，博雅青年学者。2013 年毕业于首都师范大学，获博士学位。2013 年起，先后在美国加州大学伯克利分校，中国西北大学，香港中文大学进行博士后/访问学者研究。主要以拟南芥和大豆为研究对象，利用电生理、钙成像、遗传筛选、基因编辑等方法，挖掘调控植物生长发育、逆境响应、大豆结瘤固氮、大豆产量品质的离子通道等基因资源，助力现代分子设计育种。其研究成果以第一作者（或共同第一作者）身份发表在 Nature，Nature Communications，Nature Plants，Cell Research 等国际权威学术期刊上。

王存，西北农林科技大学教授，博士生导师，西北农林科技大学生命科学学院副院长。2007.09---2013.02 就读于中国农业大学，获博士学位；2013.02---2016.11 在美国加州大学圣地亚哥分校（Julian I. Schroeder 美国科学院院士）从事博士后研究；2016.11 至今在西北农林科技大学生命科学学工作。主要研究离子通道在干旱、离子营养和重金属胁迫条件下的分子机制和调控机理。综合采用电生理学、生化化学、分子遗传学和植物生理学等手段鉴定离子通道信号转导途径中新的机制和网络图，希望为小麦的抗逆遗传改良奠定理论基础。近年来在 Plant Cell、PLos Biology、Molecular Plant、eLife、Plant Physiology 和 The Plant Journal 等国际权威学术期刊发表研究论文十余篇，ESI 1%高被引用论文 3 篇，F1000 Prime 推荐论文 2 篇。

薛绍武，华中农业大学教授 博士生导师。1999-2005 在山西大学分子科学研究所获得无机化学专业理学硕士、博士学位。2013 至今任职于华中农业大学生命科学技术学院，研究方向包括：以植物拟南芥气孔保卫细胞为模型，研究激素脱落酸、钙、二氧化碳、一氧化氮、硫化氢等分子的细胞信号传导机制；分析鉴定植物转运体、离子通道的功能；植物体重金属吸收转运机制。其研究成果发表在 PNAS, Nature Plants, Molecular Plant 等国际权威学术期刊。

会议摘要

Novel cation channels in marine photosynthetic unicells: signalling and evolution

Colin Brownlee[1], Abdul Chrachri,[1] Katherine Helliwell[1], Alison Taylor[2], Glen Wheeler[1]
[1] Marine Biological Association, Plymouth, UK
[2] University of North Carolina, Wilmington, NC USA

The silicifying diatoms (heterokonts) and calcifying coccolithophores (haptophytes) represent two groups of photosynthetic eukaryotic marine phytoplankton that account for around 50% of ocean primary production. In producing biomineralized structures they play major roles in global biogeochemical cycles of silicon and carbon and have evolved highly specialized physiologies. In order to understand their physiology better we study their electrical properties, particularly in relation to signalling and biominerlization mechanisms. Both groups exhibit very rapid Na^+ or Ca^{2+}-dependent animal-like action potentials. Parallel genomics studies have revealed the presence of animal-like 4-domain VDCCs in coccolithophores and centric, but not pennate, diatoms as well as single pore domain bacterial-like cation channels that are widespread across both groups. We have investigated the properties of the single domain channels that represent a novel class of eukaryotic ion channel (EukCats). In the model pennate diatom *Phaeodactylum tricornutum* EukatA channels behave as voltage-gated Na^+- and Ca^{2+}-permeable channels with a physiological role in generation of voltage-dependent Ca^{2+} signals. We also show that *P. tricorutum* possesses a sophisticated Ca^{2+} signalling machinery that can sense osmotic, temperature and nutrient environments with roles in coordinating metabolic responses. In coccolithophores EukCatB channels are highly Na^+-selective with rapid activation and inactivation kinetics, consistent with a key role underlying the generation of fast Na+-based action potentials. We present a hypothesis that links their activity to the regulation of H^+ channels in the plasma membrane that play an essential role in dissipation of excess H^+ produced in the calcification process. I will discuss how the EukCats fit into scheme of the evolution of selectivity in eukaryote cation channels.

Slow wave potential signalling during insect attack

Edward E. Farmer

Department of Plant Molecular Biology, University of Lausanne, 1015 Lausanne, Switzerland.

Slow wave potentials (SWPs) are generated in response to wounding. These signals, first described in the sensitive plant *Mimosa pudica*, appear to occur in all angiosperms. In Arabidopsis, SWP propagation depends on several clade 3 *GLUTAMATE RECEPTOR-LIKE* (*GLR*) genes including *GLR3.3* and *GLR3.6* that act genetically as negative regulators of membrane depolarization. Our work has established two main roles for these *GLR* genes. Firstly, *GLR3.3* and *GLR3.6* are necessary for SWP propagation leading to the activation of the synthesis of the defense hormone jasmonoyl isoleucine (JA-Ile). Secondly, the action of these GLRs in SWP signalling leads to turgor-driven leaf movements in Arabidopsis. These micromovements resemble the larger and well-known wound-response leaf movements of *M. pudica*. We are currently testing models of how SWPs are propagated and are searching for further genes involved in their formation and propagation. Xylem cell wall mutants alter the architecture of the SWP and provide insights into mechanisms of SWP propagation.

Matthew Gilliham, Waite Research Institute, University of Adelaide, Australia

Matthew is Director of the Waite Research Institute, the University of Adelaide's flagship for agriculture, food and wine innovation. He is also Professor of Crop Molecular Physiology and program leader in the Australian Research Council Centre of Excellence in Plant Energy Biology.

Matthew's areas of research specialisation is crop plant nutrition and stress resilience with a focus on salinity and drought tolerance. Specifically, his group studies transport and signalling mechanisms underpinning these processes with the aim of having them applied through plant breeding to improve crop yield and quality in the field. His discoveries include mechanisms that enhance the salt tolerance of wheat, soybean and grapevine. He is a current Web of Science Highly Cited Author and a Monitoring Editor of the ASPB Journal *Plant Physiology*.

Matthew gained a BSc in Ecology from Lancaster University and a PhD in Plant Physiology from the University of Cambridge, UK. After a postdoc at Cambridge, he immigrated to Australia to run the Plant Transport and Signalling Laboratory at the Waite Campus, University of Adelaide.

GABA signalling in guard cells acts as a 'stress memory' to optimise plant water loss

The non-protein amino acid γ-aminobutyric acid (GABA) has been proposed to be an ancient messenger for cellular communication conserved across biological kingdoms. GABA has well-defined signalling roles in animals; however, whilst GABA accumulates in plants under stress it has not been determined if, how, where and when GABA acts as an endogenous plant signalling molecule. Here, we establish that endogenous GABA is a *bona fide* plant signal, acting via a mechanism not found in animals. GABA antagonises stomatal movement in response to opening and closing stimuli in multiple plant families including dicot and monocot crops. Using *Arabidopsis thaliana*, we show guard cell GABA production is necessary and sufficient to influence stomatal aperture, transpirational water loss and drought tolerance via inhibition of stomatal guard cell plasma membrane and tonoplast-localised anion transporters. This study proposes a novel role for GABA – as a short-term 'stress memory' – opening new avenues for improving plant stress tolerance.

Membrane transporters in sensing and signalling of soil salinity and hypoxia

Sergey Shabala

Tasmanian Institute of Agriculture, University of Tasmania, Hobart, Australia; International Reserach Centre for Environmental Membrane Biology, Foshan University, Foshan, China

Soil salinity is a major environmental constraint to crop production. While the molecular identity and a functional expression of Na^+ transport system mediating Na^+ exclusion from the cytosol was studied in details over the last decade, much less is known about mechanisms by which plants sense high Na^+ levels in the rhizosphere. In this work, I summarize our current knowledge for the molecular identity of the possible candidates for this role. I advocate for the model in which several transport proteins are clustered together to form a "microdomain" in a lipid raft, allowing a rapid change in activity of one of them be translated into stress-induced Ca^{2+} and H_2O_2 'signatures". I then discuss pathways of stress signalling to downstream targets and compare kinetics and specificity of salt stress signalling in various cell types. In the second part of my presentation, I talk about the mechanistic basis of plant sensing and adapting to hypoxia, resulting from soil waterlogging/flooding. I illustrate high tissue- and time-dependence of this process and discuss essential roles of the NADPH oxidase and CAX and ACA calcium transport systems for hypoxia response in plants. Finally, I summarise the current knowledge for identify of oxygen sensors in mammalian systems and use the identified key oxygen sensing domains (PAS; GCS; GAF; PHD) to predict the potential plant counterparts in Arabidopsis. Several plasma membrane and tonoplast ion channels (such as TPC; AKT; KCO) are suggested operating as oxygen sensors in plant roots. The importance of these findings for plant breeding for abiotic stress tolerance are discussed.

Plant pressure probe and its application in rubber trees

Feng AN

Rubber Research Institute, Chinese Academy of Tropical Agricultural Sciences,
Danzhou, Hainan, 571737, China

The pressure probe was initially made to directly measure the turgor in the giant-celled alga, *Nitella*. Latter, Zimmermann & Steudle (1970s) improved it by replacing the air manometer with an electronic pressure transducer attached to an oil-filled capillary and including a piston that allowed turgor to be varied. Thus, the plant water parameters such as the half time for water exchange, hydraulic conductivity, cell wall volumetric elastic modulus, solute permeability and reflection coefficient could also be measured, which incurred the popularity of cell pressure probe in plant water relation study. Subsequently, various pressure probes such as root pressure probe, single cell sampling pressure probe and xylem pressure probe (including xylem pressure-potential probe and ion-selective xylem pressure probe) were invented basing on which makes the pressure probe to be a versatile tool in plant water relation and plant cell physiology study.

Taking the advantages of the state of the art cell pressure probe, we developed a novel phloem turgor pressure probe (PTPP) to accurately measure the real-time variation of phloem turgor pressure and to study the water relations of laticifer system in rubber tree (*Hevea brasiliensis*). Our field measurements showed that the PTPP was a sensitive and reliable technique that could be used to accurately measure the real-time variation of phloem turgor pressure (PTP) of *H. brasiliensis*. As the initial driving force for latex flow after a rubber tree being tapped, PTP is an indicator of rubber tree latex yield which could therefore be used for tapping system optimization and high yielding clone selection. There was a rapid water exchange between laticifers and surrounding tissues in both the intact and the tapped rubber trees. Using the PTPP, the rubber tree water relations can be better studied.

Cryo-EM structure and electrophysiological characterization of ALMT from Glycine max reveal a novel class of anion channels

Li Qin[1,2#], Ling-hui Tang[1,2#], Jia-shu Xu[3,4#], Xian-hui Zhang[1,2#], Yun Zhu[3,4#], Chun-rui Zhang[1,2], Xue-lei Liu[1,2], Mei-hua Wang[1,2], Fei Li[5], Fei Sun[3,4], Min Su[1,2*], Yu-jia Zhai[3,4*] & Yu-hang Chen[1,2*]

[1] State Key Laboratory of Molecular Developmental Biology, Institute of Genetics and Developmental Biology, Chinese Academy of Sciences, Beijing, China; Innovative Academy of Seed Design, Chinese Academy of Sciences, Beijing 100101, China

[2] College of Advanced Agricultural Sciences, University of Chinese Academy of Sciences, Beijing 100049, China

[3] National Laboratory of Biomacromolecules, CAS Center for Excellence in Biomacromolecules, Institute of Biophysics, Chinese Academy of Sciences, Beijing 100101, China

[4] School of Life Sciences, University of Chinese Academy of Sciences, Beijing 100049, China

[5] Department of Biology, New York University, New York, NY 10003, USA

[#]These authors contributed equally to this work.

E-mail: yuhang.chen@genetics.ac.cn

ABSTRACT

ALMT (aluminium-activated malate transporter) regulates diverse functions in plants, including stomatal function, pollen tube growth, Al^{3+} resistance, mineral nutrition, fruit acidity, microbe interactions, and seed development. Recent work has shown that ALMTs function as anion channels; however, the molecular basis of the ALMT channel activity remains elusive. Here, we describe the first cryo-EM structure of the

QUAC1/ALMT12 from *Glycine max* at 3.5 Å resolution. QUAC1/ALMT12 is a symmetrical dimer, forming a single electropositive T-shaped pore for passing anions across the membrane. The transmembrane and cytoplasmic domains are assembled into a twisted two-layer architecture, with the associated dimeric interfaces nearly perpendicular. Our structural and functional analyses reveal a domain-twisting mechanism for malate-mediated QUAC1/ALMT12 regulation. Altogether, our study uncovers the molecular basis for a novel class of anion channels and provides insights into the gating and modulation of the QUAC1/ALMT12 anion channel.

Molecular mechanism of cold-induced Ca^{2+} signature generation, sensing and decoding in Arabidopsis

Qiangbo Liu, Hao Yang, Yanglin Ding, and Shuhua Yang
State Key Laboratory of Plant Physiology and Biochemistry, College of Biological Sciences, China Agricultural University, Beijing 100193, China

Cold stress induces the transient elevation of calcium in the cytosol ($[Ca^{2+}]_{cyt}$), which can be sensed and thus lead to transcriptional reprogramming in plants; however the underlying mechanism remains elusive. First, we report that AtANN1, a calcium-permeable transporter, is important for cold-induced Ca^{2+} influx and freezing tolerance. Electrophysiological assays show that AtANN1 had Ca^{2+} transporter activity. The loss of function of *AtANN1* significantly reduced the cold-induced $[Ca^{2+}]_{cyt}$, cold-induction of *CBF* and *COR* genes, and freezing tolerance. Further study showed that cold-activated OST1 interacted with and phosphorylated AtANN1, which consequently enhanced the activities of calcium transport and binding. Secondly, we show that cold-triggered Ca^{2+} signature is sensed and decoded by a calcium-sensor protein kinase CPKn-mediated phosphorylation cascade. The plasma-membrane localized CPKn is activated rapidly by cold shock within 10 seconds in a Ca^{2+} dependent manner. Cold-activated CPKn phosphorylates and promotes nuclear shuttling of TF1, a transcription factor that specifies the transcriptional reprogramming of *COLD-RESPONSIVE* (*COR*) gene sets associated with Ca^{2+}. These findings uncover the mechanisms underlying the cold-induced Ca^{2+} signal generation, sensing and decoding in plants.

Title: MYB77 Regulates High-affinity Potassium Uptake by Promoting Expression of *HAK5*.

Yu Long

State Key Laboratory of Crop Stress Adaptation and Improvement, School of Life Sciences, Henan University, Kaifeng, 475001, China

In *Arabidopsis,* the High-affinity K^+ transporter HAK5 is the major pathway for root K^+ uptake when below 100 M; *HAK5* responds to Low-K^+ (LK) stress by strongly and rapidly increasing its expression during K^+-deficiency. Therefore, positive regulators of *HAK5* expression have the potential to improve K^+ uptake under LK. Here, we show that mutants of the transcription factor *MYB77* share a LK-induced leaf chlorosis phenotype, lower K^+ content, and lower Rb^+ uptake of the *hak5* mutant, but not the shorter root growth, and that overexpression of *MYB77* enhanced K^+ uptake and improved tolerance to LK stress. Further, we demonstrate that MYB77 positively regulates the expression of *HAK5*, by binding to the *HAK5* promoter and enhances high-affinity K^+ uptake of roots. As such, our results reveal a novel pathway for enhancing *HAK5* expression under LK stress, and provides a candidate for increasing the tolerance of plants to LK.

Molecular physiological mechanism of root response to iron toxicity

Guangjie Li[1], Lin Zhang[1], Meng Wang[1], Dongwei Di[1], Herbert J. Kronzucker[2], Weiming Shi[1,*]

1, State Key Laboratory of Soil and Sustainable Agriculture, Institute of Soil Science, Chinese Academy of Sciences, No. 71 East Beijing Road, Nanjing 210008, China; 2, Faculty of Land and Food Systems, University of British Columbia, Vancouver, BC V6T 1Z4, Canada;

Iron toxicity is a common hinderance factor in tropical, subtropical and flooded soils. When iron toxicity occurs in plants, the root growth is blocked, and when the toxicity is more serious, root rot and die. However, the biological mechanisms of iron toxicity inhibiting plant root growth are still largely unknown, which is not conducive to the advance of agronomic techniques such as root protection under iron toxicity.

We found that the root apical region was the key locus of lateral root number and primary root elongation in response to iron toxicity. The expression of PIN2 protein in root tips is dramatically reduced and involved in arresting lateral root initiation near the growing tip of the primary root in the early response to iron toxicity. Fe-induced endogenous ethylene enhances the tolerance of lateral root formation to Fe toxicity, and AUX1 plays a role in ethylene mediated lateral root formation. We showed that excess Fe arrested primary root growth by decreasing both cell elongation and division, and principally resulteds from direct external Fe contact at the root tip. Moreover, the sensitivity of the root tip region to iron toxicity is not due to the accumulation of more iron than other root regions, unlike the aluminum toxicity.

We further found that NO levels in root tips are increased significantly above levels elsewhere in the root and are involved in the arrest of primary root tip zone growth under excess Fe. NO-mediated inhibition of root growth is, at least in part,

related to NO-induced K^+ loss via nonselective cation channels (NSCCs), and increased SNO1 (sensitive to nitric oxide 1)/SOS4 (salt overly sensitive 4) activity-mediated pyridoxal-5'-phosphate (PLP) is further implicated in this process. NO also mediates K^+ homeostasis by the negative regulation of K^+ uptake. The significant K^+ loss can result in the loss of cell turgor (and hence arrest root growth) and either programmed cell death (PCD) or necrosis in the root apex. Meanwhile, excess Fe also reduces cell viability, associated with reactive oxygen species (ROS) accumulation and NO-induced hormone imbalance and protein S-nitrosylation. ROS has also been reported to activate NSCCs, resulting in K^+ loss from the cell. Furthermore, Fe-induced ethylene can partially antagonize the reduction in excess Fe-mediated primary root growth by the control of NO levels. We further identify S-nitrosoglutathione-reductase (GSNOR) variants underlying a major quantitative locus for root tolerance to Fe-toxicity by regulating the NO levels under Fe toxicity. GSNOR maintains root meristem activity and prevents cell death via inhibiting Fe-dependent nitrosative and oxidative cytotoxicity.

Keywords: Iron toxicity, apical growth, nitric oxide, potassium homogeneous, GSNOR, SON1/SOS4

***Author for correspondence: Weiming Shi (wmshi@issas.ac.cn)**

A calmodulin-gated calcium channel links pathogen patterns to calcium-dependent immunity in Arabidopsis

Pathogen-associated molecular patterns (PAMPs) activate innate immunity in both animals and plants. Although calcium has long been recognized as an essential signal for PAMP-triggered immunity (PTI) in plants, the mechanism for PAMP-induced calcium signaling remains unknown. We report here that calcium nutrient status is critical for plant defense against bacterial pathogens. When calcium supply is sufficient, two cyclic nucleotide-gated channel (CNGC) genes, CNGC2 and CNGC4, were essential for PAMP-induced calcium signature and subsequent immune responses in Arabidopsis. In a reconstitution system, the CNGC2 and CNGC4 proteins together, but

neither alone, assembled into a functional calcium channel that was blocked by calmodulin in the resting state. Upon pathogen attack, the channel was activated by the effector kinase BOTRYTIS-INDUCED KINASE1 (BIK1) of the pattern-recognition receptor (PRR) complex, triggering cytosolic calcium elevation. The CNGC-mediated calcium entry thus provides a critical link between PRR complex and calcium-dependent immunity programs in the PTI signaling pathway.

Manganese Signal Transduction in Plants

Zhenqian Zhang[1#], Chuanfeng Ju[1#], Jinping Deng[2#], Cuicui Miao[1], Zhangqing Wang[1], Lukas Wallrad[3], Laiba Javed[1], Dali Fu[1], Jörg Kudla[3], Zhizhong Gong[2, 4] and Cun Wang[1*].

[1]*State Key Laboratory of Crop Stress Biology for Arid Areas, College of Life Sciences, and Institute of Future Agriculture, Northwest Agriculture & Forestry University, Yangling, Shaanxi 712100, China.*

[2]*State Key Laboratory of Plant Physiology and Biochemistry, College of Biological Sciences, China Agricultural University, Beijing 100193, China.*

[3]*Institut fur Biologie und Biotechnologie der Pflanzen, Westfälische Wilhelms-Universität, Münster 48149, Germany.*

[4]*College of Life Sciences, Hebei University, Baoding, China*

[#]*These authors contributed equally to this work.*

***Correspondence:** cunwang@nwafu.edu.cn*

Manganese (Mn) is an essential micronutrient in plants. Despite their essential roles in Mn homeostasis, the transcriptional and post-transcriptional modification of Mn transporters remain poorly understood. Here, we demonstrated that high Mn stress induces an obvious Ca^{2+} signature in Arabidopsis. We identified four calcium-dependent protein kinases, CPK4/5/6/11, interacting with the tonoplast-localized Mn and iron transporter MTP8 *in vitro* and *in vivo*. CPKs phosphorylated the N-terminal domain of MTP8 primarily at Ser31 and Ser32 residues, which are crucial for MTP8 function. In addition, we also identified two calcineurin-B-like proteins, CBLs, and their interacting kinases, CIPKs, as key regulators for plant Mn homeostasis. Moreover, we report that sequential phosphorylation of MTP8 initially at Ser31/32 by the calcium-dependent protein kinases CPK5 and subsequently by CIPKs at Ser35 provides a wane and wax mechanism for differential Mn transport regulation. Collectively, our studies define a calcium controlled two-tiered mechanism for dynamically orchestrating Mn homeostasis under conditions of fluctuating Mn supply.

Title: Insights into Hydrogen Sulfide (H_2S) Regulation of Stomatal Movements

XUE Shaowu, Huazhong Agricultural University

Abstract

Stomatal aperture controls plant gas exchange with environment via transpirational water vapor loss and photosynthetic carbon dioxide uptake. Stomata are surrounded by pairs of guard cells that sense and transduce environmental signals to induce endogenous responses for adaptation to environmental changes. Recently, hydrogen sulfide (H2S) has been recognized as a signaling molecule that regulates stomatal movement. I will introduce the progress of mechanism of H_2S regulation of stomatal movement in my laboratory. In addition, I will also introduce some transporters/ion channels analyzed together with in collaboration with other laboratories.