BK21 FOUR IT-Bio융합시스템농업교육연구단 제 1회 국제학술대회

"SMART FARMING IN THE NEW NORMAL ERA"

25 FEBRUARY 2021
VIRTUAL CONFERENCE

주최: 전남대학교 | 순천대학교 | 조선대학교

후원: 한국연구재단

SMART FARMING IN THE NEW NORMAL ERA

25 FEBRUARY 2021 | VIRTUAL CONFERENCE

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BK21 FOUR IT-Bio융합시스템농업교육연구단

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Biotechnology Research Institute 생물공학연구소

Biotechnology Research Institute at Chonnam National University

Welcoming Message

Dear practitioners in the fields of IT-Bio convergence agricultural system,

This is Prof. Ok Ran Lee in the department of plant science at Chonnam National University, Korea. I will be the chair of the 1st international conference held by the BK21 FOUR IT-Bio Convergence System Agricultural Education and Research Group. The IT-Bio Convergence System Agricultural Education and Research Center is the first convergent research group in the Honam region related to “Smart Farm”, in which faculty members from Chonnam National University (12 members), Sunchon National University (7), and Chosun University (5) are participated. It is a project group that is drawing attention from both the academia and the general public spheres. I am personally honored to be the first chair of the organizing committee for this academic conference, and at the same time, feel a great sense of responsibility to accomplish the tasks ahead to the highest of standards. I would like to thank Prof. Jangho Kim, head of BK21 project, and all participating faculty members from the three universities for offering me an opportunity to volunteer as a chair of this important event. Special thanks to Prof. Hoon Seonwoo and Prof. Suk-Seong Hwang for accepting the co-organization chairship. I look forward to your support and cooperation, as well as asking for your generous advice so that we can have a successful academic conference.

Due to the unprecedented pandemic situation, the Virtual Conference will be held on February 25, 2021 from 8 am to 6 pm, and almost all speakers will conduct sessions online in real time. The theme of the academic conference is 'Smart Farming in the New Normal Era'. We have tried to organize the program with the blend of technical expertise from several elements. These include experts from the smart farm technology, applied agriculture and application of farming production systems as well as the 4th industrial revolution and IT technology. These elements are based on the major fields of the participating researchers which are crop physiology, genetics, cultivation, field production, livestock nutrition and smart farm IT.

Foreign speakers include Prof. Joshua J. Blakeslee and Katrina Cornish of Ohio State University, Prof. Dorothy E. Shippen of Texas A&M University, and Prof. T. Casey Barickman of Mississippi State University, USA, Prof. Lee Hickey of Queensland University, Australia, Prof. Dabing Zhang of Jia Tong University, China, Prof. A.B.M. Rubayet Bostami of BSMRA University, Bangladesh, Prof. Woong Choi of Gunma University and Prof. Jongho Lee of Komatsu University, Japan were invited. Additionally, we will have domestic speakers, including Dr. Jooryang Lee of Science and Technology Policy Institute, Dr. Yeonjung Kim of Korea Rural Economic Institute, Dr. Tae In Ahn of Korea Institute of Science and Technology, and Dr. Sun Hee Ahn of Korea Photonics Technology Institute.

The program was designed to allow intensive discussions on the direction and prospects of the agriculture industry and future farming systems. In addition, the 4 minutes presentation time given to each of the seven domestic and foreign graduate students, is structured in a manner that is expected to offer an active and quality discussion time on the agriculture industry of the future society. In this regard, we look forward to the participation and support of researchers and students from various fields.

Prof. Ok Ran Lee,

Department of Applied Plant Science, Chonnam National University

OkRanLee

조직위원장 초대글

안녕하세요 여러분! 저는 이번 BK21 FOUR IT-Bio 융합시스템 농업교육연구단에서 개최하는 제1회 국제학술대회 조직위원장직을 맡게 된 전남대학교 응용식물학과 이옥란입니다. IT-Bio 융합시스템 농업교육연구단은 전남대학교, 순천대학교, 조선대학교 소속 교수진 (전남대 12명, 순천대 7명, 조선대 5명)이 참여하여 '스마트팜' 관련 호남권 최초 융합연구단으로 학계 및 지역의 관심을 받고 있는 사업단으로 학술발표회 초대 조직위원장직을 맡게 되어 개인적으로 너무나도 큰 영광인 동시에 큰 일을 수행해 내야 한다는 막중한 책임감도 함께 느끼고 있습니다. 부족하나마 학회를 통해 봉사할 수 있는 기회를 제안해 주신 김장호 단장님과 3개 대학 참여 교수진 모두에게 감사 인사를 드립니다. 특별히 공동 조직위원장직을 수락하신 순천대 선우훈 교수님, 조선대 황석승 교수님께 감사드리는 바입니다. 모쪼록 성공적인 학술발표회가 될 수 있도록 부족한 저에게 아낌없는 조언을 부탁드림과 동시에 많은 성원과 협조를 기대합니다.

전례없던 팬데믹 상황으로 인하여 2021년 2월 25일 오전 8시부터 오후 6시까지 Virtual Conference 형식으로 진행이 될 예정이며, 거의 모든 연사분들을 실시간으로 온라인 공간에서 만나실 수 있습니다. 학술발표회 주제는 'Smart Farming in the New Normal Era'로 사업단 참여 연구진의 전공분야에 기초한 스마트팜 요소기술, 응용/적용+생산, 4차 산업혁명 IT 요소기술로 세분화된 것을 기반으로 작물생리, 유전, 재배, 생산분야 전문가 및 가축영양, 그리고 스마트팜 IT기술관련 전문가들로 프로그램을 구성하도록 노력하였습니다.

외국연사로는 미국 오하이오 주립대 Joshua J. Blakeslee와 Katrina Cornish 교수님, 택사스 A&M대학의 Dorothy E. Shippen 교수님, 그리고 미시시피 주립대의 Casey Barickman 교수님, 호주 퀸즈랜드 대학의 Lee Hickey 교수님, 중국 Jia Tong 대학의 Dabing Zhang 교수님, 방글레데시 BSMRA 대학의 A.B.M. Rubayet Bostami 교수님, 그리고 일본 군마대학의 최웅 교수님과 코마츠 대학의 이종호 교수님을 모셨으며, 국내연사로는 혁신성장정책연구본부의 이주량 본부장님 외 농촌경제연구원의 김연중 박사님, KIST의 안태인 박사님, 한국광기술원의 안선희 박사님 등 국내·외적 세계적인 석학을 모시고 다가올 미래사회의 농업 및 농산업 시스템이 나아갈 방향과 전망에 대하여 집중적으로 토론할 수 있는 프로그램으로 구성하도록 하였습니다. 또한 국내외 대학원생 7인의 각 4분 주제 발표시간도 짜임새 있게 구성하여 미래사회 농산업 주역의 활발한 활동시간도 기대해 봄직 합니다. 관련하여 각계 연구진 및 학생들의 많은 참여와 응원을 기대합니다.

전남대학교 응용식물학과 교수 이옥란

OkRanLee

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Congratulatory Address

I would like to congratulate holding the 1st International Conference of the Brain Korea 21 FOUR Interdisciplinary Program in IT-Bio Convergence System Agriculture at Chonnam National University of “confident and unconstrained CNU”

Under this tough circumstances of COVID-19 pandemic, I deeply appreciate the greatest scholars’ passion to hold this virtual conference for the exchange of opinions in the field of smart farm.

The world’s greatest scholars in the field of IT-Bio attend this wonderful conference, which will provide the latest advances in basic and applied research with the world-class scholars in smart farm.

Our Chonnam National University has put in a lot of energy and efforts into hosting this conference. I would like to thank Professor Ok Ran Lee, General Chair, and Professor Jangho Kim, the head of BK 21 Four center for IT-Bio Convergence System Agriculture as well as all the related officials for opening this conference successfully.

Our Chonnam National University was established in 1952 and is one of the flagship Korean national universities, as well as a university of "Change N Unite" that explores truth and creates new knowledge.

Through this conference, I sincerely hope that it will be a good opportunity to join Chonnam National University in various cooperative measures, including research and education of the IT-Bio Convergence System Agriculture including smart farm.

Thank you to all the professors, researchers, and students around the world for joining us, today.

Finally, I would like to express my sympathy and gratitude to all of you who have worked hard to make this conference successful.

Once again, warm welcome and thank you.

February 25, 2021

President of Chonnam National University

Sungtaek Jung

Congratulatory Address

On the occasion of the opening of the 1st International Conference of the Brain Korea 21 FOUR Interdisciplinary Program in IT-Bio Convergence System, on behalf of the IT-Bio Convergence System Agriculture center, I would like to offer my warmest congratulations and extend my sincere welcome to everyone who are with us today.

Our Chonnam National University has 24 BK21 FOUR teams, which is top 7 throughout the nation. Especially the IT-Bio Convergence System Agriculture center who has organized this conference, has the pride as the only national level BK21 team among local universities.

Titled "Smart Farming in the New Normal Era", the conference will bring together researchers and engineers from around the world to present their latest research accomplishments, innovations, and visions in the field of IT-Bio.

With 21 invited sessions, the goal of the 1st International Conference of the BK 21 FOUR Interdisciplinary Program in IT-Bio Convergence System is to create an opportunity for the participants to meet the latest research results of the world's greatest scholars in the field of IT-Bio.

We hope that the 1st International Conference of the BK 21 FOUR Interdisciplinary Program in IT-Bio Convergence System will be a valuable, memorable and an exciting platform for the participants to exchange information and ideas for their advanced researches.

We are very grateful to the IT-Bio Convergence System Agriculture center and the conference organizing committee members (Prof. Ok Ran Lee) for opening this conference successfully.

I want to extend a special welcome to students and to guests joining us for this conference. I would like to express gratitude to all of you who have worked hard to make this conference successful.

Warm welcome. Best wishes for a spectacular conference.

February 25, 2021

Dean of the Graduate School at Chonnam National University

Jin-Kyu Song

Congratulatory Address

I would like to offer my warmest congratulations for holding the 1st International Conference of Brain Korea 21 FOUR Interdisciplinary Program in IT-Bio Convergence System Agriculture at the College of Agriculture and Life Sciences in Chonnam National University who designs 'K-Agriculture'.

Based on the 111 years of history and the tradition, the College of Agriculture and Life Sciences of Chonnam National University is leading our country's agricultural development.

To prepare for the 4th industrial revolution, Chonnam National University is conducting agricultural education that combines the advanced science and technology, and is taking the lead in fostering the members of society who have the excellent field sense. In particular, the BK21 FOUR Interdisciplinary Program in IT-Bio Convergence System Agriculture is committed to foster the future agricultural manpower through the education and research of cutting-edge smart farms.

This year, our daily lives are changing due to the pandemic that we have never experienced before. In this difficult situation, I would like to thank Professor Ok Ran Lee, the general chair of the organizing committee, Professor Jangho Kim, the head of the Interdisciplinary Program in IT-Bio Convergence System Agriculture, and all the participating professors for organizing the international conference for the scholars in smart farm through online.

Through this conference, I hope that information on agriculture and young future agricultural talents can grow further, and thank you to many of you for joining us.

Once again, warm welcome and thank you.

February 25, 2021

Dean of College of Agriculture and Life Sciences, Chonnam National University

Man Jong Kang

Welcome Address

We sincerely welcome your participation in the 1st International Conference of the Brain Korea 21 FOUR Interdisciplinary Program in IT-Bio Convergence System. I'm Professor Jangho Kim of Chonnam National University, the head of the BK21 FOUR Interdisciplinary Program in IT-Bio Convergence System Agriculture.

Our BK21 FOUR Interdisciplinary Program in IT-Bio Convergence System Agriculture consists of researchers, students, and administrative staffs, including 24 excellent professors from Chonnam National University, Suncheon University, and Chosun University. In particular, as the nation's first National and Private University associated BK Research and Education Group in the field of "Smart Farm", is committed to fostering high-quality human resources to lead the future agriculture and bio industry.

I am very happy and honored that our Education Research Group has invited Professor Ok Ran Lee of Chonnam National University as the general chair of the organizing committee to hold the 1st International Conference of the Brain Korea 21 FOUR Interdisciplinary Program in IT-Bio Convergence System.

I appreciate, Sungtaek Jung, the president of Chonnam National University, Jin-Gyu Song, the Dean of Graduate School at Chonnam National University and Man Jong Kang, the Dean of College of Agriculture and Life Sciences, for delivering congratulatory speeches for this international academic conference. Please continue to give great encouragement and attention. Also, I would like to thank everyone at home and abroad for participating in this conference.

In particular, I sincerely hope that this conference will be a good opportunity for students to understand the value of the future agricultural industry and move forward together. Once again, I would like to thank and welcome everyone who are with us today. Thank you.

February 25, 2021

Head of Center for IT-Bio Convergence System Agriculture

Jangho Kim

2021 1st International Conference of the Brain Korea 21 FOUR Interdisciplinary Program in IT-Bio Convergence System

Virtual Presentation

'Smart Farming in the New Normal Era'

February. 25, 2021

7:50a.m. ~ 6:00p.m.

@Center for IT-Bio Convergence System Agriculture

■ Welcome Remark

Korean time	Chair: Dr. Ok Ran Lee
7:50~8:00	**Congratulatory address** President of Chonnam National University, Sungtaek Jung
	Congratulatory address Dean of Graduate School at Chonnam National University, Jin-Kyu Song
	Congratulatory address Dean of College of Agriculture and Life Sciences, Chonnam National University, Man Jong Kang
	Welcome address Dean of IT-Bio Convergence System Agriculture, Chonnam National University, Jangho Kim
	Welcoming message General Chair, Chonnam National University, Ok Ran Lee

■ Session 1: Invited Lectures

Korean time/ Speaker's time	Chair: Dr. Kang-Mo Ku / Ok Ran Lee
8:00~8:30 17:00~17:30	**"Telomere proteins: new players in the arabidopsis stress response"** Dr. Dorothy E. Shippen (Texas A&M University, USA)
8:35~9:05 18:35~19:05	**"Metabolic profiling of plant evironmental responses"** Dr. Joshua J. Blakeslee (Ohio State University, USA)
9:10~9:40 19:10~19:40	**"Considerations around metabolic engineering of rubber biosynthesis"** Dr. Katrina Cornish (Ohio State University, USA)

9:45~10:20 18:45~19:20	**“Utilizing agricultural technologies in plant physiology research”** Dr. T. Casey Barickman (Mississippi State University, USA)
10:20~10:30	**Coffee break**
	Chair: Dr. Jangho Kim / Hyoung Il Son
10:30~11:00	**"Nanobionic plant sensors for precision agriculture"** Dr. Seonyeong Kwak (Seoul National University, Korea)
11:05~11:35	**"Deep learning in real-world applications"** Dr. Ha Young Kim (Yonsei University, Korea)
Korean time/ Speaker's time	**Chair: Dr. Tae Ho Han**
11:40~12:10 12:40~13:10	**"Integrating technologies to develop our future crops"** Dr. Lee Hickey (The University of Queensland, Australia)

12:15~12:45 *Student Short Talks*	**"The multi-functional patatin-related phospholipase: grows and glows"** Jin Hoon Jang (Chonnam National University, Korea)
	"Bioengineered nanomaterials for agricultural technology innovation" Sunho Park (Chonnam National University, Korea)
	Chair: Dr. Hoon Seonwoo
	"Mouth shape estimation with MAR" Tomoki Arai (Gunma College, Japan)
	"Calculation of mahjong points using AI" Takuma Kano (Gunma College, Japan)
	"Sensory changes caused by different roughness of objects in AR environment" Shingo Kato (Gunma College, Japan)
	"Posture recognition system using Kinect" Shogo Sekiguchi (Gunma College, Japan)
Korean time/ Speaker's time	**"Hydrangea interspecific hybridization -fertilization barriers-"** Seong-Hwa Bak (Chonnam National University, Korea)
12:45~13:15 21:45~22:15	**"Innovating to advance crop growth and yields through photosynthesis"** Dr. Carl Bernacchi (University of Illinois, Urbana-Champaign, USA) **REC**

■ Session 2: Invited Lectures

	Chair: Dr. Nak Yong Ko
14:00~14:30	**"Reactive motion capture system"** Dr. Woong Choi (Gunma College, Japan)
14:35~15:05	**"Development of a novel system to make quantitative evaluation of motor function and clinical applications"** Dr. Jongho Lee (Komatsu University, Japan)
Korean time/ Speaker's time	**Chair: Dr. Bo-Keun Ha**
15:10~15:40 14:10~14:40	**“Plant roots sense soil compaction through restricted ethylene diffusion”** Dr. Dabing Zhang (Shanghai Jiao Tong University, China)
15:40~16:00	**Coffee break**

■ Session 3: Invited Lectures

	Chair: Dr. Jaeil Cho
16:00~16:20	**"Challenges and strategies to achieve successful technological transitions in the era of data-driven agriculture"** Dr. Tae In Ahn (KIST, Korea)
16:25~16:45	**"Smart agricultural policy in Korea"** Dr. Yeanjung Kim (Korea Rural Economic Institute, Korea)
Korean time/ Speaker's time	**Chair: Dr. Kyung Hwan Lee / Young-Soo Choi**
16:50~17:10	**"Optimization of lighting system for efficient production in plant factory“** Dr. Sun-Hee Ahn (Korea Photonics Technology Institute, Korea) **REC**
17:15~17:35 14:15~14:35	**"Smart livestock farming through modern technologies"** Dr. A.B.M. Rubayet Bostami (Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh)
17:40~18:00	**"New waves in agricultural technology, the beginning of the smart agricultural age and technology policy issues"** Dr. Jooryang Lee (Science and Technology Policy Institute, Korea)

학회 프로그램

■ Welcome Remark

시간	좌장: 이옥란 교수
7:50~8:00	**환영사 1:** President of Chonnam National University, Sungtaek Jung
	환영사 2: Dean of the Graduate School at Chonnam National University, Jin-Kyu Song
	환영사 3: Dean of College of Agriculture and Life Sciences, Chonnam National University, Man Jong Kang
	환영사 4: Dean of IT-Bio Convergence System Agriculture, Chonnam National University, Jangho Kim
	환영사 5: General Chair, Chonnam National University, Ok Ran Lee

■ Session 1: Invited Lectures

시간	좌장: 구강모, 이옥란 교수
8: 00~8: 30	**초청강연 1: "Telomere proteins: new players in the arabidopsis stress response"** Dr. Dorothy E. Shippen (Texas A&M University, USA)
8: 35~9: 05	**초청강연 2: "Metabolic profiling of plant evironmental responses"** Dr. Joshua J. Blakeslee (Ohio State University, USA)
9: 10~9: 40	**초청강연 3: "Considerations around metabolic engineering of rubber biosynthesis"** Dr. Katrina Cornish (Ohio State University, USA)
9: 45~10: 15	**초청강연 4: "Utilizing agricultural technologies in plant physiology research"** Dr. T. Casey Barickman (Mississippi State University, USA)
10: 20~10: 30	Coffee break
	좌장: 김장호, 손형일 교수
10: 30~11: 00	**초청강연 5: "Nanobionic plant sensors for precision agriculture"** Dr. Seonyeong Kwak (Seoul National University, Korea)
11: 05~11: 35	**초청강연 6: "Deep learning in real-world applications"** Dr. Ha Young Kim (Yonsei University, Korea)
	좌장: 한태호, 선우훈 교수
11: 40~12: 10	**초청강연 7: "Integrating technologies to develop our future crops"** Dr. Lee Hickey (The University of Queensland, Australia)
12: 15~12: 45	**학생발표1~7** Jin Hoon Jang (Chonnam National University, Korea) Sunho Park (Chonnam National University, Korea) Tomoki Arai (Gunma College, Japan) Takuma Kano (Gunma College, Japan) Shingo Kato (Gunma College, Japan) Shogo Sekiguchi (Gunma College, Japan) Seong-Hwa Bak (Chonnam National University, Korea)
12:45~13:15	**초청강연 8: "Innovating to advance crop growth and yields through photosynthesis"** Dr. Carl Bernacchi (University of Illinois, Urbana-Champaign, USA) **REC**

Session 2: Invited Lectures

시간	좌장: 고낙용 교수
14: 00~14: 30	초청강연 9: "Reactive motion capture system" Dr. Woong Choi (Gunma College, Japan)
14: 35~15: 05	초청강연 10 "Development of a novel system to make quantitative evaluation of motor function and clinical applications" Dr. Jongho Lee (Komatsu University, Japan)
	좌장: 하보근 교수
15: 10~15: 40	초청강연 11: “Plant roots sense soil compaction through restricted ethylene diffusion” Dr. Dabing Zhang (Shanghai Jiao Tong University, China)
15: 40~16: 00	Coffee break

Session 3: Invited Lectures

시간	좌장: 조재일 교수
16: 00~16: 20	초청강연 12: "Challenges and strategies to achieve successful technological transitions in the era of data-driven agriculture" Dr. Tae In Ahn (KIST, Korea)
16: 25~16: 45	초청강연 13: "Smart agricultural policy in Korea" Dr. Yeanjung Kim (Korea Rural Economic Institute, Korea)
	좌장: 이경환, 최영수 교수
16: 50~17: 10	초청강연 14: "Optimization of lighting system for efficient production in plant factory“ Dr. Sun-Hee Ahn (Korea Photonics Technology Institute, Korea) **REC**
17: 15~17: 35	초청강연 15: "Smart livestock farming through modern technologies" Dr. A.B.M. Rubayet Bostami (Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh)
17: 40~18: 00	초청강연 16: "New waves in agricultural technology, the beginning of the smart agricultural age and technology policy issues" Dr. Jooryang Lee (Science and Technology Policy Institute, Korea)

BK21 FOUR
IT-Bio융합시스템농업교육연구단
제 1회 국제학술대회
"Smart Farming in the New Normal Era"
20210225 (THU) 08:00~18:00

Zoom Meeting

https://jnu-ac-kr.zoom.us/j/89041530827?pwd=cW02MFVEQlQ2aUgxeFEvUXl1bG0xQT09

Meeting ID: 890 4153 0827

Password: 286231

ABSTRACT

SESSION 1: INVITED LECTURES

Telomere proteins: new players in the Arabidopsis stress response

Claudia Castillo-González, Borja Barbero Barcenilla, Ji-Hee Min and Dorothy Shippen

Department of Biochemistry and Biophysics, Texas A&M University, College Station, Texas USA

Telomeres with their binding complexes dedicated to ensuring terminal DNA replication (telomerase) and chromosome end-protection (shelterin) solve the two major challenges posed by linear chromosomes. Recent studies suggest that telomerase and shelterin components can also serve as sentinels for intrinsic and extrinsic stress, but how this is accomplished is unknown. One of the most highly conserved and pivotal components of shelterin is Protection of Telomeres 1 (POT1). POT1 is required for telomerase regulation and for protecting chromosome ends from eliciting a DNA damage response. Arabidopsis is unusual as it encodes two highly divergent POT1 paralogs, AtPOT1a and AtPOT1b. We previously showed that AtPOT1a is an accessory factor for telomerase that stimulates its enzyme activity. Here we report that AtPOT1b is not required for telomere maintenance or chromosome end protection, but instead plays a unique role in the response to oxidative stress. We show that AtPOT1a is dually localized to the nucleus and to cytoplasmic organelles and is responsible for both mitigating ROS accumulation and regulating chromatin compaction. Our investigations open new horizons for elucidating non-canonical functions of telomere-related proteins and for exploring the enigmatic interplay between the genome and the stress response.

Acknowledgement: National Institutes of Health (R01-GM065383)

Curriculum Vitae – Dr. Dorothy Shippen

Department of Biochemistry & Biophysics, Texas A&M University, 300 Olsen Road, College Station, Texas 77843-2128 USA.

Email: dshippen@tamu.edu

Education

Ph.D. in Biology, University of Alabama, Birmingham (1987) B.S. Biology, Auburn University, Montgomery, Alabama (1982) (Summa cum laude)

Research and Teaching Positions

Texas A&M University Regents Professor (2020)
University Distinguished Professor, Texas A&M University (2019)
Academic Sabbatical, Arnold Arboretum, Harvard University (2008-2009)
Assistant Professor – Full Professor, Department of Biochemistry & Biophysics, Texas A&M University (1991-2002)
Postdoctoral fellow with Elizabeth Blackburn, UC Berkeley and UCSF (1987-1991)

Selected Refereed Journal Articles (last 5 years)

1. Choi, J.Y., Abdulkina, L.R.,Yin, J., Chastukhina, I.B., Lovell, J.T., Agabekian, I.A., Young, P.G., Razzaque, S., Shippen, D.E., Juenger, T.E., Shakirov, E.V. and Purugganan, M.D. (2021) Natural variation in plant telomere length is associated with flowering time. ***Plant Cell***.

2. Bose, S., Suescún, V., Song, J., Castillo-González, C., Aklilu, B.B., Branham, E., Lynch, R. and Shippen, D.E. (2020) tRNA ADENOSINE DEAMINASE 3 is required for telomere maintenance in *Arabidopsis thaliana*. ***Plant Cell Reports***.

3 Aklilu, B., Peurois, F., Saintome, C., Culligan, K.M. Kobbe, D., Smithson, C., Chung, M., Cattoor, M., Lynch, R., Sampson, L., Fatora, J. and Shippen, D.E. (2020) Functional diversification of Replication Protein A paralogs and telomere length maintenance in Arabidopsis. ***Genetic***.

4. Kobayashi, C., Nigmatullina, L.R., Chastukhina, I.B., Lovell, J.T., Suescún, A.V., Aklilu, B., Valeeva, L.R., Nyamsuren, C., Aglyamova, G.V., Sharipova, M.R., Shippen, D.E., Juenger, T.E. and Shakirov, E.V. (2019) Components of the ribosome biogenesis pathway underlie establishment of telomere length set point in Arabidopsis. ***Nature Comm***.

5. Song, J., Logeswaran, D., Castillo-González, C., Li, Y., Bose, S., Aklilu, B., Ma, Z., Polkhovsky, A., Chen, J.J.-L. and Shippen, D.E. (2019) The conserved structure of plant telomerase RNA provides the missing link for an evolutionary pathway from ciliates to humans. ***Proc Natl Acad Sci USA***.

6. Kobayashi, C., Castillo-González C., Surovtseva Y., Canal, E., Nelson, A.D.L. and Shippen, D.E. (2019) Recent emergence and extinction of the Protection of Telomeres 1c gene in *Arabidopsis thaliana*. ***Plant Cell Reports***.

7. Lee, J.R., Zhang, J., Yang, K., Lee, S.Y., Xie, X. and Shippen, D.E. (2016) Dynamic interactions of Arabidopsis TEN1: stabilizing telomeres in response to heat stress. ***Plant Cell***.

8. Arora, A., Beilstein, M.A. and Shippen, D.E. (2016) Evolution of Arabidopsis Protection of Telomeres 1 alters nucleic acid recognition and telomerase regulation. ***Nucleic Acids Res.***

Metabolic profiling of plant environmental responses

Joshua Blakeslee, Ph.D.

OARDC Metabolite Analysis Cluster, Dept. of Hort. & Crop Science

The Ohio State University, Columbus/Wooster, Ohio, USA

Modern agricultural production is increasingly dependent upon smart farming techniques, as well as directed breeding and metabolic engineering approaches, to maximize the yield and quality of crops and other plant-based bioproducts. All of these approaches, however, are dependent upon the ability to rapidly and accurately detect and respond to changes in plant physiology and metabolism. The use of in parallel techniques to quantify plant biomolecules and bioproducts can be used to generate a metabolic profile of plant responses to a wide range of environmental conditions, abiotic stresses, and pathogen challenges. The data generated by these techniques can identify the specific biochemical pathways involved in plant growth and development under specific environmental conditions and can be used in downstream breeding and metabolic engineering efforts to increase yield, stress resistance, or bioproduct synthesis.

Curriculum Vitae – Dr. Joshua Blakeslee

Ohio Agricultural Research and Development Center, Dept. of Horticulture and Crop Science, The Ohio State University
Columbus, Ohio.
Email: blakeslee.19@osu.edu

Education

Ph.D. 2005 Purdue University, Horticulture
B.S., summa cum laude, honors, 1999, Moravian College, Biology

Research and Teaching Positions

- Associate Professor, Dept. of Horticulture and Crop Science, Ohio Agricultural Research and Development Center (OARDC), The Ohio State University, Columbus/Wooster, OH (2017)
- Founder and Manager, OARDC Metabolite Analysis Cluster (metabolomic core facility), The Ohio State University, Columbus/Wooster, OH (2013)
- Assistant Professor, Dept. of Horticulture and Crop Science, OARDC, The Ohio State University, Wooster, OH (2011-2017)
- Post-doctoral researcher, Dept. of Horticulture and Landscape Architecture, Purdue University (2010-2011)
- Post-doctoral researcher, Dept. of Molecular Biology, Cellular Biology, and Biochemistry, Brown University (2006-2010)
- Post-doctoral researcher, Dept. of Food Science & Dept. of Horticulture and Landscape Architecture, Purdue University (2005-2006)

Selected Refereed Journal Articles (last 5 years)

1. Yates-Stewart, A.D., Pekarcik, A., Michel, A., Blakeslee, J.J. (2020) Jasmonic acid-isoleucine (JA-Ile) is involved in the host-plant resistance mechanism against soybean aphid (Hemiptera: Aphididae). ***Journal of Economic Entomology***.
2. Stakso, A.K., Batnini, A., Bolanos-Carriel, C., Lin, J.E., Lin, Y., Blakeslee, J.J., Dorrance, A.E. (2020) Auxin Profiling and *GmPIN* expression in expression in *Phytophthora sojae-soybean* root interactions. ***Phytopathology***.
3. Li, G., Rongshoung, L., Egekwu, C., Blakeslee, J., Lin, J., Pettengill, E., Murphy, A.S., Peer, W.A., Islam, N., Babst, B.A., Gao, F., Komarov, S., Tai, Y.C., Coleman, G.D. (2020) Seasonal nitrogen remobilization and the role of auxin transport in poplar trees. ***Journal of Experimental Botany***.
4. Wang, H., Blakeslee, J.J., Jones, M.L., Chapin, L.J., Dami, I. (2020) Exogenous abscisic acid enhances physiological, metabolic, and transcriptional cold acclimation responses in greenhouse-grown grapevines. ***Plant Science***.
5. Clark, D., Velleman, S., Bernier, M., McCormick, J., Blakeslee, J. (2020) The effect of selection for 16-week body weight on turkey serum metabolome. ***Poultry Science***.
6. Blakeslee, J., Spatola-Rossi, T., Kreichbaumer, V. (2019) Auxin biosynthesis: spatial regulation and adaptation to stress. ***Journal of Experimental Botany***.
7. Petrella, D., Han, E.H., Nangle, E.J., Scheerens, J.C., Gardner, D.S., Blakeslee, J.J. (2018) Modulation of halotropic growth in rough bluegrass (*Poa trivialis* L.) by flavonoids and light. ***Environmental and Experimental Botany***.
8. Zhang, Q., Berkey, R., Blakeslee, J., Lin, J., Ma, X., King, H., Liddle, A., Guo, L., Munnik, T., Wang, X., Xiao, S. (2018) Arabidopsis phospholipase D α and δ oppositely modulate EDS1- and SA-independent basal resistance against adapted powdery mildew. ***Journal of Experimental Botany***.
9. Han, E.H., Petrella, D.P., Blakeslee, J.J. (2018) 'Bending' models of halotropim: incorporating protein phosphatase 2A, ABCB transporters, and auxin metabolism. ***Journal of Experimental Botany***.
10. Wang, M., Rui, L., Yan, H., Shi, H., Zhao, W., Lin, J.E., Zhang, K., Blakeslee, J.J., Mackey, D., Tang, D., Wei, Z., Wang, G.L. (2017) The major leaf ferredoxin Fd2 regulates plant innate immunity in Arabidopsis. ***Molecular Plant Pathology***.

Considerations around metabolic engineering of rubber biosynthesis

Katrina Cornish, Ph.D., FNAI, FAIMBE, FAAAS

The Ohio State University, Wooster, Ohio, USA

Successful improvement of rubber and latex producing crop yield through metabolic engineering requires the convergence of multiple enabling technologies and multiple production platforms with a thorough understanding of rubber biosynthesis, the rubber transferase complex, rate limiting factors and impacts of pathway perturbation on rubber molecular and macromolecular conformation. Some features and approaches can be applied to multiple species, but some are species-specific and are affected differently by environment. Furthermore, rubber accumulation is maturation dependent presenting a real challenge to rapid non-destructive assessment and selection of improved transgenic and wild type plants.

Acknowledgement: I acknowledge support by USDA-NIFA Hatch project # 230837

Curriculum Vitae – Dr. Katrina Cornish

Queensland Alliance for Agriculture and Food, Innovation University of Queensland, Brisbane QLD 4072, Australia.

Email: cornish.19@osu.edu

Education

Ph.D. in Plant Biology, Adaptive mechanisms of salt tolerance in grasses, The University of Birmingham, Edgbaston, UK. B.Sc. (First class honours) in Biological Sciences, specializing in plant biology and genetics, The University of Birmingham.

Research and Teaching Positions

Endowed Chair and Ohio Research Scholar, Bioemergent Materials, Departments of Horticulture and Crop Science, and of Food Agricultural and Biological Engineering, The Ohio State University (2010-present)
Senior VP R&D, Yulex Corporation, Maricopa, Arizona (2004-2010)
Lead Scientist, Western Regional Research Center, USDA-ARS, Albany, CA (1989-2004)
Research Associateships: Rubber molecular biology, Arizona State University (1988-1989)
Photosynthesis, U of Arizona, UC Santa Cruz, 1987-1988; Electrophysiology of assimilate partitioning, Cornell U (1985-1987)
Abscisic acid metabolism, MSU-DOE-PRL (1982-1985)

Selected Refereed Journal Articles (last 5 years)

1. Cornish, K. da Costa, B.M.T., McMahan, C.M. (2020) Temporal analysis of natural rubber transferases reveals intrinsic distinctions for in vitro synthesis in two rubber-producing species. ***Current Topics in Biochemical Research***.

2. Ren, X., Barrera, C.S., Tardiff, J.L., Gil A., Cornish, K. (2020) Liquid guayule natural rubber, a renewable and multifunctional rubber additive. ***Journal of Cleaner Production***.

3. Cornish, K., Kopicky, S.E., Madden, T. (2019) Hydroponic cultivation of rubber dandelion has high annual rubber yield potential. ***Rubber and Plastics News***.

4. Ramirez-Cadavid, D.A., Cornish, K., Hathwaik, U., Kozak, R., McMahan. C.M., Michel, F.C.,Jr. (2019) Development of novel processes for the aqueous extraction of natural rubber from *Taraxacum kok-saghyz* (TK). ***J Chem Technol Biotechnol***.

5. Bates, G.M., McNulty, S.K., Amstutz, N.D., Pool, V.K., Cornish, K. (2019) Planting density and harvest season effects on actual and potential latex and rubber yields in *Taraxacum kok-saghyz*. ***Hort Science***.

6. Cherian, S., Ryu, S.B., Cornish, K. (2019) Natural rubber biosynthesis in plants, the rubber transferase complex, and metabolic engineering progress and prospects. ***Plant Biotechnology Journal.***

7. Jara, F.M., Cornish, K., Carmona, M. (2019) Potential applications of guayulins to improve feasibility of guayule cultivation, ***Agronomy***.

8. Luo, Z., Iaffaldano, B.J., Cornish, K. (2018) Colchicine-induced polyploidy has the potential to improve rubber yield in *Taraxacum kok-saghyz*. ***Industrial Crops and Products***.

9. Luo, Z., Iaffaldano, B.J., Zhuang, X., Fresnedo-Ramirez, J., Cornish, K. (2018) Variance, inter-trait correlation, heritability and marker-trait association of rubber yield related characteristics in *Taraxacum kok-saghyz*. ***Plant Molecular Biology Reporter***.

Utilizing agricultural technologies in plant physiology research

T. Casey Barickman, Ph.D.

Associate Research Professor

Vegetable Physiology and Production Systems

Department of Plant and Soil Sciences

Mississippi State University

With a rapidly changing environment and increasing worldwide population, there is tremendous pressure to increase global food production by integrating novel and economical plant science research solutions. Utilizing technologies such as a sensor for irrigation and plant phenotyping, controlled environment production, and the use of light-emitting diodes (LED) to grow high-yielding and superior quality plants and fruits will be an integral part of accelerating solutions to agricultural problems. At Mississippi State University, the vegetable physiology lab aims to conduct plant science research that integrates these technologies to comprehensively examine how vegetable crops respond to environmental stress factors such as water, temperature, light, and nutrients. The presentation will overview experiments on soil moisture sensor technology, low-cost open-source technologies for plant phenotyping, plant photosynthesis, controlled environments to determine the effects of environmental stress, and implementing LED technology for increased plant quality.

Curriculum Vitae – Dr. T. Casey Barickman

Mississippi State University, North Mississippi Research and Extension Center, Verona, MS 38879, USA

Email: t.c.barickman@msstate.edu

Education

Ph.D. in Horticulture: Plant Physiology, The University of Tennessee (2014)
M.S. in Horticulture: Plant Physiology, The University of Tennessee (2009)
B.S. in Horticulture/Plant Health and Protection, Iowa State University (2005)

Research and Teaching Positions

Associate Research Professor, Department of Plant and Soil Sciences, Mississippi State University (2020-Present).
Assistant Research Professor, Department of Plant and Soil Sciences, Mississippi State University (2014-2020).
Research Associate II, Plant Sciences Department, The University of Tennessee (2006-2014)
Research Associate I, Plant Sciences Department, The University of Tennessee (2005-March 2006).

Selected Refereed Journal Articles (last 5 years)

1. Brazel, S.R., T.C. Barickman, and C.E. Sams. (In Press). Short-Term waterlogging of kale (*Brassica oleracea* L. var. *acephala*) plants causes a decrease in carotenoids and chlorophylls while increasing nutritionally important glucosinolates. ***Acta Horticulturae***.

2. Barickman, T.C., O.J. Olorunwa, A. Sehgal, H. Walne, K.R. Reddy, and W. Gai. (In Review) Interactive Effects of Temperature and Elevated CO_2 on Growth, Development, and Phytonutrients in Basil (*Ocimum basilicum* L.). ***Environmental and Experimental Botany***.

3. Barickman, T.C., K.R. Reddy, A. Sehgal, H. Walne, and S.R. Brazel. (In Review) Individual and Interactive Effects of UV-B radiation and Elevated CO_2 on Morpho-physiological and Biochemical Properties of *Ocimum basilicum* L. ***Journal of the American Society for Horticultural Sciences***.

4. Barickman, T.C., B. Adhikari, A. Sehgal, H. Walne, K.R. Reddy, and W. Gai. (In Review) Interactive Effects of Temperature and Elevated CO_2 on Growth, Development, and Phytonutrients in Basil (*Ocimum basilicum* L.). ***Journal of Plant Physiology***.

5. Ravelombola, W., L. Dong, C. Barickman, H. Xiong, D. Olaoye, G. Bhattarai, B. Zia, H. Alshaya, I. Alatawi, and A. Shi. (In Review). Evaluation of salt tolerance in cowpea at seedling stage. ***Euphytica***.

6. Minaev, N., M. Tomaso-Peterson, T. Tseng, D. Chesser, T.C. Barickman, and J. McCurdy. (In Review). Fluxapyroxad + Pyroclostrobin containing fungicide effects on ultra-dwarf bermudagrass establishment. *Crop, Forage, &* ***Turfgrass Management***.

7. Barickman, T.C., K.M. Ku, and C.E. Sams. (2020) Differing precision irrigation thresholds for kale induces changes in physiological performance, metabolites, and yield. ***Environmental and Experimental Botany***.

8. Barickman, T.C., D.A. Kopsell, C.E. Sams, and R.C. Morrow. (2020) Sole source LED lighting and fertility impact shoot and root tissue mineral elements in Chinese kale (*Brassica oleracea* var. alboglabra). ***Horticulturae***.

9. Meyers, S., T.C. Barickman, J. Main, and T. Horgan. (2020) Yellow nutsedge (*Cyperus esculentus*) interference in simulated sweetpotato (*Ipomoea batatas*) plant beds. ***Weed Science***.

10. Minaev, N., M. Tomaso-Peterson, T. Tseng, D. Chesser, T.C. Barickman, and J. McCurdy. (2020) Harvest aids for improved bermudagrass sod shelf-life and transplantation success. ***Agrosystems, Geosciences & Environment***.

11. Barickman, T.C., D.A. Kopsell, and C.E. Sams. (2019) Applications of abscisic acid and calcium treatments affect the concentrations of mineral nutrients in tomato leaf and fruit tissue. ***Horticulturae***.

12. Barickman, T.C., C.R. Simpson, C.E. Sams. (2019) Waterlogging causes early modification in the physiological performance, carotenoids, chlorophylls, proline, and soluble sugars of cucumber plants. ***Plants***.

13. Sublett, W.L., T.C. Barickman, and C.E. Sams. (2018) The effects of environment and nutrients on hydroponic lettuce yields, quality, and phytonutrients. ***Horticulturae***.

14. Barickman, T.C., W.L. Sublett, D. Crow, E. Schenstra, and C. Miles. (2018) Lettuce biomass accumulation and phytonutrient concentrations are influenced by genotype, N application rate and location. ***Horticulturea***.

15. Sublett, W.L., T.C. Barickman, and C.E. Sams. (2018) Effects of elevated temperature and potassium on biomass and quality of dark red 'Lollo Rosso' Lettuce. ***Horticulturea***.

16. Begitschke, E., J.D. McCurdy, T. Tseng, T.C. Barickman, B.R. Stewart, C.M. Baldwin, M.P. Richard, and M. Tomaso-Peterson. (2018) Effects of preemergence herbicide on hybrid bermudagrass root growth and morphology. ***HortScience***.

17. Begitschke, E., J.D. McCurdy, T. Tseng, T.C. Barickman, B.R. Stewart, C.M. Baldwin, M.P. Richard, and J.K. Ward. (2018) Preemergence herbicide effects on establishment and tensile strength of sprigged hybrid bermudagrass. ***Agronomy Journal***.

18. Barickman, T.C., T.E Horgan, and J. Wilson. (2017) Efficacy of fungicide applications and powdery mildew resistance in three pumpkin cultivars. ***Crop Protection***.

19. Barickman. T.C., D.A. Kopsell, and C.E. Sams. (2017) Abscisic acid improves tomato fruit quality by increasing soluble sugar concentrations. ***Journal of Plant Nutrition***.

20. Barickman, T.C., D.A. Kopsell, and C.E. Sams. (2017) Effects of abscisic acid on tomato fruit aroma volatiles. ***Journal of Plant Nutrition***.

21. McCurdy, D.W. Held, J.M. Gunn, and T.C. Barickman. (2017) Dew from warm-season turfgrasses as a possible route for pollinator exposure to lawn-applied imidacloprid. ***Crop, Forage, & Turfgrass Management***.

22. Stafne, E.T., F. Matta, and T.C. Barickman. (2017) Ericoid mycorrhizal fungi and soil nutrient uptake of two rabbiteye blueberry cultivars. ***Acta Horticulturae***.

23. Li, T., G. Bi, T.C. Barickman, B. Evans, and J. LeCompte. (2017) Effects of colored shade cloth on the quality and yield of vegetable and cut flower. ***HortTechnology***.

Nanobionic plant sensors for precision agriculture

Seonyeong Kwak

Seoul National University

Nanotechnology is exclusively advantageous as a species-independent technique that can be applied directly to a variety of wild-type plants and can translate endogenous signals into digital information. This talk will highlight nanobionic plant sensors that use technologies to deliver functional nanomaterials into living plants and engineered them into sensing devices. We will briefly introduce the concept of 'plant nanobionics,' explain nanoparticle co-localization mechanism in plants and show the latest nanobionic plant sensor prototype. By interfacing plant tissues, cells, or organelles with rationally designed functional nanoparticles, we have engineered non-transgenic plants to act as a self-powered sensor that recognizes their surroundings. Real-time monitoring within individual plants enables reporting plant health status, alarming the onset of stress or resource shortages, and screening stress-tolerant varieties. We believe this nanobionic plant sensor has great potential to be utilized in precision agriculture by helping manage plant stressors.

Curriculum Vitae – Dr. Seonyeong Kwak

Gwanak-ro, Gwanak-gu, Seoul 08826, Republic of Korea

Email: seon.y.kwak@snu.ac.kr

Education

Ph.D. in Department of Chemical & Biological Engineering, Seoul National University (2012)

Research and Teaching Positions

Assistant Professor, Department of Biosystems and Biomaterials Science and Engineering, Seoul National University (2019-current)
Postdoctoral Associate, Department of Chemical Engineering, Massachusetts Institute of Technology (2014-2018)
Postdoctoral Associate, Department of Chemical Engineering, Hanyang University (2013)

Selected Refereed Journal Articles (last 5 years)

1. Kwak SY, Lew TTS, Sweeney CJ, Koman VB, Wong MH, Bohmert-Tatarev K, Snell KD, Seo JS, Chua N-H, Strano MS. (2019) Chloroplast-Selective Gene Delivery and Expression in planta using Chitosan-Complexed Single-Walled Carbon Nanotube Carriers. ***Nature Nanotechnology.***

2. Kwak SY, Giraldo JP, Lew TTS, Wong MH, Liu P, McGee M, Koman VB, Strano MS. (2018) Polymethacrylamide and Carbon Composites that Grow, Strengthen and Self-Repair using Ambient Carbon Dioxide Fixation, ***Advanced Materials.***

3. Kwak SY, Giraldo JP, Wong MH, Koman V, Lew TTS, Ell J, Weidman M, Sinclair R, Landry M, Tisdale W, Strano MS (2017). A Nanobionic Light-Emitting Plant. ***Nano Letters.***

Deep learning in real-world applications

Ha Young Kim

Graduate School of Information, Yonsei University, Yonsei-ro 50, Seodaemun-gu, Seoul, 03722, Republic of Korea

The remarkable performance of deep learning is based on its ability to learn high-level features by processing large amounts of data. This exceptionally superior performance has attracted the attention of researchers in diverse fields. First, I will briefly introduce deep learning and explain how it is practically applied in various fields including computer vision, healthcare, finance, civil engineering and so on. In particular, I will present a deep learning approach for rice blast disease prediction related to plant disease research in more detail. Among all diseases affecting rice production, rice blast disease has the greatest impact. Thus, monitoring and precise prediction of the occurrence of this disease are important; early prediction of the disease would be especially helpful for prevention. Historical data on rice blast occurrence in representative areas of rice production in South Korea and historical climatic data are used to develop a region-specific model for three different regions: Cheolwon, Icheon and Milyang. A rice blast incidence is then predicted a year in advance using long-term memory networks (LSTMs). The predictive performance of the proposed LSTM model is evaluated by varying the input variables (i.e., rice blast disease scores, air temperature, relative humidity and sunshine hours). The most widely cultivated rice varieties are also selected and the prediction results for those varieties are analyzed.

Curriculum Vitae – Dr. Ha Young Kim

Graduate School of Information, Yonsei University,
Yonsei-ro 50, Seodaemun-gu, Seoul, 03722, Republic of Korea

Email: hayoung.kim@yonsei.ac.kr

Education

Ph.D. in Mathematics, Purdue University (2010) Graduate Certificate in Research
M.S. in Mathematics, Purdue University (2007)
B.S. in Mathematics, Kyung Hee University (2000)

Research and Teaching Positions

Assistant Professor, Graduate School of Information, Yonsei University (Sep 2019 – current)
Head Professor, Strategic Management of Big Data Analytics (SMBA), Graduate School of Information, Yonsei University (Mar 2020 – current)
Assistant Professor, Department of Financial Engineering, School of Business, Ajou University (Sep 2016 - Aug 2019)
Assistant Professor, Department of Data Science, Graduate School, Ajou University (Sep 2017 - Aug 2019)
Researcher, Samsung Advanced Institute of Technology, Samsung Electronics (June 2011 - Aug 2016)
Visiting Lecturer, Department of Mathematics and Actuarial Science, Indiana University Northwest (Aug 2010 - May 2011)

Selected Refereed Journal Articles (last 5 years)

1. Ji Hyun Jang, Jisang Yoon, Jungeun Kim, Jinmo Gu, Ha Young Kim*. (2021) DeepOption: A Novel Option Pricing Framework Based on Deep Learning with Fused Distilled Data from Multiple Parametric Methods. ***Information Fusion***.

2. S. W. Lee, Ha Young Kim*. (2020) Stock Market Forecasting with Super-High Dimensional Time-Series Data Using ConvLSTM, Trend Sampling, and Specialized Data Augmentation. ***Expert Systems With Applications***

3. B. R. Kang, H. Lee, K. Park, H. Ryu, Ha Young Kim*. (2020) BshapeNet: Object Detection and Instance Segmentation with Bounding Shape Masks. ***Pattern Recognition Letters***.

4. G. Jeong, Ha Young Kim*. (2019) Improving Financial Trading Decisions Using Deep Q-learning: Predicting the Number of Shares, Action Strategies, and Transfer Learning. ***Expert Systems With Applications***.

5. Ha Young Kim*, C.H. Won. (2018) Forecasting the Volatility of Stock Price Index: A Hybrid Model Integrating LSTM with Multiple GARCH-Type Models. **Expert Systems With Applications**.

Integrating technologies to develop our future crops

Lee Hickey

Queensland Alliance for Agriculture and Food Innovation, The University of Queensland, Brisbane, Queensland, Australia

Farmers around the world have recently experienced significant crop losses due to severe heat and drought. Such extreme weather events and the need to feed a rapidly growing population have raised concerns for global food security. Crop improvements can help us to meet the challenge of feeding a population of 10 billion, but can we breed better varieties fast enough? Speed breeding manipulates the growing environment by regulating light and temperature for the purpose of rapid generation advance. Protocols are now available for a range of short-day and long-day crop species, which enable growing up to six generations per year. This seminar highlights how technologies such as marker-assisted selection, unmanned aerial vehicle (UAV) sensing platforms and genomic selection can be galvanized by using speed breeding to enable plant breeders to keep pace with a changing environment and ever-increasing human population. The successful integration of leading-edge technologies is expected to accelerate the rate of genetic improvement in plant breeding programs to deliver more productive and resilient crops.

Curriculum Vitae – A/Prof Lee Hickey

Queensland Alliance for Agriculture and Food, Innovation University of Queensland, Brisbane QLD 4072, Australia

Email: l.hickey@uq.edu.au

Education

Ph.D. in Quantitative and Molecular Plant Breeding, The University of Queensland (2012)
Graduate Certificate in Research Commercialisation, The University of Queensland (2012)
B.Agr Sc (Hons Class I), The University of Queensland (2007)

Research and Teaching Positions

Associate Professor, Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland (UQ) (2020-current)
Senior Research Fellow & ARC DECRA Fellow, Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland (UQ) (2017-2019)
Research Fellow, QAAFI, UQ (2012-2016)
PhD candidate, School of Agriculture and Food Science, UQ (2007-2012)
Biometrics Teaching Assistant, School of Land, Crop and Food Science, UQ (2008-2009)
Maize Research Intern, Pioneer Hi-Bred International, Inc. Dallas Center, IA, USA (2008)

Selected Refereed Journal Articles (last 5 years)

1. Bhatta M, Sandro P, Smith MR, Delaney O, Voss-Fels KP, Gutierrez L, Hickey LT. (2021) Need for speed: manipulating plant growth to accelerate breeding cycles. ***Current Opinion in Plant Biology***.

2. Hickey LT, Hafeez A, Robinson H, Jackson SA, Leal-Bertioli SCM, Tester M, Gao C, Godwin ID, Hayes BJ, Wulff BBH. (2019) Breeding crops to feed 10 billion. ***Nature Biotechnology***.

3. Godwin ID, Rutkoski J, Varshney RK, Hickey LT. (2019) Technological perspectives for plant breeding. ***Theoretical and Applied Genetics.***

4. Ghosh S, Watson A, Gonzalez-Navarro OE, Ramirez-Gonzalez RH, Yanes L, Mendoza-Suárez M, Simmonds J, Wells R, Rayner T, Green P, Hafeez A, Hayta S, Melton RE, Steed A, Sarkar A, Carter J, Perkins L, Lord J, Tester M, Osbourn A, Moscou MJ, Nicholson P, Harwood W, Martin C, Domoney C, Uauy C, Hazard B, Wulff BBH, Hickey LT. (2018) Speed breeding in growth chambers and glasshouses for crop breeding and model plant research. ***Nature Protocols.***

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The multi-functional patatin-related phospholipase: grows and glows

Jin Hoon Jang and Ok Ran Lee*

Department of Applied Plant Science, College of Agriculture and Life Science, Chonnam National University, Gwangju 61186, Republic of Korea

* Corresponding author: mpizlee@jnu.ac.kr

Patatin-related phospholipase As (pPLAs) are major hydrolases acting on acyl-lipids and play important roles in various plant developmental and physiological processes. We report here the characterization of pPLAIIIα in Arabidopsis and hybrid poplar based on the biochemical and physiological characterization of pPLAIIIα knockouts, complementants and overexpressors, as well as heterologous expression of the protein. In vitro activity assays on the purified recombinant protein showed that despite lack of canonical phospholipase motifs. Overexpression of pPLAIIIα in Arabidopsis resulted in a decrease in many lipid molecular species, but the composition in major lipid classes was not affected. While Arabidopsis pplaIIIα knockout mutants showed some phenotypes comparable to other pPLAIIIs, such as reduced trichome length and increased hypocotyl length, control of seed size and germination were identified as distinctive pPLAIIIα-mediated functions. Overexpression of pPLAIIIα resulted in reduced plant height with radially expanded stem growth in Arabidopsis and in hybrid poplars. Compared with the wild type, the secondary cell wall structure in overexpression lines was altered as well, showing a reduced lignification in xylem. Furthermore, Overexpression of pPLAIIIα caused increased resistance to turnip crinkle virus, which associated with a two-fold higher salicylic acid:jasmonic acid ratio. These results therefore show that pPLAIIIα has functions that overlap with those of other pPLAIIIs but also distinctive functions.

Acknowledgement: This work was supported by the National Research Foundation of Korea, the Ministry of Science, Information and Communication Technology, and Future Planning (Basic Science Research Program grant no. 2019R1A2C1004140), the New Breeding Technologies Development Program of the Rural Development Administration, Republic of Korea (project no. PJ01532502).

Curriculum Vitae – Mr. Jin Hoon Jang

Department of Applied Plant Science, College of Agriculture and Life Science, Chonnam National University. 77 Yongbong-ro, Buk-gu, Gwangju 61186

Email: jinhun92@naver.com

Education

M.S. in Applied Plant Science, Chonnam National University (2017-2019) – Advisor: Prof. Ok Ran Lee
B.S. in Bio-Engineering, Chonnam National University (2011–2017)

Conference Oral Presentations

1. ‘pPLAIIIα affects germination rate and confers resistance to turnip crinkle virus when overexpressed’ 2020 Annual Conference of the Korean Society for Plant Biotechnology. online conference.
2. ‘Patatin-related phosphoflipase pPLAIIIα regulates longitudinal cell growth and germination in Arabidopsis’ 2020 International Symposium and Annual Meeting of Korean Society for Applied Biological Chemistry. online conference.
3. ‘Patatin-related phospholipase AIIIβ from ginseng alters cell growth pattern and reduces lignin content in Arabidopsis and hybrid poplar’ 2019 International Asian-Oceanian Symposium on Plant Lipids, Canberra, Australia.
4. ‘Overexpression of ginseng-derived *PgpPLAIIIβ* altered cell growth patterns and reduced lignified fiber cells in Arabidopsis and hybrid poplars’ 2019 International Symposium and Annual Meeting of Korean Society for Applied Biological Chemistry, Busan, Korea.
5. ‘Patatin-related phospholipase *PgpPLAIIIβ* from ginseng regulates cell growth patterns and lignified fiber cells in Arabidopsis and hybrid poplars’ 2019 Annual Conference of the Korean Society for Plant Biotechnology, Jeonju, Korea.
6. ‘Overexpression of ginseng patatin-related phospholipase *pPLAIIIβ* regulated seed germination rate and altered cell wall composition’ 2018 Annual Conference of the Korean Society of Medicinal Crop Science, Jeonju, Korea.
7. ‘Reduced lipid species by overexpression of phospholipase AIIIα involved in prolonged plant longevity and resistance to a plant virus’ 2018 International Symposium and Annual Meeting of Korean Society for Applied Biological Chemistry, Jeju, Korea.

Selected Refereed Journal Articles (last 5 years)

1. Jang JH, Nguyen NQ, Légeret B, Beisson F, Kim YJ, Sim HJ, Lee OR. (2020). Phospholipase pPLAIIIα Increases Germination Rate and Resistance to Turnip Crinkle Virus when Overexpressed. ***Plant Physiology***.

2. Jang JH and Lee OR. (2020). Patatin-Related Phospholipase AtpPLAIIIα Affects Lignification of Xylem in Arabidopsis and Hybrid Poplars. ***Plants***.

3. Jang JH, Khanom S, Moon YK, Shin SI, Lee OR. (2020). PgCYP76B93 docks on phenylurea herbicides and its expression enhances chlorotoluron tolerance in Arabidopsis. ***Applied Biological Chemistry***.

4. Jang JH and Lee OR. (2020). Overexpression of ginseng patatin-related phospholipase pPLAIIIβ alters the polarity of cell growth and decreases lignin content in Arabidopsis. ***Journal of ginseng research***.

5. Jang JH, Bae EK, Choi YI, Lee OR. (2019). Ginseng-derived patatin-related phospholipase PgpPLAIIIβ alters plant growth and lignification of xylem in hybrid poplars. ***Plant Science***.

5. Khanom S, Jang JH, Lee OR. (2020) Overexpression of ginseng cytochrome P450 CYP736A12 alters plant growth and confers phenylurea herbicide tolerance in Arabidopsis. ***Journal of ginseng research***.

Bioengineered nanomaterials for agricultural technology innovation

Sunho Park[1,2], Yonghyun Gwon[1,2], Dream Kim[1], Woochan Kim[1,2],

Hyoseong Kim[1], Jangho Kim[1,2,*]

[1]Department of Rural and Biosystems Engineering, Chonnam National University, Gwangju 61186, Republic of Korea.

[2]Interdisciplinary Program in IT-Bio Convergence System, Chonnam National University, Gwangju 61186, Republic of Korea.

* Corresponding author: rain2000@jnu.ac.kr

Bioengineered nanomaterials enable us to solve the various problems and to replace the conventional method in agricultural field. In this study, we propose two types of nanomaterials (e.g., carbon-based nanomaterials and natural-derived nanomaterials) for agricultural technology innovation. Specifically, graphene oxide (GO), which is one of carbon-based nanomaterials, used as assistant for plant growth and stability, and it has had a positive effect on plant growth by increasing root length, leaf number, leaf area, and flower number. The directly GO injected fruit showed the enhanced sugar concentration with the promoted perimeter. In addition, we developed the natural-derived gelatin nanoparticle as versatile nanomaterials to control the functions of the disruptor like insect pests and weeds for crops or to increase the plant and crop growth. Gelatin nanoparticles (GNPs) are able to adsorb the drug, and it was gradually released under controlled condition. GNPs with positively charged surface can be easily attached on the surface of plant leaves, and it remains after washing. Using these abilities of GNPs, the treatment of GNPs with the pesticide and herbicide cause extensive damage to insects and weeds while the treatment of GNPs shows the enhanced plant growth. Our findings suggest that bioengineered nanomaterials may provide positive effects in agricultural field, and it has a potential for agricultural technology innovation.

Acknowledgement: This work was supported by National Research Foundation of Korea (NRF) grants funded by the Korea government (2019R1I1A3A0106345 and 2019M3A9H1103737), as well as by the Korea Institute of Planning and Evaluation for Technology in Food, Agriculture and Forestry (IPET) through the Agriculture, Food and Rural Affairs Research Center Support Program, funded by the Ministry of Agriculture, Food and Rural Affairs (MAFRA) (Project No. 714002).

Curriculum Vitae – Ms. Sunho Park

Department of Rural and Biosystems Engineering, Chonnam National University, Gwangju 61186, Republic of Korea.

Email: preference9330@gmail.com

Education

M.S and B.S. in Rural and Biosystems Engineering (2016-2018 / 2012-2016), Chonnam National University – Advisor: Prof. Jangho Kim

Professional Activities and Services

AKABFE Editorial Board Member (Korean Student Representation), The Association of Korean Agricultural, Biological & Food Engineers. (2017 – 2018)
IEEE NANOMED Conference Secretariat, The 13th IEEE International Conference on Nano/Molecular Medicine & Engineering (IEEE-NANOMED 2019) Conference Secretariat.

Selected Refereed Journal Articles (last 5 years)

1. S. Park, Y. Jeon, T. Han, S. Kim, Y. Gwon, J. Kim. (2020) Nanoscale manufacturing as and enabling strategy for the design of smart food packaging systems. ***Food Packaging and Shelf Life***.

2. S. Park, H. Kim, K.S. Choi, M.K. Ji, S. Kim, Y. Gwon, C. Park, J. Kim, H.P. Lim. (2020) Graphene-Chitosan hybrid dental implants with enhanced antibacterial and cell proliferation properties. ***Applied Sciences***.

3 S. Park, K.S. Choi, S. Kim, Y. Gwon, J. Kim. (2020) Graphene oxide-assisted promotion of plant growth and stability. ***Nanomaterials***.

4. S. Park, H.H. Park, K. Sun, Y. Gwon, M. Seong, S. Kim, T.E. Park, H. Hyun, J. Kim, H.E. Jeong. (2019) Hydrogel nanospike patch as a flexible anti-pathogenic scaffold for regulating stem cell behavior. ***ACS NANO***.

5. S. Park, T. Kim, Y. Gwon, S. Kim, D. Kim, H.H. Park, H.E. Jeong, K. Kim, J. Kim. (2019) Graphene-layered eggshell membrane as a flexible and functional scaffold for enhanced proliferation and differentiation of stem cells. ***ACS Applied Bio Materials***.

6. S. Park, T. Kim, D. Jo, J.S. Jung, G. Jo, Y. Park, Y.H. Kim, J. Kim, K. Kim, H. Hyun. (2019) Bioengineered short carbon nanotubes as tumor-targeted carriers for biomedical imaging. ***Macromolecular Research***.

7. S. Park, H. Seonwoo, K.T. Lim, S. Park, D. Lee, D. Kim, W.C. Kim, J.H. Chung, J. Kim. (2019) Engineering cell-graphene interface for controlling stem cell behavior. ***Nanoscale Soft Materials in Nano/BioMedicine***.

8. S. Park, D. Lee, D. Kim, W. Kim, S. Kim, S. Park, J. Kim. (2019) Nanopatterned scaffolds for neural tissue engineering and regenerative medicine, ***Advances in Experimental Medicine and Biology***.

9. S. Park, K.S. Choi, W. Kim, D. Lee, D. Kim, J. Kim. (2018) Engineering nanowrinkled microfibers composed of eggshell membrane and graphene. ***Materials Letters***.

10. S. Park, K.S. Choi, D. Kim, W. Kim, D. Lee, H.N. Kim, K.T. Lim, J.W. Kim, Y.R. Kim, J. Kim. (2018) Controlled extracellular topographical and chemical cues for acceleration of neuronal development. ***Journal of Industrial and Engineering Chemistry***.

11. C. Park, S. Park, D. Lee, K.S. Choi, H.P. Lim, J. Kim, (2017) Graphene as an enabling strategy for dental implant and tissue regeneration. ***Tissue Engineering and Regenerative Medicine***.

Mouth shape estimation with MAR

Tomoki Arai, Woong Choi

Department of Information and Computer Engineering,

National Institute of Technology, Gunma College

580 Toriba, Maebashi, Gunma,371-8530 Japan

It is difficult to accurately reflect the actor's mouth shape on the 2D avatar in real time. However, in terms of improving the understanding of the actor's remarks, it is desirable that the actor and the avatar's mouth move in the same way. In many conventional methods, the movement of landmarks virtually placed on the lips is made to follow the animation, and the mouth shape of the actor is reproduced on the 2D avatar. Therefore, we propose a method of estimating which of the templates the actor's mouth shape fits into and using the result to create the avatar's mouth shape. As the first step of this method, in this study, we tried to classify the basic mouth shape in Japanese utterance using the Mouth Aspect Ratio (MAR), which is the aspect ratio of the mouth. As a result, it was found that the mouth shape corresponding to five Japanese vowel sounds and the stable state with the mouth closed can be classified.

Curriculum Vitae – Mr. Tomoki Arai

Department of Information and Computer Engineering, National Institute of Technology, Gunma College 580 Toriba, Maebashi, Gunma, 371-8530 Japan

Email: ap20802@gunma.kosen-ac.jp

Education
Department of Information and Computer Engineering (2015-)

Research Interests
Virtual Reality, Augmented Reality, Human Computer Interaction, Human Sensing

Research Areas
Human interfaces and interactions

Calculation of mahjong points using AI

Takuma Kano, Kiyoshi Takayama, Woong Choi

Department of Information and Computer Engineering,

National Institute of Technology, Gunma College

580 Toriba, Maebashi, Gunma,371-8530 Japan

In recent years, the problem of declining birthrates and aging populations has become more serious in developed countries such as Europe, the United States, and Asian countries including Japan. Therefore, we focused on mahjong game, which is effective in preventing dementia. However, it is difficult for beginners and even intermediate players to proceed with the game instantly because mahjong has complicated yaku (hand), and the calculation of points using them is even more complicated. Therefore, we are developing a mahjong progression support system using AI, aiming at making it easier for players who have difficulty calculation mahjong points. Since simple learning did not produce results that could be used in the system, we achieved significant results by changing the size of the mahjong tiles in the images to be learned.

Curriculum Vitae – Mr. Takuma Kano

Department of Information and Computer Engineering, National Institute of Technology, Gunma College 580 Toriba, Maebashi, Gunma, 371-8530 Japan

Email: t9.kanou@gmail.com

Education

Department of Information and Computer Engineering, National Institute of Technology, Gunma College (2016-)

Research Interests

Computer Vision, Augmented Reality.

"SMART FARMING IN THE NEW NORMAL ERA"

Curriculum Vitae – Mr. Kiyoshi Takayama

Department of Information and Computer Engineering, National Institute of Technology, Gunma College 580 Toriba, Maebashi, Gunma, 371-8530 Japan

Email: tkym258@gmail.com

Education

Department of Information and Computer Engineering (2016-)

Research Interests

Virtual Reality, Augmented Reality.

Sensory changes caused by different roughness of objects in AR environment

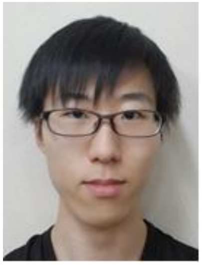
Shingo Kato, Woong Choi

Department of Information and Computer Engineering,

National Institute of Technology, Gunma College

580 Toriba, Maebashi, Gunma,371-8530 Japan

By using Augmented Reality (AR), We can display virtual objects in real space. However, that objects aren’t actually there, we can’t get sensory feedback if we will touch that. In this study we will place real object at the position of the virtual object in order to make the user feel that the virtual object really exists. Incidentally, the factors that make a human use to perceive materials change depending on their taste, as well as temperature, micro-roughness, macro-roughness, softness and hardness. Therefore, in this study, we will focus on the micro and macro roughness in order to quantitatively investigate the permissible range which the difference in roughness between real and virtual objects is acceptable. The preliminary experiment results suggest that the virtual object have an possibility to impact on examinee’s judgement when they haven’t very confidence that two object’s macro-roughness whether equal.



Curriculum Vitae – Mr. Shingo Kato

Department of Information and Computer Engineering, National Institute of Technology, Gunma College 580 Toriba, Maebashi, Gunma, 371-8530 Japan

Email: ap20808@gunma.kosen-ac.jp

Education

Department of Information and Computer Engineering (2015-)

Research Interests

Augmented Reality, Mixed Reality, Human Computer Interaction, Pseudo-haptics

Research Areas

Texture perception, Tactile Sensation

Posture recognition system using kinect

Shogo Sekiguchi, Taichi Koyanagi, Woong Choi

Department of Information and Computer Engineering,

National Institute of Technology, Gunma College

580 Toriba, Maebashi, Gunma,371-8530 Japan

In recent years, stiff shoulders and back pain have become more serious as national diseases in Japan. According to the data of the National Life Basic Survey conducted by the Ministry of Health, Labor and Welfare of Japan, it is known that the number of patients with back pain and stiff shoulders is the highest from more than 30 years ago to the present. Musculoskeletal symptoms such as stiff shoulders and low back pain are said to occur when daily factors such as age, obesity, work environment and illness strongly affect disc degeneration. In addition, it is said that about 20% of chronic patients have alleviated their symptoms by medical temporary treatment. In other words, low back pain and stiff shoulders are easy to get and hard to cure. The purpose of this research is to construct a system that proposes a posture that can prevent musculoskeletal disorders by deriving the degree of fatigue based on appropriate parameters using Kinect, which is a three-dimensional depth sensor.

Curriculum Vitae – Mr. Shogo Sekiguchi

Department of Information and Computer Engineering, National Institute of Technology, Gunma College 580 Toriba, Maebashi, Gunma, 371-8530 Japan

Email: obeyer17@gmail.com

Education

Department of Information and Computer Engineering (2015-)

Research Interests

Virtual Reality, Human Computer Interaction

"SMART FARMING IN THE NEW NORMAL ERA"

Curriculum Vitae – Mr. Taichi Koyanagi

Department of Information and Computer Engineering, National Institute of Technology, Gunma College 580 Toriba, Maebashi, Gunma, 371-8530 Japan

Email: Taichi.kosen@gmail.com

Education

Department of Information and Computer Engineering (2016-)

Research Interests

Virtual Reality, Communication Engineering

Hydrangea interspecific hybridization-fertilization barriers-

Seong-Hwa Bak[1,2], Tae-Ho Han[1,2]

[1]Department of Horticulture, Chonnam National University, Gwangju 61186, Republic of Korea

[2]Interdisciplinary Program in IT-Bio Convergence System, Chonnam National University, Gwangju 61186, Republic of Korea.

Hydrangea is popular plant on the flower market so there are close to 1000 cultivars, and known to have as many as 75 to as few as 23 species depending on the species classification. In particular, *Hydrangea macrophylla*, the most popular species, and bred intensively. *Hydrangea macrophylla* have low cold hardiness among hydrangea species But the cultivar development is mainly focused on *Hydrangea macrophylla*. Thereby, *Hydrangea* breeding in future requires a various interspecific hybridization, the best way to increase genetic diversity. However, it is difficult to obtain plants through interspecific hybridization because the seeds are degraded by barriers such as pre- and post- fertilization. As a way to overcome, immature ovule culture is often used. This study observed a post fertilization barrier in actual hydrangea interspecific hybridization, and determined proper stage of ovule culture after pollination to obtain the interspecific seedlings. The ovary expanded from 4 weeks after pollination. Embryos began to form from week 5, and the size of embryos increased at 6 weeks and remained unchanged from week 7. The seeds in 5 weeks was small numbered, but there was no degradation of the seeds till 14 weeks. The germination rate of seeds was extreamly low ranging from 0 to 3.44%. The germination rate was highest at 9 and 11 weeks. Even after germination we encountered abnormal germination and death during the nursery period. There was no significant difference in the germination rate between 1/2 MS and 1/2 B5 medium, but the plant survival rate was higher in 1/2 B5 medium because of vigorous growth after germination and was suitable for ovule culture of interspecific hybridization. In conclusion, we propose to perform immature ovule culture during 6 to 13 weeks after pollination considering the number of seeds per capsule, seed germination rate, and number of days required for germination are combined.

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Curriculum Vitae – Ms. Seong-Hwa Bak

Department of Horticulture Science, Chonnam National University, Gwngju 61186, Republic of Korea

Email: zoxoco7@naver.com

Education

Doctoral programs in Dept. Horticultural Science, Chonnam National University (2018-)
M.S. in horticultural Science, Chonnam National University (2017)
B.S. in horticultural Science, Chonnam National University (2015)

Research and Teaching Positions

PhD candidate, Graduate School Department of horticultural Science, Cheonnam National University (CNU) (Mar 2018 - current)
Technical Committee member, Agri-food technology SNS consulting support project Flower section, CNU, Korea Institute of Planning and Evaluation for Technology in Food, Agriculture and Forestry (IPET) (Jan 2019- current)
Researcher, Greenhouse CO2 production management and control system development, CNU, Ministry of Science and ICT (Jun 2020 – current)
Researcher, Preservation and management of vegetative reproduction plant genetic resources, CNU, Rural Development Administration (RDA) (Jan 2019 – Dec 2020)
Researcher, Development of domestic varieties of cut and pot flowers Hydrangea, CNU, IPET (Sept 2018 – Aug 2020)
Researcher, Development of crop growth recognition and autonomous spray positioning drone system, CNU, Ministry of SMEs and Startups (Sept 2018 – Dec 2019)
Researcher, LMO risk assessment agency operation, CNU, RDA (Mar 2018 – Aug 2018)

Selected Refereed Journal Articles (last 5 years)

1. Sung-Wha, P., Sang-Hyun, L., Jong Bo, K., Hyo Jin, J., Seong-Gon, W., & Tae-Ho, H. (2017). Development of mass propagation system via rhizome culture in elite breeding line C269 of Alstroemeria. ***Flower Res. J.***

2. S. H. Park, J. B. Kim, H. J. Jung, T. H. Han, (2016). Review of in vitro propagation of Alstroemeria. ***Trends in Agriculture & Life Sciences***.

Innovating to advance crop growth and yields through photosynthesis

Carl Bernacchi

Departments of Crop Sciences and Plant Biology,

University of Illinois, Urbana-Champaign

Changing global food preferences, changing land uses, climate change, and growing populations are placing pressure on agricultural ecosystems. Historic breeding efforts have continually met growing demands in industrialized areas of the planet but have fallen short globally. Furthermore, the rate of agricultural demand is outpacing yield increases from traditional breeding techniques. As a result, significant efforts are underway to improve crop production using both traditional and molecular breeding techniques. While widespread genetic data is increasingly available, there is a significant lack of phenotyping capabilities to understand how crop management and environmental conditions interact with genetics. Here, I will present ongoing research on the development and applications of high throughput phenotyping techniques on a wide range of crop species. The focus of the phenotyping will include physiological analysis of the factors that ultimately lead to crop yield. The research will include the sensors, techniques, and analysis pipelines associated with characterizing crop growth patterns as well as future directions that this research is headed.

Curriculum Vitae – Dr. Carl Bernacchi

Departments of Crop Sciences and Plant Biology, University of Illinois, Urbana-Champaign

Email: bernacch@illinois.edu

Education

PhD in Plant Biology, The University of Illinois, Urbana, IL USA (2002)
Masters in Biology and Environmental Science, Bradley University, Peoria, IL USA (1997)
Bachelors of Science, Bradley University, Peoria, IL USA (1995)

Research and Teaching Positions

Research Plant Physiologist, USDA-ARS Photosynthesis Research Unit, Champaign, IL (2009-present)
Professor, Department of Plant Biology, UIUC (2020-present)
Affiliate, Department of Crop Sciences, UIUC (2016-present)
Faculty, Genomic Ecology of Global Change, IGB, UIUC (2008-present)
Visiting Scientist, Rothamsted Research, Harpenden, UK (2014-2015)
Associate Professor, Department of Plant Biology, UIUC (2014-2019)
Assistant Professor, Department of Plant Biology, UIUC (2009-2014)
Assistant Professional Scientist, Illinois State Water Survey, Champaign, IL (2004-2009)
USDA-ARS Post-Doctoral Research Associate, Urbana, IL (2002-2004)
Instructor of Biology, Department of Biology, Bradley University (1997-1998)

Selected Refereed Journal Articles (last 5 years)

1. Meacham-Hensold, K; Montes, CM; Wu, J; Guan, K; Fu, P; Ainsworth, EA; Pederson, TL; Moore, CE; Brown, KL; Raines, C; Bernacchi, CJ (2019) High-throughput field phenotyping using hyperspectral reflectance and partial least squares regression (PLSR) reveals genetic modifications to photosynthetic capacity. ***Remote sensing of environment***.

2. Fu, P; Meacham-Hensold, K; Guan, K; Bernacchi, CJ (2019) Hyperspectral leaf reflectance as proxy for photosynthetic capacities: An ensemble approach based on multiple machine learning algorithms. ***Frontiers in Plant Science***.

3. Fu, P; Meacham-Hensold, K; Guan, K; Wu, J; Bernacchi, CJ (2020) Estimating photosynthetic traits from reflectance spectra: A synthesis of spectral indices, numerical inversion, and partial least square regression. ***Plant, cell & environment***.

4. Meacham-Hensold, K; Fu, P; Wu, J; Serbin, S; Montes, CM; Ainsworth, EA; Guan, K; Dracup, E; Pederson, T; Driever, S; Bernacchi, CJ (2020) Plot-level rapid screening for photosynthetic parameters using proximal hyperspectral imaging. ***Journal of experimental botany***.

5. Fu, P; Meacham-Hensold, K; Siebers, MH; Bernacchi, CJ (2020) The inverse relationship between solar-induced fluorescence yield and photosynthetic capacity: benefits for field phenotyping. ***Journal of Experimental Botany***.

6. Siebers, MH; Gomez-Casanovas, N; Fu, P; Meacham-Hensold, K; Moore, CE; Bernacchi, CJ (2021) Emerging approaches to measure photosynthesis from the leaf to the ecosystem. ***Emerging Topics in Life Sciences***.

ABSTRACT

SESSION 2: INVITED LECTURES

Reactive motion capture system

Woong Choi

Department of Information and Computer Engineering, National Institute of Technology, Gunma College 580 Toriba, Maebashi, Gunma,371-8530 Japan

Creating character motion from conventional motion capture systems is difficult because they require a variety of task environments. To overcome this drawback, we developed a reactive motion capture system that combines a conventional motion capture system with force feedback and visual information in the human-scale virtual environment. Our purpose is to make animations with character motion data generated from the interaction with force feedback and the virtual environment, using the fact that a person's motion in the real world can be represented by the reactions of the person to real objects. In this research, we made animations via several scenarios for animating character motion generation with the reactive motion capture system. The results demonstrated that character motion generated by the developed system was useful for producing the animation, which includes the scene of reactive motion.

Curriculum Vitae – Ph.D. Woong Choi

Department of Information and Computer Engineering, National Institute of Technology, Gunma College 580 Toriba, Maebashi, Gunma,371-8530 Japan

Email: wchoi@ice.gunma-ct.ac.jp

Education

Ph.D. in Computational Intelligence and Systems Science, Interdisciplinary Graduate School of Science and Engineering, Tokyo Institute of Technology (2005)
Master in Autonomous Robot Control Systems Lab, Graduate School of Control and Instrumentation Engineering, Chosun University (2000)
Bachelor, Department of Control and Instrumentation Engineering, Chosun University (1998)

Research and Teaching Positions

Associate Professor, National Institute of Technology, Gunma College (2017-current).
Lector, National Institute of Technology, Gunma College (2013-2017)
Assistant Professor, National Institute of Technology, Gunma College (2010-2013)
Postdoctoral fellow, Kinugasa Research Organization, Ritsumeikan University (2005-2010)

Selected Refereed Journal Articles (last 5 years)

1. Geonhui Lee, Woong Choi, Hanjin Jo, Wookhyun Park, Jaehyo Kim. (2020) Analysis of motor control strategy for frontal and sagittal planes of circular tracking movements using visual feedback noise from velocity change and depth information. ***PLOS ONE.***

2. Liang Li, Tatsuro Yamada, Woong Choi. (2020) The Effect of Depth Information on Visual Complexity Perception in Three-Dimensional Textures. ***Applied Sciences.***

3. Woong Choi, Jongho Lee, Liang Li. (2020) Analysis of Three-Dimensional Circular Tracking Movements Based on Temporo-Spatial Parameters in Polar Coordinates. ***Applied Sciences.***

4. Woong Choi, Liang Li, Jongho Lee. (2019) Characteristic of Motor Control in Three-Dimensional Circular Tracking Movements during Monocular Vision. ***BioMed Research International.***

5. Woong Choi, Jongho Lee, Naoki Yanagihara, Liang Li, Jaehyo Kim. (2018) Development of a quantitative evaluation system for visuo-motor control in three-dimensional virtual reality space. ***Scientific Reports.***

6. Woong Choi, Liang Li, Satoru Satoh, Kozaburo Hachimura. (2016) Multisensory Integration in the Virtual Hand Illusion with Active Movement. ***BioMed Research International***

Development of a novel system to make quantitative evaluation of motor function and clinical applications

Jongho Lee

Department of clinical engineering, Komatsu University, Komatsu, Japan

Quantitative evaluation of motor functions of patients with neurological disorders is vital for evidence-based treatments. To support the treatment of neurological patients, we developed a new system for quantitative evaluation of the wrist movement and proposed new methods to analyze movement disorders in neurological diseases. First, we proposed a method to make a quantitative evaluation for movement disorders based on the EMG signals. We established one-to-one relationship between movement disorders and causal activities of the muscles for the wrist movement. Second, we developed a method to dissociate motor commands for visually guided smooth pursuit movement of the wrist joint into components from two parallel controllers: 1) a controller continuously synchronizing the wrist movement with target motion in a predictive manner; 2) a feedback controller correcting positional errors with the target intermittently. The method provided a new quantitative tool to evaluate various treatments for neurological patients or stroke patients with paretic upper limb in terms of motor controllers. Finally, we extracted a new parameter characterizing the pathophysiological condition of the patient with Parkinson's disease from high frequency range (3~8Hz) in the smooth pursuit movement. In this conference, I'd like to introduce our studies using these methods.

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Curriculum Vitae – Dr. Jongho, Lee

Department of Clinical Engineering, Faculty of Health Sciences, Komatsu University, Japan

Email: jongho.lee@komatsu-u.ac.jp

Education

Ph.D. in the Precision and Intelligence Laboratory, Tokyo Institute of Technology (2005) Master course in the Department of Electronics Engineering, Graduate School of Chonnam National University (2000-2002)
College course in the Department of Automatic Control and Instrumentation Engineering, Chosun University (1992-1998)

Research and Teaching Positions

Associate Professor, Department of Clinical Engineering, Faculty of Health Sciences, Komatsu University (2018-current)
Chief Researcher, Department of Sensory Motor Systems, Tokyo Metropolitan Institute of Medical Science (2013-2018)
Senior Researcher, Department of Sensory Motor Systems, Tokyo Metropolitan Institute of Medical Science (2010-2013)
Postdoctoral fellow, Department of Behavioral Physiology, Tokyo Metropolitan Institute for Neuroscience (2005-2010)

Selected Refereed Journal Articles (last 5 years)

1. Choi, Woong, Jongho Lee, and Liang Li. (2020) Analysis of three-dimensional circular tracking movements based on temporo-spatial parameters in polar coordinates. ***Applied Sciences.***
2. Tanaka, H., Ishikawa, T., Lee, J., and Kakei, S. (2020) The cerebro-cerebellum as a locus of forward model: a review. ***Frontiers in systems neuroscience.***
3. Min, Kyuengbo, Jongho Lee, and Shinji Kakei. (2020) Dynamic Modulation of a Learned Motor Skill for Its Recruitment. ***Frontiers in Computational Neuroscience.***
4. Kim, Hyeonseok, Jongho Lee, and Jaehyo Kim. (2019) Muscle synergy analysis for stroke during two degrees of freedom reaching task on horizontal plane. ***International Journal of Precision Engineering and Manufacturing***
5. Choi, Woong, Liang Li, and Jongho Lee. (2019) Characteristic of motor control in three-dimensional circular tracking movements during monocular vision. ***BioMed research international.***
6. Kakei, S., Lee, J., Mitoma, H., Tanaka, H., Manto, M., and Hampe, C. S. (2019) Contribution of the cerebellum to predictive motor control and its evaluation in ataxic patients. ***Frontiers in human neuroscience.***
7. Choi, W., Lee, J., Yanagihara, N., Li, L., and Kim, J. (2018) Development of a quantitative evaluation system for visuo-motor control in three-dimensional virtual reality space. ***Scientific reports.***
8. Kim, Hyeonseok, Jongho Lee, and Jaehyo Kim. (2018) Electromyography-signal-based muscle fatigue assessment for knee rehabilitation monitoring systems. ***Biomedical engineering letters.***
9. Min, K., Shin, D., Lee, J., and Kakei, S. (2018) Electromyogram refinement using muscle synergy-based regulation of uncertain information. ***Journal of biomechanics.***
10. Kakei, S., Ishikawa, T., Lee, J., Honda, T., and Hoffman, D. S. (2018) Physiological and morphological principles underpinning recruitment of the cerebellar reserve. ***CNS & Neurological Disorders-Drug Targets.***
11. Shimoda, N., Lee, J., Kodama, M., Kakei, S., and Masakado, Y. (2017) Quantitative evaluation of age-related decline in control of preprogramed movement. ***Plos one.***
12. Fujiwara, Y., Lee, J., Ishikawa, T., Kakei, S., & Izawa, J. (2017) Diverse coordinate frames on sensorimotor areas in visuomotor transformation. ***Scientific reports.***
13. Kim, J., Lee, J., Kakei, S., and Kim, J. (2017). Motor control characteristics for circular tracking movements of human wrist. ***Advanced Robotics.***

Plant roots sense soil compaction through restricted ethylene diffusion

Dabing Zhang

School of Life Sciences and Biotechnology, Shanghai Jiao Tong University, Shanghai, 200240 China

Soil compaction represents a major challenge for modern agriculture. Compaction is intuitively thought to reduce root growth by limiting their ability to penetrate harder soils. We report instead that root growth in compacted soil is actively suppressed by the volatile hormone ethylene. Mutant roots insensitive to ethylene penetrate compacted soil more effectively than wildtype. We demonstrate roots sense mechanical impedance employing the gaseous signal ethylene, as soil compaction lowers gas diffusion through a reduction in air-filled pores, causing ethylene to accumulate in root tissues and trigger hormone responses which restricts growth. We propose ethylene acts as an early warning signal for roots to avoid compacted soils, revealing approaches to breed crops resilient to soil compaction.

Curriculum Vitae – Dr. Dabing Zhang

School of Life Sciences and Biotechnolgy Shanghai Jiao Tong University, China

Email: zhangdb@sjtu.edu.cn

Education

Ph.D. Shanghai Institute of Plant Physiology and Ecology, Chinese Academy of Sciences, China (1994-1998)
M.S. Nanjing University, China (1991-1994)
B.S. Jiangsu Educational College (1989-1991)

Research and Teaching Positions

Chair Professor, School of Life Sciences and Biotechnology, Shanghai Jiao Tong University (SJTU), China (2015-current)
Distinguished Professor, School of Life Sciences and Biotechnology, SJTU, China (2008-2015)
Professor, School of Life Sciences and Biotechnology, SJTU, China (2001-2005)
Associate Professor, Agri-Tech Center of Shanghai Academy of Agricultural Sciences (1999-2001)
Assistant Professor, Agri-Tech Center of Shanghai Academy of Agricultural Sciences (1998-1999)

Selected Refereed Journal Articles (last 5 years)

1. Huang, G., Liang, W., Sturrock, C. J., Pandey, B. K., Giri, J., Mairhofer, S., and Zhang, D. (2018) Rice actin binding protein RMD controls crown root angle in response to external phosphate. ***Nature communications.***

2. Yu, J., Han, J., Kim, Y. J., Song, M., Yang, Z., He, Y., and Zhang, D. (2017) Two rice receptor-like kinases maintain male fertility under changing temperatures. ***Proceedings of the National Academy of Sciences.***

3. Cai, Q., Yuan, Z., Chen, M., Yin, C., Luo, Z., Zhao, X., and Zhang, D. (2014) Jasmonic acid regulates spikelet development in rice. ***Nature Communications.***

4. Li, G., Liang, W., Zhang, X., Ren, H., Hu, J., Bennett, M. J., and Zhang, D. (2014) Rice actin-binding protein RMD is a key link in the auxin–actin regulatory loop that controls cell growth. ***Proceedings of the National Academy of Sciences.***

5. Zhang, Dabing, and Zheng Yuan. (2014) Molecular control of grass inflorescence development. ***Annual Review of Plant Biology.***

ABSTRACT

SESSION 3: INVITED LECTURES

Challenges and strategies to achieve successful technological transitions in the era of data-driven agriculture

Tae In Ahn

Smart Farm Research Center, KIST Gangneung Institute of Natural Products, Gangneung 25451, Korea

Recently, agricultural production systems are undergoing a technological transition process. One of the most observable changes in this circumstance is rapidly increasing data flows. Ultimately, this change could lead to the automation of the conventional decision-making process by farmers. Exploiting useful information in the agricultural data chain is primarily based on collecting data that reflects interactions between plants and the environment. Technologies related to capturing, transferring, and storing data are already being deployed in agricultural production systems. The data chain between growers, cultivation systems, and plants is also being embodied in agricultural production systems. For example, water management sensor-based research and development relating to transpiration are being actively conducted. The data chain for plant water management is well-established with sensors to measure root zone moisture content, substrate weight, solar radiation, and humidity. The data chain for plant water management is being utilized to make efficient water management by farmers in the field. However, appropriate interpretation of the sensor data is crucial for systematic linkage between plants and the cultivation system under the automated data acquisition system. Plants are inherently dynamic. Farmers' water management practice at the commercial farm has advanced to comprehensive decision-making with time-series changes in plant physiological statuses such as vegetative and generative growth and root distribution. Thus, a technological system that considers plants' dynamic aspects could be an important source of the dominant technology to achieve a successful technological transition in agricultural systems. The technological significance of plant dynamics is becoming increasingly evident. Research on plant dynamics in agriculture is emerging, and new technological opportunities are being introduced. However, the translation of sensor data into knowledge about the plants is still challenging. This presentation introduces technological changes based on recent data flows in agriculture and discusses challenges and strategies to achieve successful technological transitions in the era of data-driven agriculture.

Acknowledgement: This research was supported by National R&D Program through the National Research Foundation of Korea(NRF) funded by Ministry of Science and ICT(2020M3A9I3037807).

Curriculum Vitae – Dr. Tae In Ahn

Address: Smart Farm Research Center, KIST Gangneung Institute of Natural Products, Gangneung 25451

Email: tiahn@kist.re.kr

Education

Ph.D. in the Department of Plant Science, Seoul National University, Korea. (2019)
B.S. in the Department of Applied Plant Science, Kangwon National University, Korea. (2008)

Research and Teaching Positions

Postdoctoral Researcher (Mar 2019 – current)

Selected Refereed Journal Articles (last 5 years)

1. Ahn, TI, Yang, JS, Park, SH, Moon, HW, Lee, JY. (2020) Translation of irrigation, drainage, and electrical conductivity data in a soilless culture system into plant growth information for the development of an online indicator related to plant nutritional aspects. ***Agronomy***.

2. Ahn, TI, Son, JE. (2019) Theoretical and experimental analysis of nutrient variations in electrical conductivity-based closed-loop soilless culture systems by nutrient replenishment method. ***Agronomy***.

3. Moon, T*, Ahn, TI*, Son, JE. (2019) Long short-term memory for a model-free estimation of macronutrient ion concentrations of root-zone in closed-loop soilless cultures. **Plant methods**. (*equally contributed)

4. Moon, T*, Ahn, TI*, Son, JE. (2018) Forecasting root-zone electrical conductivity of nutrient solutions in closed-loop soilless cultures via a recurrent neural network using environmental and cultivation Information. ***Frontiers in plant science***. (*equally contributed)

5. Cho, WJ, Kim, HJ, Jung, DH, Kim, DW, Ahn, TI, Son, JE. (2018) On-site ion monitoring system for precision hydroponic nutrient management. ***Computers and electronics in agriculture***.

6. Kim, JH, Lee, JW, Ahn, TI, Shin, JH, Park, KS, Son, JE. (2016) Sweet pepper (*Capsicum annuum* L.) canopy photosynthesis modeling using 3D plant architecture and light ray-tracing. ***Frontiers in plant science***.

Smart agricultural policy in Korea

Yeanjung Kim

Korea Rural Economic Institute, 601 Bitgaram-ro, Naju-si, Jeollanam-do

A smart farm can be classified into the smart farm in the narrow sense or the broad sense. The former integrates ICT technology to produce horticultural crops in greenhouses, raise livestock, grow fruit trees, and field crops. On the contrary, the latter includes not only the production but also the distribution and consumption.

In the ‘70s and ‘80s, agriculture in Korea was characterized as labor-intensive and then it moved on to a land-intensive type in the 1990s-2000s. The 2010s have been the era of capital-intensive agriculture and it is expected to be capital and technology-intensive in the future. To apply a smart farm system is to identify the agricultural problems and to apply technology to solve them. What horticultural farms need the most is to increase production per unit area and to reduce the production costs and heating costs. There are many policies to encourage the spreading of smart farms in Korea, which are exemplified by the case of Smart Farm Innovation Valley project. This project, initiated by the government in 2018, is a large-scale high-tech smart farm complex project in which the government selected FOUR regions-Gimje, Sangju, Goheung, and Miryang-to support them. The goal of Smart Farm Innovation Valley is to educate and train young people to start and lead innovative agricultural businesses. Core facilities of the Smart Innovation Valley include a nursery center, rental smart farm, demonstration complex, and APC. The FOUR smart farm spreading strategies are as follows. The first is to build the basis to utilize smart technologies. The second is to distribute the developed technologies in the field. Then, the third is to establish the infrastructure-laws, institutions, and personal information protection-to operate the smart farms efficiently. And finally, the last is to organize a governance system in which the government, academia, farmers, research institutes can cooperate for the expansion of smart farms.

Curriculum Vitae – Dr. Yeanjung Kim

Korea Rural Economic Institute, 601 Bitgaram-ro, Naju-si, Jeollanam-do

Email: yjkim@krei.re.kr

Education

Ph.D. in Agricultural Economics, Chonbuk National University (1995)
Master of Agricultural Economics, Chonbuk National University (1990)
Bachelor of Science in Agricultural Economics, Chonbuk National university (1987)

Research and Teaching Positions

Senior Research Fellow, Korea Rural Economic Institute(2015-present)
Director of Resource and Environment Research Department (2015-2017)
Head of Agricultural Industry Team (2012-2014)
Team Leader, Agricultural Outlook Information Center (2006-2007)

Selected Refereed Journal Articles (last 5 years)

1. YeanJung Kim. (2020) "Research on smart agricultural development plans". ***MAFRA.***

2. YeanJung Kim. (2019) "A Study on the Response Strategies of Agriculture ans Rural Areas in the FOURth Industrial Revolution", ***KREI***

3. YeanJung Kim. (2018) "Expert seminar on the future prospects of agriculture in the era of the 4th Industrial Revolution", ***KREI***

4. YeanJung Kim. (2017) "Development of Smart Agriculture Coping with the 4th Industrial Revolution", ***KREI***

Optimization of lighting system for efficient production in plant factory

Ahn, Sun-Hee

Korea Photonics Technology Institute

Plant factories are beneficial. It can produce crops regardless of season or location by artificially controlling the environmental conditions inside the facilities, such as the light, temperature, humidity, carbon dioxide concentration, and culture medium. To control a facility's inside environment with high precision, plant factories combine modern industry, biotechnology, nutrient cultivation and information technology. Light is an important physical environment factor and plays a key role in the regulating of plants' growth, development and their metabolism. To increase the production capacity, controlled growing systems using artificial lighting have been taken into consideration. High-pressure sodium lamp, metal halide lamp and fluorescent lamp were used as a light source for artificial light at the early stages of plat factories. Artificial light for growth of plant, it has a high light efficiency, however, high power, thermal stability, light quality and quantity of light were remain to solve the problem. In order to solve such disadvantages, light-emitting diode (LED) is widely used as artificial light in the plant factory. Recent development of LED technologies presents an enormous potential for improving plant growth and making systems more sustainable. LED technology can result in significant reduction in energy consumption. Its spectrum can be easily tailored whenever different photosynthetic action spectrums may be needed for growing different parts of different plants in various seasons. LEDs make it possible to optimize the growth conditions and to manipulate metabolism, yield and quality through modification of light quality and quantity, which are tightly linked with the two main characteristics of light wavelength and fluence.

Acknowledgement: Sun-hee Ahn was supported by the Basic Science Research Program (2019R1A2C1084080) of the National Research Foundation (NRF), funded by the Ministry of Science, ICT & Future Planning

Curriculum Vitae – Dr. Sun-Hee Ahn

Address: Medical & Bio Photonics Research Center
Chumdanbencheo-ro 108 beon-gil 9 (Wolchul-Dong), KOPTI
Bukgu, Gwangju 61007, Korea

Email: l.hickey@uq.edu.au

Education

Ph.D. in Department of Biotechnology and Bioengineering, Pukyong National University (2006)
M.S. in Department of Biotechnology and Bioengineering, Pukyong National University (2003)
B.S. in Department of Biotechnology and Bioengineering, Pukyong National University (2001)

Research and Teaching Positions

Senior Researcher, Medical & Bio Photonics Research Center, KOPTI, Korea (Dec 2018 – current)
Research Professor, School of Dentistry, Chonnam National University, Korea (Dec 2012 – Nov 2018)
Research Scientist, Department of Medicine, Duke University, NC (May 2008 – Aug 2012)
Postdoctoral Associate, School of Dental Medicine, Case Western Reserve University, OH (Sept 2006 – May 2008)

Selected Refereed Journal Articles (last 5 years)

1. Lee J*, Ahn SH*, Chen Z, Kang S, Choi DK, Moon C, Min SH, Park BJ, Lee TH. (2020) N-[2-(4-Acetyl-1-Piperazinyl)Phenyl]-2-(3-Methylphenoxy)Acetamide (NAPMA) Inhibits Osteoclast Differentiation and Protects against Ovariectomy-Induced Osteoporosis. ***Molecules***.

2. Ahn SH, Chen Z, Lee J, Lee SW, Min SH, Kim ND, Lee TH (2018) Inhibitory Effects of 2N1HIA (2-(3-(2-Fluoro-4-Methoxyphenyl)-6-Oxo-1(6H)-Pyridazinyl)-N-1H-Indol-5-Ylaceta-mide) on Osteoclast Differentiation via Suppressing Cathepsin K Expression. ***Molecules***.

3. Ahn SH, Lee JK, Kim ND, Kim SH, Lee S, Jung S, Chay KO, Lee TH (2018) DPIE [2-(1,2-diphenyl-1H-indol-3-yl)ethanamine] Augments Pro-Inflammatory Cytokine Production in IL-1β-Stimulated Primary Human Oral Cells. ***International Journal of Molecular Sciences***.

4. Ahn SH, Cheon S, Park C, Lee JH, Lee SW, Lee TH (2017) Transcriptome profiling analysis of senescent gingival fibroblasts in response to Fusobacterium nucleatum infection. **PLoS One**.

5. Ahn SH, Cho SH, Song JE, Kim S, Oh SS, Jung S, Cho KA, and Lee TH (2016) Caveolin 1 plays a role of negative effector in senescent human gingival fibroblasts to Fusobacterium nucleatum infection. ***Molecular Oral Microbiology***.

6. Ahn SH, Song JE, Kim S, Cho SH, Lim YK, Kook JK, Kook MS, Lee TH (2016) NOX1/2 activated by Fusobacterium nucleatum in human gingival fibroblasts facilitates attachment of Porphyromonas gingivalis. ***Archives of Microbiology***.

Smart livestock farming through modern technologies

A.B.M Rubayet Bostami [1,3], Muhammad Ammar Dilawar [1,2], Hong Seok Mun [1], Dhanushka Rathnayake [1], Sreynak Pov [1], Chul Ju Yang [1,2,*]

[1]Animal Nutrition and Feed Science Laboratory, Department of Animal Science and Technology, Sunchon National University, 255 Jungang-ro, Suncheon, Jeollanam-do 57922, Republic of Korea.
[2]Interdisciplinary Program in IT-Bio Convergence System, Sunchon National University, 255, Jungang-ro, Suncheon-si, Jeollanam-do 57922, Republic of Korea.
[3]Department of Animal Science and Nutrition, BSMRAU, Bangladesh.

[*] Corresponding author: yangcj@scnu.ac.kr

Agriculture has a special meaning and significance in the history of humans because humans cannot survive without food. Since the global population increasing trend is very high and will be around 9.6 billion by 2050. To provide sufficient amount of quality and safety food, agriculture is the most crucial industry, accordingly agricultural technologies are evolving rapidly. The technological revolution in agriculture and livestock subsector led by advances in modern approaches to maximize productivity and ensure safety and quality aspects of food. However, the growth for demand in livestock products comes with social, economic and environmental challenges. Therefore, several factors are associated and to be considered for the successful livestock production. From the last few decades, there has been an elevated concern on awareness regarding the animal welfare and food safety and quality issues. This has triggered many countries to adopt new protocols to convert all traditional farming into automated farming. Smart Farming is a development that emphasizes the use of information and communication technology in the cyber-physical farm management cycle. Smart farm is designed in such a way that the climate can be controlled based on animals' requirements through automation and technological innovations. Desired level of temperature, relative humidity, ventilation air flow and other conditions to maximize the productivity. All parameters are monitored and controlled with the help of software application or PIC (Programmable Intelligent Computers). Monitored sensor values are uploaded on the webpage then the person in-charge can know the internal environment through mobile, laptop or PC. Despite a growing population, now predicted to reach 9.6 billion by 2050, the agriculture industry must rise to meet demand, regardless of environmental challenges like unfavorable weather conditions and climate change. To meet the needs of that growing population, the agriculture industry will have to adopt new technologies like smart farming, precision livestock management and big data application to gain a much-needed edge. New agricultural applications in smart farming and precision farming through Big data, ICT or IoT will enable the industry to increase operational efficiency, lower costs, reduce waste, and improve the quality of their yield. Easy to access, smart monitoring and management of livestock farm can eventually ensure minimization of manpower, resource waste and operational cost whereas maximize the efficiency of resource management, overall production cost and net profit.

Acknowledgement: This work was supported by the BK21 plus program through the National Research Foundation (NRF) funded by the Ministry of Education of Korea (5199990214660).

Curriculum Vitae – Dr. A.B.M. Ruabyet Bostami

Department of Animal Science and Nutrition, In-charge, Livestock and Poultry Farm, Faculty of Veterinary Medicine and Animal Science, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, Bangladesh.
Email: l.hickey@uq.edu.au

Education

Ph.D. Suncheon National University
M.S. Animal Science, Bangladesh Agricultural University (2007)
B.S. Animal Husbandry, Bangladesh Agricultural University (2004)

Research Experiences

Associate Professor, Bangabandhu Sheikh Mujibur Rahman Agricultural University (2018 -)
Assistant Professor, Bangabandhu Sheikh Mujibur Rahman Agricultural University (5 years)
Lecturer, Bangabandhu Sheikh Mujibur Rahman Agricultural University (2 years)
Scientific Officer at Bangladesh Livestock Research Institute (BLRI) (3 Years 2 months)

Selected Refereed Journal Articles (last 5 years)

1. A.B.M. Rubayet Bostami, Chul-Ju Yang, Rokibul Islam Khan, M Delowar Hossain, AKM Zilani Rabbi. (2020) Effect of Pharmacologically Active Medicinal Byproduct Combination as Feed Additives on Performance, Fecal Microbiology, Hematological Parameters and Economic Efficacy in Broiler Chicken. ***Journal of Nutrition and Food Sciences***.

2. A.B.M. Rubayet Bostami, Mun, H. S., & Yang, C. J. (2018) Loin eye muscle physicochemical attributes, sensory evaluation and proximate composition in Korean Hanwoo cattle subjected to slaughtering along with stunning with or without pithing. ***Meat science***.

3. A.B.M. Rubayet Bostami, M.S.K. Sarker and Chul-Ju Yang. (2017) Performance and Meat Fatty Acid Profile In Mixed Sex Broilers Fed Diet Supplemented With Fermented Medicinal Plant Combinations. ***Journal of Animal and Plant Science***.

4. A.B.M. Rubayet Bostami, H.S. Mun and C.J. Yang. (2017) Breast and Thigh meat Chemical Composition and Fatty Acid Profile in Broilers Fed Diet with Dietary Fat Sources. ***Journal of Food Processing and Technology***.

5. A.B.M. Rubayet Bostami, H.S. Mun, G.I. Kim, S. Seilsuth and C.J. Yang. (2017) Evaluation of dietary fat sources on growth performance, excreta microbiology and noxious gas emissions in Ross broilers. ***African Journal of Agricultural Research***.

6. Y.J. Kim, A.B.M.R. Bostami, H. S. Mun, M. M. Islam, S.Y. Ko, Chul-Ju Yang. (2017) Performance, Immunity, Meat Composition and Fatty Acid Pattern in Broilers After Dietary Supplementation of Fermented *Ginkgo biloba* and *Citrus junos.* ***Journal of Nutrition and Food Science***.

7. S.T. Ahmed, A. B. M. Rubayet Bostami, Hong-Seok Mun, and Chul-Ju Yang. (2017) Efficacy of chlorine dioxide gas in reducing *Escherichia coli* and *Salmonella* from broiler house environments. ***Journal of Applied Poultry Research***.

New waves in agricultural technology, the beginning of the smart agricultural age and technology policy issues

Joo Ryang Lee

Division of Research on Innovation Policy for Growth, Science and Technology Policy Institute (STEPI)

Recently, agriculture has faced a variety of crises, including food crisis, climate change, declining agricultural population, and aging rural areas. In particular, Korean agriculture has been stagnant in almost all sectors except livestock since the late 2000s. Smart agriculture has emerged as a new opportunity factor in this agricultural crisis. In smart agriculture, convergence between various industries and convergence between technologies are combined. There are two main characteristics in the era of smart agriculture. The first is the start of competition inside and outside the agricultural industry. A competitive structure will be formed between external ICT ventures armed with the latest ICT technology and internal leading farmers armed with experience in agriculture. The second is the inflow of technology, manpower, and capital from outside the agricultural industry. In terms of technology, as agriculture is digitized, the core technology of agriculture is shifted, production elements are evolving, and the agricultural ecosystem is being reorganized. The influx of manpower is explained by the advancement of leading farmers within the agricultural industry and the start-up of agricultural venture start-ups outside the agricultural industry. Investment in the AgTech sector is increasing in line with the prospect that the smart agricultural market will be activated. The government is pushing for various policy projects such as technology development, industrial ecosystem development, and human resources development to revitalize smart agriculture. In order to respond to innovations and changes in the smart agricultural era in the future, policies with utilization in mind in the agricultural field will have to be pursued.

Curriculum Vitae – Dr. Lee Jooryang

Address: #522, Building B, Sejong National Research Complex 370, Sicheong-daero, Sejong-si, 30147, Korea

Email: jrlee@stepi.re.kr

Education

PhD in Information Systems, Yonsei University, Seoul, Korea (2006)
Doctoral Research Fellow, British Columbia University, Vancouver, Canada (2005 – 2006)
M.B.A. in Business Administration, Yonsei University, Seoul, Korea (2001)
B.S. in Food Science and Technology, Seoul National University, Seoul, Korea (1995)

Research Experience

Research Fellow / Chief Director, STEPI (Science and Technology Policy Institute), Sejong, Korea (2009 – current)
Research Fellow, Hyundai Research Institute, Seoul, Korea (2007 – 2009)
Strategy Consultant / Project Leader, LG CNS, Seoul, Korea (1998 – 2005)

Selected Refereed S&T Policy Reports and Journal Articles (last 3 years)

1. Lee J., et al (2020), Study on Integrated Support and Strategy Development for Agricultural R&D(Ⅱ), Rural Development Administration.

2. Lee J., et al (2019), Study on Integrated Support and Strategy Development for Agricultural R&D(Ⅰ), Rural Development Administration.

3. Lee J., et al (2018), The S&T Policy Study on Extension of Smart-Farming in Korea, Science and Technology Policy Institute.

4. Lee J., et al (2018), A Study on Analyzing of Agroindustry R&D investment MAP.

5. Lee, J., Koh, M., & Jeong, G. (2017). Analysis of the impact of agricultural R&D investment on food security. ***Applied Economics Letters***.

AUTHOR INDEX

	**Dr. Dorothy Shippen** Department of Biochemistry & Biophysics, Texas A&M University, USA **Research and Teaching Positions** Texas A&M University Regents Professor (2020) University Distinguished Professor, Texas A&M University (2019) **Education** Ph.D. in Biology, University of Alabama, Birmingham (1987)
	**Dr. Joshua Blakeslee** Department of Horticulture and Crop Science, The Ohio State University, USA **Research and Teaching Positions** Associate Professor, Dept. of Horticulture and Crop Science, Ohio Agricultural Research and Development Center (OARDC) (2017~) **Education** Ph.D. Purdue University, Horticulture (2005)
	**Dr. Katrina Cornish** Queensland Alliance for Agriculture and Food, Innovation, The Ohio State University, USA **Research and Teaching Positions** Endowed Chair and Ohio Research Scholar, Department of Horticulture and Crop Science, The Ohio State University (2010~) **Education** PhD in Plant Biology, Adaptive mechanisms of salt tolerance in grasses, The University of Birmingham
	**Dr. T. Casey Barickman** Mississippi State University, North Mississippi Research and Extension Center, USA **Research and Teaching Positions** Associate Research Professor, Department of Plant and Soil Sciences, Mississippi State University (2020~) **Education** Ph.D. in Horticulture, Plant Physiology, The University of Tennessee (2014)

	**Dr. Seonyeong Kwak** Department of Chemical & Biological Engineering, Seoul National University, Korea **Research and Teaching Positions** Assistant Professor, Department of Biosystems and Biomaterials Science and Engineering, Seoul National University (2019~) Postdoctoral Associate, Department of Chemical Engineering, Massachusetts Institute of Technology (2014~2018) **Education** Ph.D. in Department of Chemical & Biological Engineering, Seoul National University (2012)
	**Dr. Ha Young Kim** Graduate School of Information, Yonsei University, Korea **Research and Teaching Positions** Head Professor, Strategic Management of Big Data Analytics (SMBA), Graduate School of Information, Yonsei University (2020~) Assistant Professor, Graduate School of Information, Yonsei University (2019~) **Education** PhD in Mathematics, Purdue University (2010)
	**Dr. Lee Hickey** Queensland Alliance for Agriculture and Food, Innovation University of Queensland, Australia **Research and Teaching Positions** Associate Professor, Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland (2020~) Senior Research Fellow & ARC DECRA Fellow, Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland (2017~2019) **Education** Ph.D. in Quantitative and Molecular Plant Breeding, The University of Queensland (2012)

	**Dr. Carl Bernacchi** Departments of Crop Sciences and Plant Biology, University of Illinois, Urbana-Champaign, USA **Research and Teaching Positions** Professor, Department of Plant Biology, UIUC (2020~) Research Plant Physiologist, USDA-ARS Photosynthesis Research Unit, Champaign, IL (2009~) **Education** Ph.D. in Plant Biology, The University of Illinois (2002)
	**Ph.D. Woong Choi** Department of Information and Computer Engineering, National Institute of Technology, Gunma College, Japan **Research and Teaching Positions** Associate Professor, National Institute of Technology, Gunma College (2017~) **Education** Ph.D. in Computational Intelligence and Systems Science, Interdisciplinary Graduate School of Science and Engineering, Tokyo Institute of Technology (2005)
	**Dr. Jongho, Lee** Department of Clinical Engineering, Faculty of Health Sciences, Komatsu University, Japan **Research and Teaching Positions** Associate Professor, Department of Clinical Engineering, Faculty of Health Sciences, Komatsu University (2018~) Chief Researcher, Department of Sensory Motor Systems, Tokyo Metropolitan Institute of Medical Science (2013~2018) **Education** Ph.D. in the Precision and Intelligence Laboratory, Tokyo Institute of Technology (2005)
	**Dr. Dabing Zhang** School of Life Sciences and Biotechnolgy Shanghai Jiao Tong University, China **Research and Teaching Positions** Chair Professor, School of Life Sciences and Biotechnology, Shanghai Jiao Tong University (SJTU) (2015~) **Education** Ph.D. Shanghai Institute of Plant Physiology and Ecology, Chinese Academy of Sciences (1994~1998)

Dr. Tae In Ahn

Smart Farm Research Center, KIST, Gangneung Institute of Natural Products, Korea

Research and Teaching Positions

Postdoctoral Researcher (2019~)

Education

Ph.D. in the Department of Plant Science, Seoul National University (2019)

Department of Applied Plant Science, Kangwon National University (2008)

Dr. Yeanjung Kim

Korea Rural Economic Institute

Research and Teaching Positions

Senior Research Fellow, Korea Rural Economic Institute (2015~)

Director of Resource and Environment Research Department (2015~2017)

Head of Agricultural Industry Team (2012~2014)

Education

Ph.D. in Agricultural Economics, Chonbuk National University (1995)

Dr. Sun-Hee Ahn

Medical & Bio Photonics Research Center, KOPTI, Korea

Research and Teaching Positions

Senior Researcher, Medical & Bio Photonics Research Center, KOPTI (2018~)

Research Professor, School of Dentistry, Chonnam National University, Korea (2012~2018)

Education

Ph.D. in Department of Biotechnology and Bioengineering, Pukyong National University (2006)

	**Dr. A.B.M. Ruabyet Bostami** Department of Animal Science and Nutrition, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh **Research and Teaching Positions** Associate Professor and Head, Department of Animal Science and Nutrition, Bangabandhu Sheikh Mujibur Rahman Agricultural University (2018~) **Education** Doctor of Philosophy, Sunchon National University (2017) Master of Science in Animal Science, Bangladesh Agricultural University (2007)
	**Dr. Lee Jooryang** Science and Technology Policy Institute (STEPI), Korea **Research and Teaching Positions** Research Fellow / Chief Director, STEPI (Science and Technology Policy Institute) (2009~) Research Fellow, Hyundai Research Institute, Seoul, Korea (2007~2009) **Education** Ph.D. in Information Systems, Yonsei University (2006)

1. 2021년 BK21 FOUR IT-Bio 사업단 참여 교수진 연락처

	이름	소속	이메일
조직위원장	이옥란	전남대학교	mpizlee@jnu.ac.kr
사업단장	김장호	전남대학교	rain2000@jnu.ac.kr
좌장	구강모	전남대학교	ku9@jnu.ac.kr
좌장	손형일	전남대학교	hison@jnu.ac.kr
좌장	한태호	전남대학교	hanth@jnu.ac.kr
공동조직위원장, 좌장	선우훈	순천대학교	uhun906@gmail.com
좌장	고낙용	조선대학교	nyko@chosun.ac.kr
좌장	하보근	전남대학교	bkha@jnu.ac.kr
좌장	조재일	전남대학교	chojaeil@jnu.ac.kr
좌장	이경환	전남대학교	khlee@jnu.ac.kr
좌장	최영수	전남대학교	y-choi@jnu.ac.kr
공동조직위원장	황석승	조선대학교	hwangss@chosun.ac.kr
	이상현	전남대학교	pear@jnu.ac.kr
	이재원	전남대학교	ljw43376@chonnam.ac.kr
	강혜정	전남대학교	hjkang@jnu.ac.kr
	이진이	조선대학교	jinyilee@chosun.ac.kr
	반성범	조선대학교	sbpan@chosun.ac.kr
	곽근창	조선대학교	kwak@chosun.ac.kr
	조주식	순천대학교	uhun906@scnu.ac.kr

	양철주	순천대학교	yangcj@scnu.ac.kr
	심춘보	순천대학교	cbsim@scnu.ac.kr
	노일섭	순천대학교	nis@scnu.ac.kr
	정상철	순천대학교	jsc@scnu.ac.kr
	조용윤	순천대학교	yycho@sunchon.ac.kr
조교	김한아	전남대학교	kimhan930@gmail.com
조교	진희서	조선대학교	jin14eun@naver.com
조교	윤재원	순천대학교	rksdnl14@naver.com

2. 2021년 BK21 FOUR 국제학술대회 연사 연락처

	Name	Affiliation	E-mail
1	Dr. Dorothy Shippen	Texas A&M University, USA	dshippen@tamu.edu
2	Dr. Joshua J. Blakeslee	Ohio State University, USA	blakeslee.19@osu.edu
3	Dr Katrina Cornish, Ph.D	University of Queensland, Australia	cornish.19@osu.edu
4	Dr. T. Casey Barickman	Mississippi State University, USA	t.c.barickman@msstate.edu
5	Dr. Seonyeong Kwak	Seoul National University, Korea	seon.y.kwak@snu.ac.kr
6	Dr. Ha Young Kim	Yonsei University, Korea	hayoung.kim@yonsei.ac.kr
7	Dr. Lee Hickey	The University of Queensland, Australia	l.hickey@uq.edu.au
8	Dr. Carl Bernacchi	University of Illinois, Urbana-Champaign, USA	bernacch@illinois.edu
9	Ph.D. Woong Choi	Gunma College, Japan	wchoi@ice.gunma-ct.ac.jp
10	Dr. Jongho Lee	Komatsu University, Japan	zhangdb@sjtu.edu.cn
11	Dr. Dabing Zhang	Shanghai Jia Tong University, China	tiahn@kist.re.kr
12	Dr. Tae In Ahn	KIST, Korea	tiahn@kist.re.kr
13	Dr. Yeanjung Kim	Korea Rural Economic Institute, Korea	hwangss@chosun.ac.kr
14	Dr Ahn, Sun-Hee	Medical & Bio Photonics Research Center, KOPTI, Korea	sun3193@kopti.re.kr
15	Dr. A.B.M. Rubayet Bostami	Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh	rubayet@bsmrau.edu.bd, rubayetbau@yahoo.co.in
16	Dr. Jooryang Lee	Science and Technology Policy Institute, Korea	jrlee@stepi.re.kr

Guide for Zoom Meeting Attendance

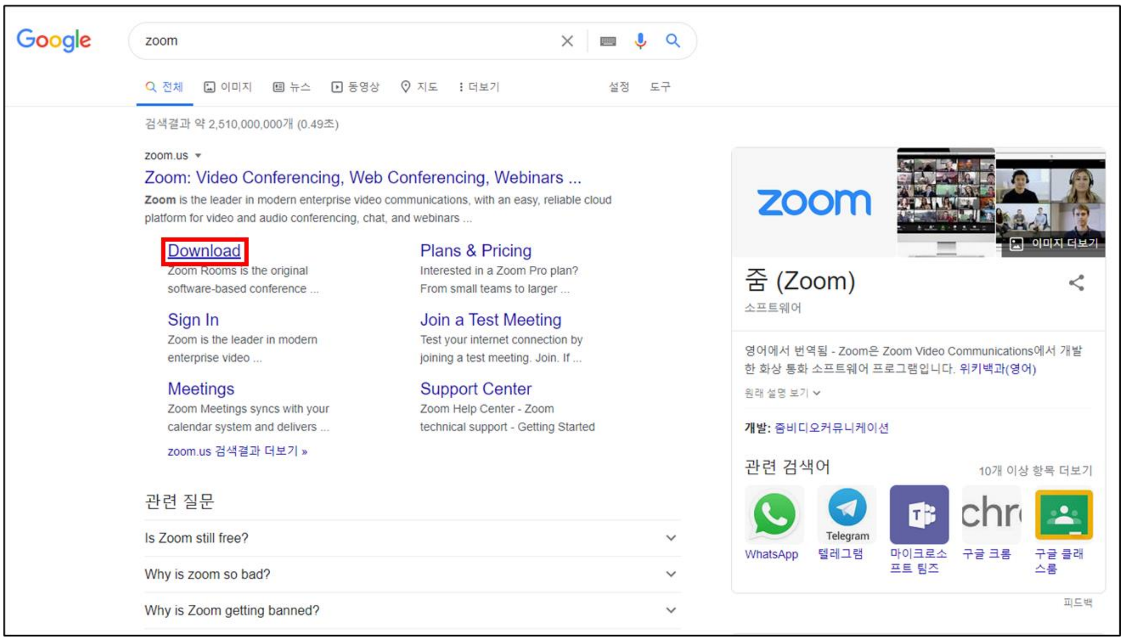
Zoom 설치 및 회의 참가 가이드

‘Smart Farming in the New Normal Era’
February. 25, 2021 (8:00a.m. ~ 6:00p.m)
[Zoom meeting]
Meeting link: https://jnu-ac-kr.zoom.us/j/89041530827?pwd=cW02MFVEQlQ2aUgxeFEvUXl1bG0xQT09
Meeting ID: 890 4153 0827
password: 286231

- 이미 zoom 프로그램이 설치되어 있다면, zoom meeting link (URL)를 클릭해주시면 바로 zoom meeting에 참여할 수 있습니다.
  If you already have the zoom program installed, you can join the zoom meeting right away by clicking the zoom meeting link (URL).
- Zoom 프로그램이 설치가 안되어있다면, 설치 및 회의 접속 가이드를 따라 진행 해주시면 됩니다.
  If the Zoom program is not installed, please follow the installation and meeting attendance guide.

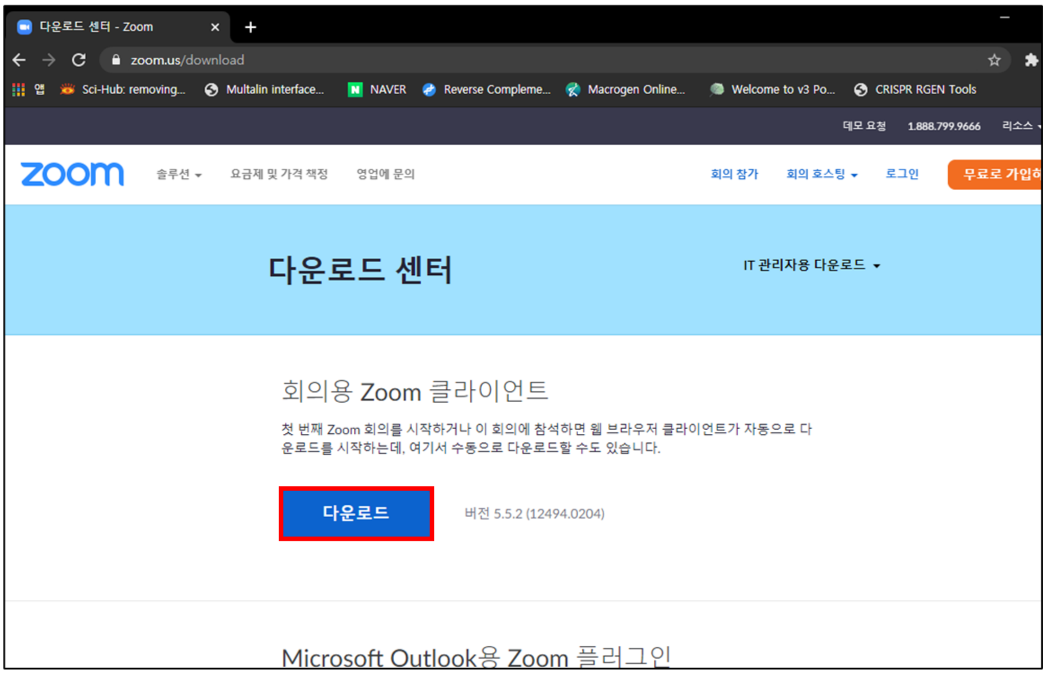
- **Zoom 설치 및 회의 참가 가이드**
  Guide of Zoom program setup

  1. Google 검색창에서 "zoom" 검색 후 > "Download" 클릭
     Search “zoom” in Google > Click the Download button



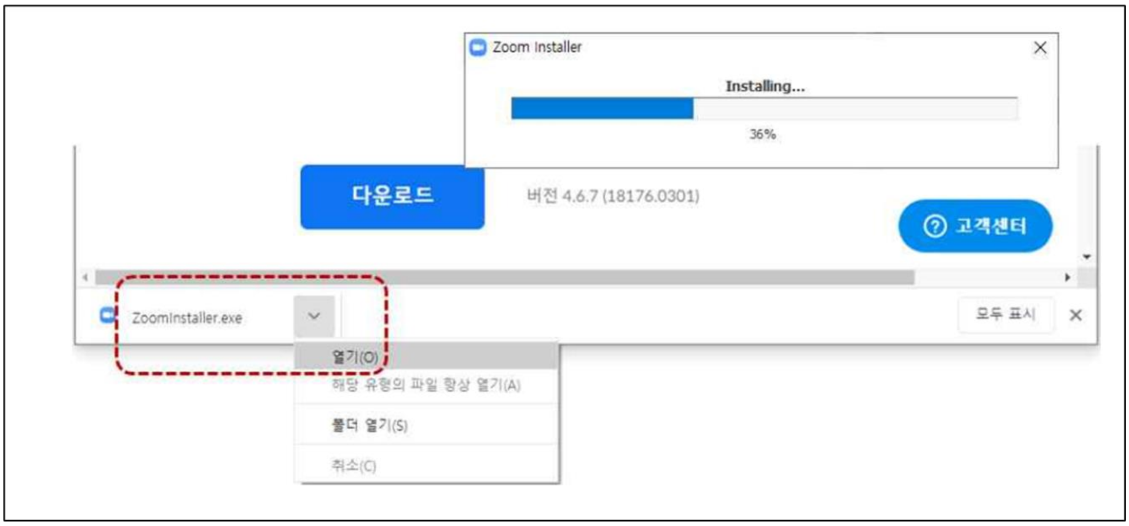
- **Zoom 설치 및 회의 참가 가이드**
  Guide of Zoom program setup

  2. "다운로드" 클릭
     Click the download button



- **Zoom 설치 및 회의 참가 가이드**
  Guide of Zoom program setup

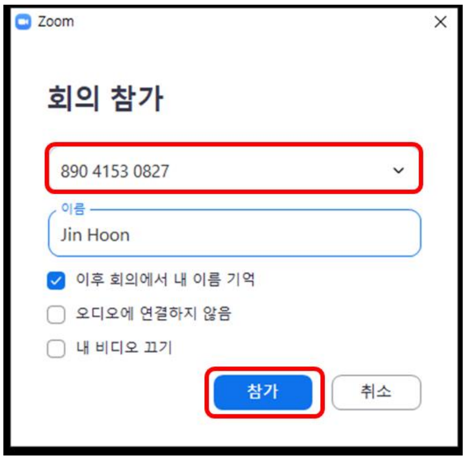
  3. Zoom 설치파일 실행 후 설치
     Open the zoom installation file > Install the zoom program

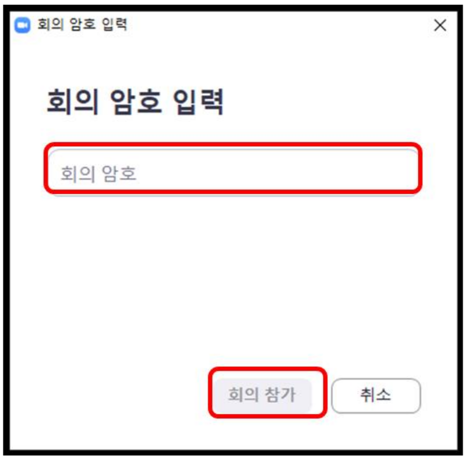


4. Zoom 프로그램 실행 후 '회의참가' 버튼 클릭
After running zoom program, click the 'participation in meeting' button

- **Zoom 설치 및 회의 참가 가이드**
  Guide of Zoom program setup

5. Meeting ID를 입력하고 '참가' 버튼을 클릭 > 회의 암호 입력 후 '회의 참가' 클릭
Enter the Meeting ID and click the'Join' button
 > Enter the meeting password and click'Join the Meeting'





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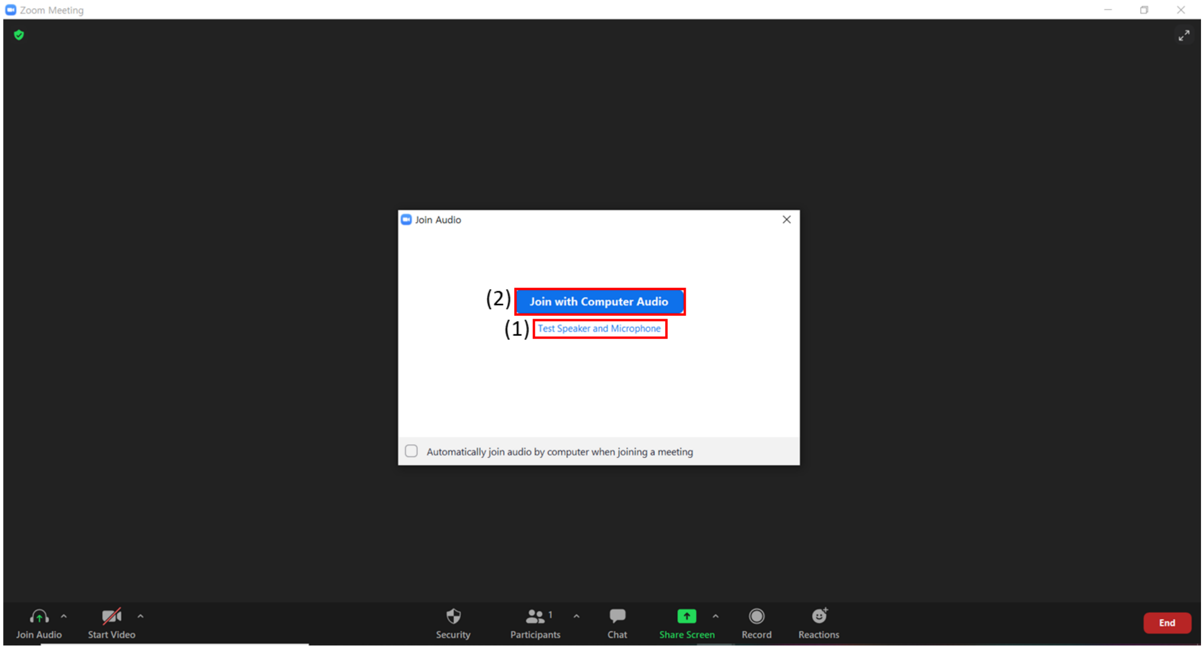
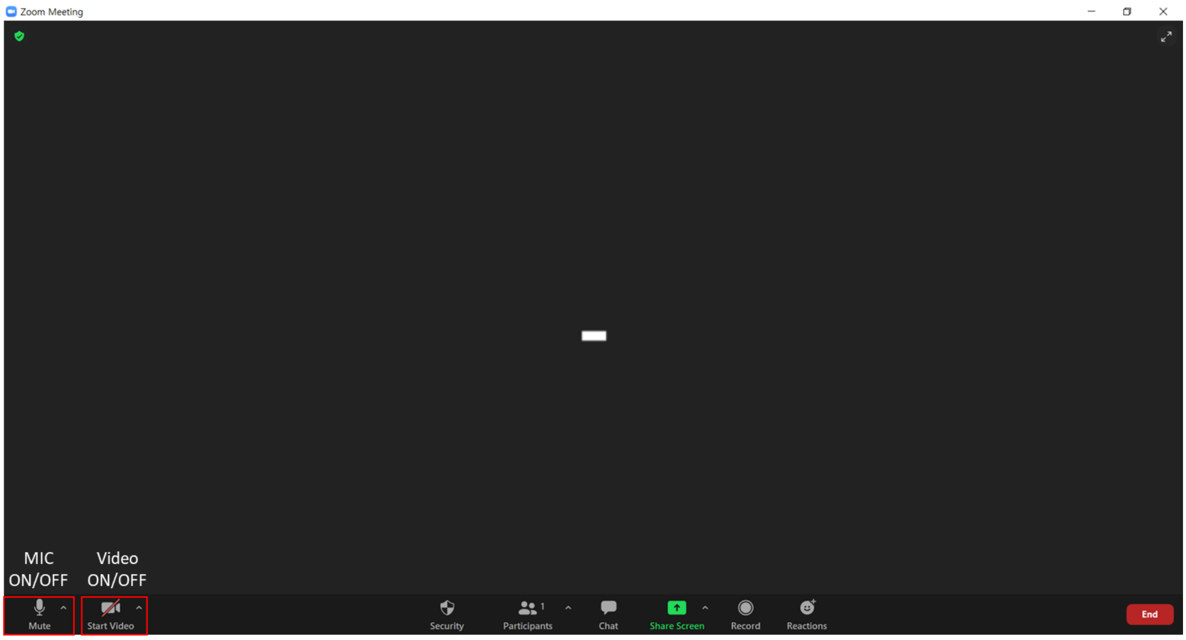
- ## Zoom 설치 및 회의 참가 가이드
Guide of Zoom program setup

6. (1) 스피커, 마이크 테스트 버튼을 눌러서 작동 유무를 확인한다
Before join the meeting, Please check the speaker and microphone (click the **'Test Speaker and Microphone'** button
(2) 컴퓨터 오디오로 참가 버튼을 누르면 회의 화면을 볼 수 있다.
Click the 'Join with computer audio' button > You can see the meeting



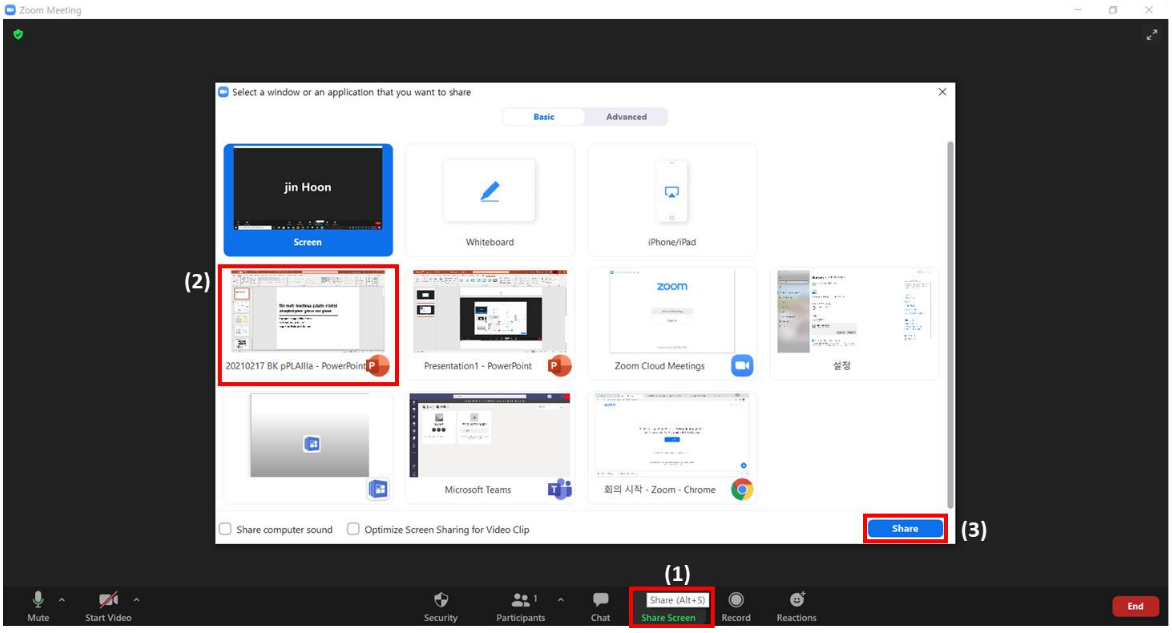
- ## Zoom 설치 및 회의 참가 가이드
Guide of Zoom program setup

7. (1) 미팅에 참여한 뒤, 음소거 버튼으로 마이크를 ON/OFF 할 수 있다. **(필요시에만 마이크를 켜 주시길 바랍니다.)**
After joining the meeting, you can turn the microphone ON/OFF with the mute button. **(Please turn on the microphone only when necessary.)**
(2) 비디오 시작 버튼을 클릭하면 웹캠 (얼굴 화면)을 보여줄 수 있습니다. **(가급적 비디오를 켜 주시길 바랍니다.)**
Click the **'start video button'**, you can show your webcam (face screen) **(We recommend turning on the video.)**



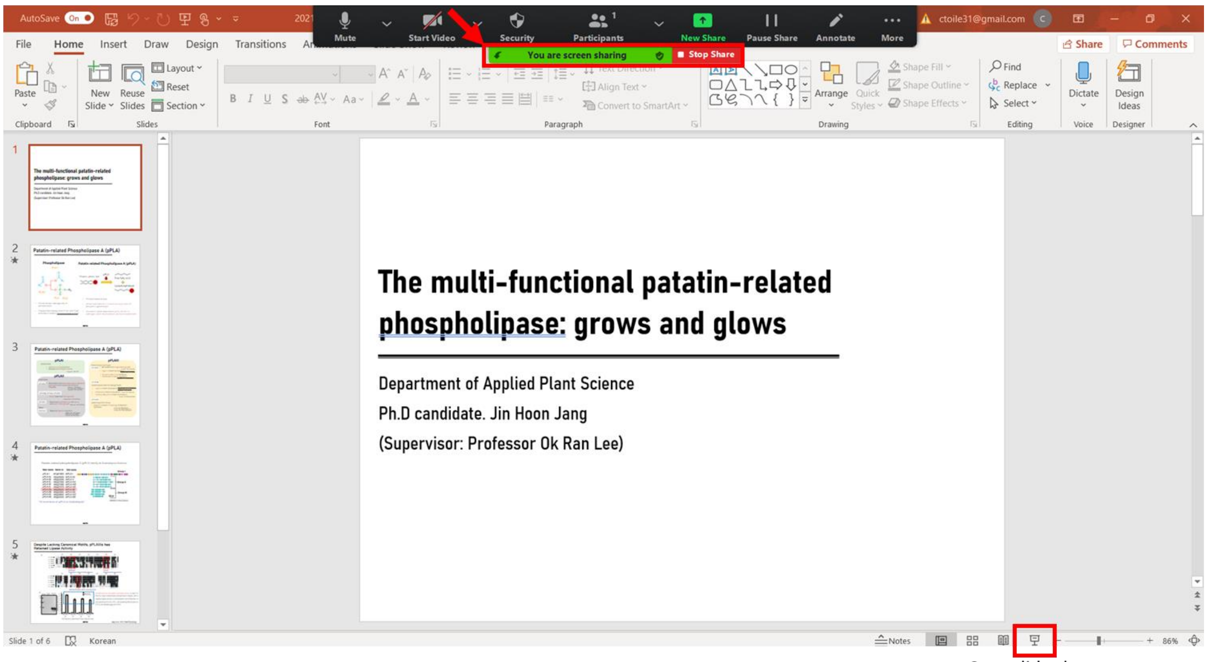
- ## Zoom 설치 및 회의 참가 가이드
  Guide of Zoom program setup
  발표자 화면공유 (Speaker's screen sharing)

8. (1) 화면 공유 버튼을 클릭 > (2) 공유할 창 (ex, ppt 파일)을 클릭 > (3) '공유' 버튼을 클릭
   (1) Click the **'Share Screen'** button > (2) Click the screen you want to share. > (3) Click the **'Share'** button



- ## Zoom 설치 및 회의 참가 가이드
  Guide of Zoom program setup
  발표자 화면공유 (Speaker's screen sharing)

9. 화면공유가 되었다면, **화면공유중 이라는 안내문구**를 확인할 수 있다. > 슬라이드 쇼 버튼을 누르고 발표 시작
   If the screen is shared, you can check the message that **'You are screen sharing'** > Start to presentation



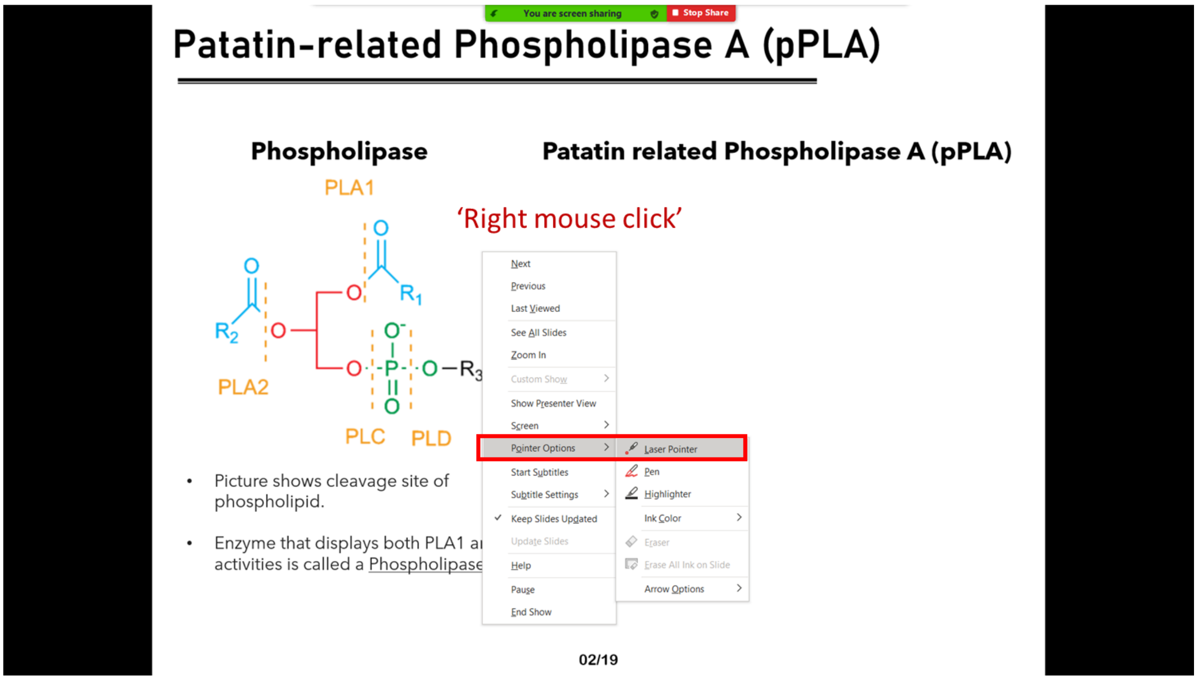
Start slide show

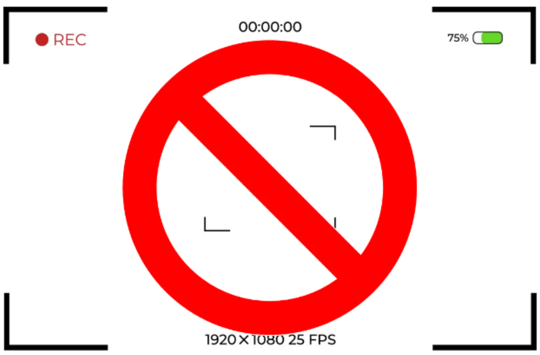
- **Zoom 설치 및 회의 참가 가이드**

Guide of Zoom program setup

발표자 화면공유 (Speaker's screen sharing)

10. 파워포인트 발표 (슬라이드쇼) 중 마우스 우클릭 > 포인터 기능 사용가능
 Right mouse click on ppt slide > You can use the pointer



 'https://kor.pngtree.com/so/음소거'	 'https://kor.pngtree.com/so/카메라'
발표자를 제외한 모든 참가자들 음소거 해주세요. **Please press the mute button.**	**실시간 온라인 강의(ZOOM) 시, 별도의 기기를 이용하여 녹화하는 행위 금지 (저작권 및 초상권 침해 가능성)** **Do not recording**

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SMART FARMING IN THE NEW NORMAL ERA

25 FEBRUARY 2021 | VIRTUAL CONFERENCE

BK21 FOUR IT-Bio융합시스템농업교육연구단 제 1회 국제학술대회

"SMART FARMING IN THE NEW NORMAL ERA"