Thu. Sep 9, 2021

Room 1 (Poster)

Poster Session | Field Crop Production | P1: Poster Session

[P1] Field Crop Production

12:15 PM - 2:00 PM Room 1 (Poster) (Field Crop Production)

[P1-01] Seed Size Evaluation of Rice Genotypes for Direct Seeding Development Cultivar

○Ahmad Rifqi Fauzi[1], Ahmad Junaedi[2], Iskandar Lubis[2], Munif Ghulamahdi[3], Hajrial Aswidinnoor[4]
（1.Graduate School of Agronomy and Horticulture Study Program, Bogor Agricultural University, Indonesia, 2.Division of Plant Production, Agronomy and Horticulture Department, Faculty of Agriculture, Bogor Agricultural University, Indonesia, 3.Division of Plant Ecophysiology, Agronomy and Horticulture Department, Faculty of Agriculture, Bogor Agricultural University, Indonesia, 4.Division of Plant Genetic and Plant Breeding, Agronomy and Horticulture Department, Faculty of Agriculture, Bogor Agricultural University, Indonesia）

12:15 PM - 1:00 PM

[P1-02] Effects of Seed Drying and Storage Conditions on the Germination Characteristics and Emergence Rates in Early-Winter Direct Seeding of Paddy Rice

○Kensaku Suzuki, Seiji Oikawa, Naoko Aikawa, Hiroyuki Shimono （Department of Plant Biosciences, Faculty of Agriculture, Iwate University, Japan）

1:15 PM - 2:00 PM

[P1-03] Root-Elongated Seeds Can Extend the First Leaf Quickly in Direct-Seeded Rice

○Hiromi Imasu, Hiroyuki Shiratsuchi, Keiko Ito, Masami Furuhata （Tohoku Agricultural Research Center, National Agriculture and Food Research Organization, Japan）

12:15 PM - 1:00 PM

[P1-04] Effect of Seed Maturity on Seedling Establishment in Early-Winter Direct-Sowing Cultivation In Rice

○Seiji Oikawa, Kensaku Suzuki, Naoko Aikawa, Maya Matsunami, Hiroyuki Shimono （Department of Plant Biosciences, Faculty of Agriculture, Iwate University, Japan）

1:15 PM - 2:00 PM

[P1-05] Effect of Deep Seed Placement on the Crop Establishment and Yield of Dry Direct-Seeded Rice

○Noriko Kanno[1], Kyoko Ito[2], Taiken Nakashima[2], Ricardo Garcia[3], Roel R. Suralta[4], Aurora M. Corales[4], Crisanta S. Bueno[5], Niño P. M. C. Banayo[5], Pompe C. Sta. Cruz[5], Virender Kumar[6], Yoichiro Kato[1]
（1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Graduate School of Agriculture, Hokkaido University, Japan, 3.Pangasinan State University Sta Maria, Philippines, 4.Philippine Rice Research Institute, Philippines, 5.University of the Philippines Los Baños, Philippines, 6.International Rice Research Institute, Philippines）

12:15 PM - 1:00 PM

[P1-06] Identification of Quantitative Trait Loci Controlling Nitrogen Use Efficiency-Related Traits in Rice at the Seedling Stage under Salt Condition by Genome-Wide Association Study

○NhungThi Hong Phan[1,2], Cuong Van Pham[2], Pierre Bertin[1] （1.Earth and Life Institue, Université Catholique de Louvain, Belgium, 2.Agronomy Faculty, Vietnam National University of Agriculture, Vietnam）

1:15 PM - 2:00 PM

[P1-07] Analysis of the N Uptake Pattern to Improve Increasing Yields of Dry Direct-Seeding Rice in a Cool Climate

○Mari Namikawa[1,2], Toshihiro Hasegawa[1], Takayuki Yabiku[1], Toshinori Matsunami[1] （1.Tohoku Agricultural Research Center, National Agriculture and Food Research Organization, Japan, 2.Crop Science Laboratory, United Graduate School of Agricultural Sciences, Iwate University, Japan）

12:15 PM - 1:00 PM

[P1-08] Changes in Rice Farming from 2009 to 2019 in Three Rice Ecosystems with Contrasting Water Availability in Cambodia
-Labor Saving and Mechanization-

○Rinako Takashima[1,2], Akihiko Kamoshita[2], Sareth Chea[3], Sophornthida Lim[3] （1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Asian Natural Environmental Science Center, The University of Tokyo, Japan, 3.Socioeconomic office, Cambodian Agricultural Research and Development Institute (CARDI), Cambodia）

1:15 PM - 2:00 PM

[P1-09] Effect of Climate on the Yield of 'Ilpum' Rice Cultivar in Gyeongbuk Province, South Korea over the Past 25 Years

○Jong-Hee Shin[1], Chae-Min Han[1], Jung-Bae Kwon[1], Sang-Kuk Kim[2], Yong-Seub Shin[1] (1.Crop Research, Gyeongsangbuk-do Provincial Agricultural Research and Extension Services, Korea, 2., Bioresources Research Institute, Korea)

12:15 PM - 1:00 PM

[P1-10] Differences in Growth and Physiological Characteristics of Winter Wheat Growth under Various Nitrogen Topdressing Conditions

Jae-Gyeong Jeong[1], Jaeeun Choi[1], Young-Hun Lee[1], Gi-Eun Song[1,2], Jonghan Ko[3], Kyung-Do Lee[4], ○Sang-In Shim[1] (1.Department of Agronomy, Gyeongsang National University, Korea, 2.Division of Applied Life Science (BK21 Plus), Gyeongsang National University, Korea, 3.Department of Applied Plant Science, Chonnam National University, Korea, 4.Climate Change and Agro-Ecology Division, RDA, Korea)

1:15 PM - 2:00 PM

[P1-11] Importance of Water Resource Conservation in Agriculture of the Aso Region - Lessons from the Kumamoto Earthquake

○Jun Abe[1], Naoki Kato[2], Atsushi Kashimura[1], Hitoshi Kinouchi[1], Chinobu Okamoto[1] (1.School of Agriculture, Tokai University, Japan, 2.Kyushu Okinawa Agricultural Research Center, National Agriculture and Food Research Organization, Japan)

12:15 PM - 1:00 PM

[P1-12] Cultivar Difference of Iron Toxicity Tolerance in Rice (*Oryza sativa* L.) during Germination and Seedling Stages

○Haruka Aratani[1], Indrastuti A. Rumanti[2], Yoichiro Kato[1] (1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2., Indonesian Center for Rice Research, Indonesia)

1:15 PM - 2:00 PM

[P1-13] Variation in Grain Characteristics of Upland Rice Cultivated in Southeast Sulawesi, Indonesia

○Mayumi Kikuta[1], Yulius Barra Pasolon[2], Fransiscus Suramas Rembon[2], Akira Miyazaki[3], Yoshinori Yamamoto[3] (1.Graduate School of Integrated Sciences of Life, Hiroshima University, Japan, 2.Faculty of Agriculture, Halu Oleo University, Indonesia, 3.Faculty of Agriculture and Marine Science, Kochi University, Japan)

12:15 PM - 1:00 PM

[P1-14] Combined UAV and Phenotyping Data to Optimize the Growing Status and Management System on Rice Variety, TN11 and NCYU-TN2 in Taiwan

○Yu-Chien Tseng[1], Chun-Yi Wu[1], Wen Lii Huang[1], Wei-Jun Huang[2], Rong-Kuen Chen[3] (1.Agronomy Department, National Chiayi University, Taiwan, 2.Biomechatronic Engineering Department, National Chiayi University, Taiwan, 3.Chiayi Branch Station, Tainan District Agricultural Research and Extension Station, Taiwan)

1:15 PM - 2:00 PM

[P1-15] On-Farm Assessment on Growth and Yield Response of Maize to Different Planting Methods and Tillage Conditions in Rice-Based Cropping System in the Philippines

Kyoko Ito[1], Noriko Kanno[2], Ricardo Garcia[3], Roel R. Suralta[4], Aurora M. Corales[4], John O. Abon[4], Elmer G. Bautista[4], Crisanta S. Bueno[5], Niño P. M. C. Banayo[5], Pompe C. Sta. Cruz[5], Yoichiro Kato[2], ○Taiken Nakashima[1] (1.Graduate School of Agriculture, Hokkaido University, Japan, 2.The University of Tokyo, Japan, 3.Pangasinan State University Sta Maria, Philippines, 4.Philippine Rice Research Institute, Philippines, 5.University of the Philippines Los Baños, Philippines)

12:15 PM - 1:00 PM

[P1-16] Assessment of Dual-Purpose Sweet Potato Cultivation in Japan: Effects of Shoot Harvest Regimes and Cultivar Differences

○Kazuki Taguchi (Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan)

1:15 PM - 2:00 PM

[P1-17] Improved Fertilizer Use Efficiency of Rice by Deep-Place Fertilization Method

○Mumtahina Nabila[1], Keigo Yoshinaga[2], Shin Okamura[3], Tomoya Kumachi[2], Hiroyuki Shimono[2,4], Maya Matsunami[2] (1.United Graduate School of Agricultural Sciences, Iwate University, Japan, 2.Faculty of Agriculture, Iwate University, Japan, 3.Graduate School of Integrated Arts and Sciences, Iwate University, Japan, 4.Agri-Innovation Center,

Iwate University, Japan）
12:15 PM - 1:00 PM

[P1-18] Ex-Ante Analysis of Rice Agroecosystems Areas, Yield and Production in Asia
○Jayson Osopelia Villamor （Department of Crop Science, Central Luzon State University, Philippines）
1:15 PM - 2:00 PM

[P1-19] NB-LRR-Encoding Genes Conferring Susceptibility to Organophosphate Pesticides and Leaf Greenness in Sorghum
○Zihuan Jing[1], Fiona Wacera W[1], Tsuneaki Takami[1], Hideki Takanashi[2], Fumi Fukada[1], Yoji Kawano[1], Hiromi Kajiya-Kanegae[3], Hiroyoshi Iwata[2], Nobuhiro Tsutsumi[2], Wataru Sakamoto[1] （1.Institute of Plant Science and Resources, Okayama University, Japan, 2.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 3.Research Center for Agricultural Information Technology, National Agriculture and Food Research Organization, Japan）
12:15 PM - 1:00 PM

[P1-20] Effect of *Phytophthora sojae* Inoculation on Soybean — Mortality as Affected by Environmental Factors and Growth of Survived Plant
○Terufumi Tada, Momo Kato, Chihiro Tanaka, Tatsuhiko Shiraiwa （Graduate School of Agriculture, Kyoto University, Japan）
1:15 PM - 2:00 PM

[P1-21] Effect of Narrow-Row Planting with Inter-Row Strip Tillage by Chisel Plough on Yield and Labor Saving to Soybean Cultivation at Field Converted from Paddy in Shonai-Plane of Japan
○Hiroyuki Takeda[1], Hidefumi Saito[1], Naoto Ikeyama[2], Hiroshi Saito[3] （1.Tohoku Agricultural Research Center, National Agriculture and Food Research Organization, Japan, 2.Faculty of Agriculture, Yamagata University, Japan, 3.Rice Breeding and Crop Science Experiment Station, Yamagata Integrated Agricultural Research Center, Japan）
12:15 PM - 1:00 PM

[P1-22] The Evaluation of Disease Resistance, Agronomic Traits and Yield Among Four Market Types in Peanut (*Arachis hypogaea* L.) Germplasm Collection
○Hsin-I Kuo[1], Hung-Yu Dai[2], Yong-Pei Wu[3], Yu-Chien Tseng[1] （1.Agronomy Department, National Chaiyi University, Taiwan, 2.Agronomy Department, Chiayi Agricultural Experiment Station, Taiwan Agricultural Research Institute, Taiwan, 3.Crop Division, Taiwan Agricultural Research Institute, Taiwan）
1:15 PM - 2:00 PM

[P1-23] Investigation of the Albinism Derived from Sub-Species Hybridization in Peanuts
○Chuan-You Li[1], Hung-Yu Dai[2], Yu-Chien Tseng[1] （1.Agronomy Department, National Chiayi University, Taiwan, 2.Crop Division, Taiwan Agricultural Research Institute, Taiwan）
12:15 PM - 1:00 PM

[P1-24] Co-Inoculation of *Bacillus pumilus* TUAT1 and *Bradyrhizobium diazoefficiens* USDA110 on Soybean
○Rifa Fadhilah Munifah Hasibuan, Hinako Sugiura, Minori Miyatake, Naoko Ohkama-Ohtsu, Keisuke Katsura （Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan）
1:15 PM - 2:00 PM

[P1-25] Fodder and Grain Production by Double-Cropping System of Rye
○Masahiro Akimoto[1], Honami Okamoto[2], Taiki Yoshihira[3] （1.Agro-Environmental Science, Obihiro University of Agriculture and Veterinary Medicine, Japan, 2.Plant Science Unit, Obihiro University of Agriculture and Veterinary Medicine, Japan, 3.Collage of Agriculture, Food and Environmental Sciences, Rakuno Gakuen University, Japan）
12:15 PM - 1:00 PM

[P1-26] Anaerobic and High Light Stress-Induced Leaf Abscission in Chili Pepper (*Capsicum* spp.)
○Keita Goto[1], Shotaro Tamaru[1], Peter Balyejusa Ssenyonga[2], Emmanuel Kiprono Bore[2], Shin Yabuta[3], Jun-Ichi Sakagami[3] （1.The United Graduate School of Agricultural Sciences, Kagoshima University, Japan, 2.Graduate School of Agriculture, Forestry and Fisheries, Kagoshima University, Japan, 3.Faculty of Agriculture, Kagoshima University, Japan）
1:15 PM - 2:00 PM

[P1-27] Leaf Senescence Evaluation of Selected Interspecific Progenies between *O. sativa* and *O. glaberrima*; NERICA Varieties for Stay-Green Characteristics during Grain-Filling Period

○Peter Balyejusa Ssenyonga[1], Shin Yabuta[2], Shotaro Tamaru[3], Jun-Ichi Sakagami[1,2,3] (1.Graduate School of Agriculture, Forestry and Fisheries, Kagoshima University, Japan, 2.Faculty of Agriculture, Kagoshima University, Japan, 3.The United graduate School of Agricultural Sciences, Kagoshima University, Japan)
12:15 PM - 1:00 PM

Room 2 (Poster)

Poster Session | Farming System | P2: Poster Session

[P2] Farming System

12:15 PM - 2:00 PM Room 2 (Poster) (Farming System)

[P2-01] Soil Fertility Decline by Repeated Cropping of Rice for Whole Crop Silage – A Case of Mifune Town in Kumamoto Prefecture, Japan

○Naoki Moritsuka[1], Kaori Matsuoka[2], Kosuke Baba[1] (1.Faculty of Agriculture and Marine Science, Kochi University, Japan, 2.Institute of Agro-Environmental Sciences, National Agriculture and Food Research Organization, Japan)
12:15 PM - 1:00 PM

[P2-02] A Case Study of Learning to Work on a Farm in a Special Need Education School for Children with Intellectual Disabilities – Focusing on the Cultivation of Rice Plant

○Izumi Oh-E (Retired, Tohoku Agricultural Research Center, National Agriculture and Food Research Organization, Japan)
1:15 PM - 2:00 PM

[P2-03] Growth and Yield of Rice, and Soil Enzyme Activites in Super Low External-Input Paddy Rice Field

○Taichi Tsujimoto[1], Kazuhiro Hosoya[1], Hideto Ueno[1], Yo Toma[1], Yoichi Yamashita[2], Masataka Adachi[2], Takayuki Kono[2] (1.Graduate School of Agriculture, Ehime University, Japan, 2.Faculty of Agriculture, Ehime University, Japan)
12:15 PM - 1:00 PM

[P2-04] Nitrogen and Water Demands for Maximum Growth of *Solanum tuberosum* under Doubled CO_2: Interaction with Phosphorus Based on the Demands

○Yan Yi, Daisuke Sugiura, Katsuya Yano (Graduate School of Bioagricultural Sciences, Nagoya University, Japan)
1:15 PM - 2:00 PM

[P2-05] An Evaluation on *Glycine tabacina* for Being a Cover Crop

○Kuan-Huang Lin, Yuan-Ching Tsai (Department of Agronomy, National Chiayi University, Taiwan)
12:15 PM - 1:00 PM

[P2-06] Different Tillage Systems rather than Winter Cropping Affect the Corn Growth and Yield, and the Community Composition of Arbuscular Mycorrhizal Fungi

○Yuya Tatewaki[1], Ryo Matsuno[2], Koya Nakamura[1], Kengo Wada[1], Masao Higo[2], Katsunori Isobe[2] (1.Graduate School of Bioresource Sciences, Nihon University, Japan, 2.College of Bioresource Sciences, Nihon University, Japan)
1:15 PM - 2:00 PM

[P2-07] Decomposition of Hairy Vetch Mulch under Snow and Its Effect on Nitrogen Dynamics in Soil

○Toshiyuki Hirata[1], Taishi Uchibayashi[2], Atsushi Matsumura[3] (1.Field Science Center for Northern Biosphere, Hokkaido University, Japan, 2.Graduate School of Environmental Science, Hokkaido University, Japan, 3.Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Japan)
12:15 PM - 1:00 PM

[P2-08] Effect of Peanut Residues on Nitrogen and Phosphorus Uptake of the Succeeding Wheat Grown in the Paddy-Converted Upland Field

○Haruki Masuda[1], Yuko Michiyama[1], Daisuke Yoshimura[1], Takuji Seo[1], Toru Kira[1], Atsushi Matsumura[2], Hiroyuki Daimon[1] (1.Faculty of Agriculture, Ryukoku University., Japan, 2.Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Japan)
1:15 PM - 2:00 PM

[P2-09] Effect of Shoot Cutting and Mulching of Hairy Vetch during Flowering Stage on the Yield and N Content of Wheat in the Mixed Cropping System

○Kan Tamaki[1], Daisuke Yoshimura[1], Takuji Seo[1], Toru Kira[1], Atsushi Matsumura[2], Arata Tarui[2], Hiroyuki Daimon[1] (1.Faculty of Agriculture, Ryukoku University, Japan, 2.Graduate School of Life and

Environmental Sciences, Osaka Prefecture University, Japan）
12:15 PM - 1:00 PM

[P2-10] DNA Barcoding of Weed Species in Hokkaido and Application to *ex-situ* Evaluate of Their Abundance
○Maria Stefanie Dwiyanti[1], Toshiyuki Hirata[2], Hironori Nagano[1], Junya Yamagishi[3], Masahiro Akimoto[4]（1.Research Faculty of Agriculture, Hokkaido University, Japan, 2.Field Science Center for Northern Biosphere, Hokkaido University, Japan, 3.Research Center for Zoonosis Control, Hokkaido University, Japan, 4.Department of Agro-environmental Science, Obihiro University for Agriculture and Veterinary Medicine, Japan）
1:15 PM - 2:00 PM

[P2-11] Climate Impact on Yield and Cultivation Area of Rainfed Rice in Central Benin, West Africa
○Joji Miyazawa, Akira Miyazaki（Faculty of Agriculture and Marine Science, Kochi University, Japan）
12:15 PM - 1:00 PM

[P2-12] Cropping System Which Consists of Potato in Winter Season, Green Manure and Sugarcane under Kunigami Merge Soil in Northern Part of Okinawa Island
○Hideyuki Mochida（Innovation creation section, Bio-Oriented Technology Research Advancement Institution, Japan）
1:15 PM - 2:00 PM

[P2-13] Evaluation of Crop Performance under Different Nitrogen Regimes in Rice-Ratoon Rice Systems in Central Japan
○Weiyi Xie, Yoichiro Kato（Graduate School of Agricultural Sciences, The University of Tokyo, Japan）
12:15 PM - 1:00 PM

[P2-14] Grain Yield and Biodiversity in Lowland Rice Ecosystems: Comparison between Conventional and Organic Management Practices
○Haruki Okuda, Yoichiro Kato（Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）
1:15 PM - 2:00 PM

[P2-15] Using a High Density Seedling Mat Reduces Transplanted Rice (*Oryza sativa* L.) Production Costs: A Case Study in Vietnam
○Kazunori Sawamoto[1], Ngo Quang Hieu[2], Truong Chi Thanh[3]（1.Development Division, Yanmar Agribusiness Co., Ltd., Japan, 2. Can Tho University, Vietnam, 3.Yanmar Agricultural Research Institute, Vietnam）
12:15 PM - 1:00 PM

[P2-16] Evaluation of the Differences in Yield Response to Organic Fertilizer between Two Soybean High-Yielding Lines 'Toiku 273' and 'Tokei1335' by Hierarchical Bayesian Model
○Yuichi Nagasaki[1], Hiroyuki Tsuji[1], Satoshi Kobayashi[2], Hideki Kurosaki[3]（1.Hokkaido Agricultural Research Center, National Agriculture and Food Research Organization, Japan, 2.Agricultural Research Department Tokachi Agricultural Experiment Station, Hokkaido Research Organization, Japan, 3.Agricultural Research Department Central Agricultural Experimental Station, Hokkaido Research Organization, Japan）
1:15 PM - 2:00 PM

[P2-17] Effect of Varieties and Organic Manures on Rice Yield and Methane Emission under Water Management
○Ei Phyu Win[1], Kyaw Kyaw Win[2], Kyaw Ngwe[3], Than Da Min[4], Hla Than[5]（1.Department of Agronomy, Yezin Agricultural University, Myanmar, 2.Department of Agronomy, Yezin Agricultural University, Myanmar, 3.Department of Soil and Water Science, Yezin Agricultural University, Myanmar, 4.Department of Agronomy, Yezin Agricultural University, Myanmar, 5.Department of Agronomy, Yezin Agricultural University, Myanmar）
12:15 PM - 1:00 PM

[P2-18] Soil Temperature, Growth and Yield of Rhizome by Different Mulching Treatments of Chinese Artichoke (*Stachys sieboldii* Miq.)
○Yeongmi Jang, Bumsik Choi, Sharavdorj Khulan, Jin-Woong Cho（College of Agricultural and Life Sciences, Chungnam National University, Korea）
1:15 PM - 2:00 PM

[P2-19] Effect of Different Types of Mulching on Soil Temperature, Growth and Rhizome Yield of Lycopi Herba (*Lycopus lucidus* Turcz.)
○Yeongmi Jang, Bumsik Choi, Sharavdorj Khulan, Jin-Woong Cho（College of Agricultural and Life

Sciences, Chungnam National University, Korea）
12:15 PM - 1:00 PM

[P2-20] Effect of Flood and Drip Irrigation and Difference of Organic Material Input on Morphological and Physiological Traits in Rice Root
○Jiabin Bian[1], Kanchana Chomsang[2], Masahiro Morokuma[3], Masanori Toyota[3]（1.College of Agronomy & Resources and Environment, Tianjin Agricultural University, China, 2.United Graduate School of Agricultural Science, Ehime University, Japan, 3.Faculty of Agriculture, Kagawa University, Japan）
1:15 PM - 2:00 PM

[P2-21] *In Vitro* Screening and Morphological Trait Assisted Selection for Salinty Tolerance in Wheat Genotypes at Seedling Stage
○Mohammad Hasanuzzaman[1], Nihar Ranjan Saha[1], Sayma Farabi[1], Muhammad Monirul Islam[2], Muhammad Shahidul Haque[1]（1.Department of Biotechnology, Bangladesh Agricultural University, Bangladesh, 2.Biotechnolohy Division, Bangladesh Institute of Nuclear Agriculture, Bangladesh）
12:15 PM - 1:00 PM

[P2-22] Verification of Effects of "Three-dimensional farming system" on Soybean Cultivation in a Converted Paddy Field in a Temperate Zone
○Irumi Shimizu[1], Yuto Seno[2], Tesshu Tamai[2]（1.Graduate School of Agriculture, Ryukoku University, Japan, 2.Faculty of Agriculture, Ryukoku University, Japan）
1:15 PM - 2:00 PM

[P2-23] Production of Nitrogen Fixed Nutrient Solution for Hydroponic Culture by Flow Plasma System
○Tesshu Tamai[1], Ryoji Iyo[1], Yuya Yokoyama[1], Yoshiteru Mizukoshi[2], Yoshimi Nishimura[3], Chiaki Terashima[4]（1.Faculty of Agriculture, Ryukoku University, Japan, 2.Future Technology Research Laboratory, ULVAC, Inc., Japan, 3.Kurita Manufacturing Co., Ltd, Japan, 4.Photocatalysis International Research Center, Tokyo University of Science, Japan）
12:15 PM - 1:00 PM

[P2-24] Alternative Usage of Poultry Litter Ash for Phosphorus and Potassium Fertilizer in Forage Rice Cultivation
○Yuka Sasaki[1], Keishiro Sato[1,2], Takayuki Tokuhashi[1,3], Ken-ichi Kakuda[1]（1.Faculty of Agriculture, Yamagata University, Japan, 2., Agro-Kanesho Co., Ltd., Japan, 3.Niigata Central Union of Agricultural Cooperatives, Japan）
1:15 PM - 2:00 PM

[P2-25] Effects of Shading by Solar Panels on Growth and Yield of C_3 and C_4 Crops
○Masahiro Morokuma, Masanori Toyota（Faculty of Agriculture, Kagawa University, Japan）
12:15 PM - 1:00 PM

[P2-26] Effects of Proximity to Missing and Poorly Growing Plants on Cabbage Head Size
○Hiroyuki Tsuji（Division of Farming System Research, Hokkaido Agricultural Research Center, National Agriculture and Food Research Organization, Japan）
1:15 PM - 2:00 PM

[P2-27] Three-Dimensional Analysis of Soybean Grain Shapes Using a Flatbed Scanner
○Dan Eiju[1,2], Masataka Wakayama[1], Fumiko Namiwa[3], Masaru Tomita[1,2]（1.Institute for Advance Biosciences Keio University, Japan, 2.Faculty of Environment and Information Studies, Keio University, Japan, 3.Horticulture Science, Yamagata Integrated Agricultural Research Center, Japan）
12:15 PM - 1:00 PM

[P2-28] Satellite-Based Assessment of Soybean Plant Density by Using UAV Imagery and Machine Learning Algorithm
○Luthfan Nur Habibi[1], Tsutomu Matsui[2], Takashi Tanaka[2,3]（1.Graduate School of Natural Science and Technology, Gifu University, Japan, 2.Faculty of Applied Biological Sciences, Gifu University, Japan, 3.Artificial Intelligence Advanced Research Center, Gifu University, Japan）
1:15 PM - 2:00 PM

[P2-29] Effect of Environmental Differences on Empirical Regression Models for Estimating Leaf Area Index Using Vegetation Indices in Rice
○Tomoaki Yamaguchi[1], Daniel Menge[2], Emily Gichuhi[2], Peprah Clement Oppong[1], Megumi Yamashita[1], Daigo Makihara[3], Keisuke Katsura[1]（1.Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan, 2., Kenya Agricultural and

Livestock Research Organization, Kenya, 3.International Center for Research and Education in Agriculture, Nagoya University, Japan）
12:15 PM - 1:00 PM

[P2-30] Detection of Lodging Area in a Paddy Field from a Digital Surface Model (DSM)

○Tadashi Tsukaguchi[1], Fumio Uno[2], Yoichi Fujihara[1] （1.Faculty of bioresources and environmental sciences, Ishikawa Prefectural University, Japan, 2.Ishikawa Agriculture and Forestry Research Center, Japan）
1:15 PM - 2:00 PM

[P2-31] Nitrogen Dynamics in Paddy Fields under Different Rice Bran Levels

○Mchuno Alfred Peter, Tasuku Eigen, Ami Shimomura, Beno Anton Kiwale, Kunio Watanabe, Nobuhito Sekiya （Graduate School of Bioresources, Mie University, Japan）
12:15 PM - 1:00 PM

[P2-32] Do New Rice Cultivars Respond to Chemical Fertilizers Better than Old Cultivars?

○Beno Anton Kiwale, Asaka Murai, Mchuno Alfred Peter, Nobuhito Sekiya （Graduate School of Bioresources, Mie University, Japan）
1:15 PM - 2:00 PM

[P2-33] A Case Study on Labor Productivity of Paddy Rice Seed Production in Japan

○Mizuho Fujii, Akihiko Kamoshita （Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）
12:15 PM - 1:00 PM

[P2-34] Selection of Sorghum Growth Indicators for the Development of Smart Farm of Field Food Crops

○Kang-Su Kwak, Si-Young Rho （Division of Smart Farm Development, Department of Agricultural Engineering, National Institute of Agricultural Sciences, Rural Development Administration, Korea）
1:15 PM - 2:00 PM

Room 3 (Poster)

Poster Session | Abiotic Stress for Crop Production | P3: Poster Session

[P3] Abiotic Stress for Crop Production

12:15 PM - 2:00 PM Room 3 (Poster) (Abiotic Stress for Crop Production)

[P3-01] Influence of Low Temperature at Booting Stage on Growth and Yield in Fall and Spring Sown Wheat

Jaeeun Choi[1], Jae-Gyeong Jung[1], Young-Hun Lee[1], Ki-Eun Song[1,2], Jonghan Ko[3], Kyung-Do Lee[4], ○Sang-In Shim[1] （1.Department of Agronomy, Gyeongsang National University, Korea, 2.Division of Applied Life Science (BK21 Plus), Gyeongsang National University, Korea, 3.Department of Applied Plant Science, Chonnam National University, Korea, 4.Climate Change and Agro-Ecology Division, Rural Development Administration, Korea）
12:15 PM - 1:00 PM

[P3-02] Selection of Transcripts Relating to Chlorophyll Content of Rice Seedlings at Low Temperature Using RNA-Sequencing Data

○Akari Fukuda[1], Tatsuro Hirose[2], Yoichi Hashida[2], Naohiro Aoki[3], Atsuhi J. Nagano[4] （1.Institute of Crop Science, National Agriculture and Food Research Organization, Japan, 2.Faculty of Agriculture, Takasaki University of Health and Welfare, Japan, 3.Graduate School of Agricultural and Life Science, The University of Tokyo, Japan, 4.Faculty of Agriculture, Ryukoku University, Japan）
1:15 PM - 2:00 PM

[P3-03] Membrane Lipid Unsaturation Confers Cold Germination Ability to Seeds of Upland Cotton (*Gossypium hirsutum*)

Lakhvir Kaur Dhaliwal[1], Junghyun Shim[1], Masoud Zabet[2], Benildo G. de los Reyes[1], ○Rosalyn B. Angeles-Shim[1] （1.Department of Plant and Soil Science, College of Agricultural Sciences and Natural Resources, Texas Tech University, United States, 2.Center for Biotechnology and Genomics, Texas Tech University, United States）
12:15 PM - 1:00 PM

[P3-04] Characteristics of Photoassimilates Distribution in the Resistant Variety to the High-Temperature Damage to Rice Grain Ripening

○Saki Yoshino[1], Chiharu Sone[2,3], Kyoko Toyofuku[2,3], Fumiaki Takakai[2,3], Takato Mizumoto[2], Yoko Ishikawa[2,3], Atsushi Ogawa[2,3] （1.Graduate School of Bioresource Sciences, Akita Prefectural University, Japan, 2.Faculty of Bioresource Sciences, Akita Prefectural University, Japan, 3.Japan Science and

Technology Agency, Core Research for Evolutionary Science and Technology Project, Japan）
1:15 PM - 2:00 PM

[P3-05] Comparison of Drought Resistance of NERICA, Asian Rice and African Rice and Effects of Phosphorus Fertilizer
○Michihiko Fujii （Faculty of Education, Shizuoka University, Japan）
12:15 PM - 1:00 PM

[P3-06] The Effects of Arbuscular Mycorrhizal Symbiosis on the Growth, Yield and Drought Resistance of Foxtail Millets (*Setaria italica*)
○Wei-Yi Lin, Ou-Chi Chang, Yi-An Chen, Ting-Chen Chang （Department of Agronomy, National Taiwan University, Taiwan）
1:15 PM - 2:00 PM

[P3-07] The Effect of Ultra-Fine Bubble on Soybean Growth under Osmotic Stress Condition
○Kaito Yamashita[1], Yoshihiro Hirooka[1], Yoshikatsu Ueda[2], Koji Yamane[1], Chikashi Kamimura[3], Morio Iijima[1] （1.Graduate School of Agriculture, Kindai University, Japan, 2.Research Institute for Sustainable Humanosphere, Kyoto University, Japan, 3.Eatech Co. Ltd, Japan）
12:15 PM - 1:00 PM

[P3-08] Simple Model for Root Distribution across Soil Depth in Rice (*Oryza sativa* L.) under Fluctuating Soil Moisture Conditions
Hien Thi Thanh Nguyen, Tohru Kobata, ○Kuniyuki Saitoh （Graduate School of Environmental and Life Science, Okayama University, Japan）
1:15 PM - 2:00 PM

[P3-09] Diurnal Changes in Chloroplast Positioning and Photosynthesis in Finger Millet
○Eri Maai[1], Kazusa Nishimura[2], Rihito Takisawa[3], Tetsuya Nakazaki[2] （1.Faculty of International Agriculture and Food Studies, Tokyo University of Agriculture, Japan, 2.Graduate School of Agriculture, Kyoto University, Japan, 3.Faculty of Agriculture, Ryukoku University, Japan）
12:15 PM - 1:00 PM

[P3-10] Effect of Seed Hydro-Priming on Initial, Middle, and Late Growth Stage of Rice under the Different Soil Moisture Conditions
○Yoshihiro Nakao[1], Minoru Yoshino[2], Kisho Miyamoto[2], Aki Houshiyama[1], Eri Ishikawa[1], Jun-Ichi Sakagami[1] （1.Faculty of Agriculture, Kagoshima University, Japan, 2.Japan International Cooperation Agency, Japan）
1:15 PM - 2:00 PM

[P3-11] Differences in Aquaporin Expression and Their Response to Osmotic Stress among Component Roots in a Rice Root System
○Yumika Watanabe[1, 2], Shiro Mitsuya[1], Akira Yamauchi[1] （1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.School of Biological Sciences, The University of Western Australia, Australia）
12:15 PM - 1:00 PM

[P3-12] Does Plasticity of Anatomical Traits Influence Water Stress Tolerance in Rice?
○Manikanta Ch L N[1], Beena R[2], Rejeth R[3] （1.Department of Plant Physiology, Kerala Agricultural University, India, 2.Department of Plant Physiology, Kerala Agricultural University, India, 3.Department of Plant Physiology, Kerala Agricultural University, India）
1:15 PM - 2:00 PM

[P3-13] Crops Response to Water Stress Combination with Temperature Like— Rainfed Condition in Cereal
○Phanthasin Khanthavong[1,3], Shin Yabuta[2], Jun-Ichi Sakagami[1,2] （1.The United Graduate School of Agricultural Sciences, Kagoshima University, Japan, 2.Faculty of Agriculture, Kagoshima University, Japan, 3.Maize and Cash Crops Research Center, National Agriculture and Forestry Research Institute, Laos）
12:15 PM - 1:00 PM

[P3-14] Root and Leaf Plasticity in Response to Soil Moisture Fluctuation in Rice
○Yasutaka Noda[1.2], Mana Kano-Nakata[2], Shiro Mitsuya[1], Akira Yamauchi[1] （1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.International Center for Research and Education in Agriculture (ICREA), Nagoya University, Japan）
1:15 PM - 2:00 PM

[P3-15] Combination of GGE and BLUP Models in the Selection of Rice Varieties Adapted to the Rainfed Lowlands
○Via Ann Marcelo[1], Maria Corazon Cabral[2], Jonathan Niones[3], Roel Suralta[4], Mana Kano-Nakata[2], Akira

Yamauchi[2] (1.Plant Breeding and Biotechnology Division, Philippine Rice Research Institute, Philippines, 2.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 3.Genetic Resources Division, Philippine Rice Research Institute, Philippines, 4.Crop Biotechnology Center, Philippine Rice Research Institute, Philippines)
12:15 PM - 1:00 PM

[P3-16] Absorption and Physiological Treatment Mechanism of Cesium under High NaCl Conditions in Quinoa (*Chenopodium quinoa* Willd.)

○Kengo Wada[1], Katsunori Isobe[2], Masao Higo[2], Yoshihiro Kawamura[1], Yuya Tatewaki[1], Koya Nakamura[1] (1.Graduate School of Bioresource Science, Nihon University, Japan, 2.College of Bioresource Science, Nihon University, Japan)
1:15 PM - 2:00 PM

[P3-17] Differences in the Strategies of Salinity Tolerance between Two Different Genotypic Groups of Quinoa (*Chenopodium quinoa* Willd.)

○Mire Hong[1], Yasunari Fujita[2], Yasuo Yasui[3], Keisuke Katsura[1] (1.Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan, 2.Biological Resourse and Post-harvest Division, Japan International Research Center for Agriculture Sciences, Japan, 3.Graduate School of Agriculture, Kyoto University, Japan)
12:15 PM - 1:00 PM

[P3-18] Mapping of Salinity Tolerance in Rice Through Genome-Wide Association Study (GWAS) at Seedling and Reproductive Stages

○Marjorie Punzalan de Ocampo[1,2], Bui Phuoc Tam[1,3], JamesA. Egdane[1], Shiro Mitsuya[2], Akira Yamauchi[2], Amelia Henry[1], Abdelbagi M. Ismail[1] (1.Strategic Innovation-Systems Physiology, International Rice Research Institute, Philippines, 2.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 3.CuuLong Delta Rice Research Institute, Vietnam)
1:15 PM - 2:00 PM

[P3-19] NaCl-Stimulated ATP Synthesis in a Halophyte (*Mesembryanthemum crystallinum* L.)

○Ryoma Sato[1], Kazuki Yoshida[1], Ayako Konishi[2], Dan Q. Tran[3], Kazuyuki Saito[4], John C. Cushman[5], Sakae Agarie[4] (1.Graduate school of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 2.Faculty of Agriculture, Kagawa University, Japan, 3.The United Graduate School of Agricultural Sciences, Ehime University, Japan, 4.Faculty of Agriculture, Kyushu University, Japan, 5.Department of Biochemistry and Molecular Biology, University of Nevada, United States)
12:15 PM - 1:00 PM

[P3-20] Expression Analysis of Genes Involved in Removal of Na^+ and Cl^- by Leaf Sheath in Rice

○Sarin Neang[1,3], Nicola Stephanie Skoulding[1], Joyce A. Cartagena[1], Mana Kano-Nakata[2], Akira Yamauchi[1], Shiro Mitsuya[1] (1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.International Center for Research and Education in Agriculture, Nagoya University, Japan, 3.Department of Agro-Industry, Ministry of Agriculture, Forestry and Fisheries, Cambodia)
1:15 PM - 2:00 PM

[P3-22] Evaluation of Salinity Tolerance in Rice Lines Carrying Overlapping Chromosome Segments of *Oryza longistaminata* in a Genetic Background of Kernel Basmati

○Rena Tomita[1], Emily Waringa Gichuhi[2], Daniel Makori Menge[2], Mayumi Kikuta[3], Daigo Makihara[4] (1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.Industrial Crops Research Institute, Kenya Agricultural and Livestock Research Organization, Kenya, 3.Graduate School of Integrated Sciences for Life, Hiroshima University, Japan, 4.International Center for Research and Education in Agriculture, Nagoya University, Japan)
1:15 PM - 2:00 PM

[P3-23] Identification of Rice Varieties Showing Superior Salt Removal Ability in Leaf Sheath and Its Contrasting Varieties

○Itsuki Goto, Akira Yamauchi, Shiro Mitsuya (Graduate School of Bioagricultural Sciences, Nagoya University, Japan)
12:15 PM - 1:00 PM

[P3-24] Transcriptional Regulation of the Stress-Inducible Photosynthesis in the Common Ice Plant, *Mesembryanthemum crystallinum* L.

○Sakae Agarie[1], Kento Kuroda[2], Kasumi Nishikawa[2], Nanako Isshiki[2], Yoko Ide[3], Kazuyuki Saito[1], John C. Cushman[4] (1.Faculty of Agriculture, Kyushu University, Japan, 2.Faculty of Agriculture, Kagawa

University, Japan, 3.Faculty of Agriculture, Saga University, Japan, 4.Department of Biochemistry and Molecular Biology, University of Nevada, Reno, United States）

1:15 PM - 2:00 PM

[P3-25] Morphological Characterization of Calcium Oxalate Crystals and Effect of Growth-Medium Calcium Levels on Morphology of the Crystals in Tubers and Roots of Chinese Yam

○Michio Kawasaki[1,2], Ryotaro Shibata[2], Shinichiro Ito[2]
（1.Faculty of Agriculture, Setsunan University, Japan, 2.Faculty of Agriculture and Life Science, Hirosaki University〔previous affiliation〕, Japan）

12:15 PM - 1:00 PM

[P3-26] Root Type-Specific Transcriptome Diversity in Salinity Tolerant and Sensitive Rice Varieties

○Joyce Cartagena[1], Yao Yao[1], Shiro Mitsuya[1], Takashi Tsuge[2]（1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.Department of Biological Chemistry, Chubu University, Japan）

1:15 PM - 2:00 PM

[P3-27] Breeding for Submergence-Tolerant Rice by Marker Assisted Backcross

○Yu-Chien Tseng[1], Yu-Chia Hsu[1], Yu-Chin Chang[2], Yong-Pei Wu[2]（1.Agronomy Department, National Chiayi University, Taiwan, 2.Agronomy Department, Chiayi Agricultural Experiment Station, Taiwan Agricultural Research Institute, Taiwan）

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[P3-28] Seed-Flooding Tolerance in Soybean is Related to Germination Ability under Water

○Shinjiro Ootsuka, Ryutaro Morita, Junko Yamagishi, Naohiro Aoki（Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

1:15 PM - 2:00 PM

[P3-30] Utilization of *SEMIDWARF1* for Vigorous Growth, Weed Competitiveness and Deep-Water Resistance in Rice Varieties for Organic Farming

○Marina Iwasa, Keisuke Katsura, Takashi Motobayashi, Taiichiro Ookawa（Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan）

1:15 PM - 2:00 PM

[P3-31] Naked Waxy Barley Yield and Grain β-glucan Affected by Soil Heterogeneity in Different Arable Lands

○Atsushi Matsumura[1], Takuya Morishita[2], Syuusuke Nakai[2], Hiroyuki Masumoto[1], Masanori Yanase[1]
（1.Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Japan, 2.College of Life, Environment and Advanced Sciences, Osaka Prefecture University, Japan）

12:15 PM - 1:00 PM

[P3-32] Transitional Oxygen Point (TOP), a Physiological Indicator to Evaluate Waterlogging Tolerance in Crops

○Yutaro Oba[1], Akihiro Nose[1], Makoto Tokuda[2], Shao Hui Zheng[1]（1.Tropical Crop Science, Agriculture, Saga University, Japan, 2.Systems Ecology, Agriculture, Saga University, Japan）

1:15 PM - 2:00 PM

[P3-33] Comparative Transcriptome Analysis in Sorghum (*Sorghum bicolor* L.) Leaves during Vegetative Stage under Waterlogging Stress

○Ku Hyun Kwon[1], Sang-Heon Choi[1], Ju-Young Choi[1], Soo-Jeong Kwon[1], Hyen-Chung Chun[2], Dong-Gyu Lee[1], Seong-Hyun Yu[1], Tae-Woong Yun[1], Sun Hee Woo[1]
（1.Department of Crop Science, Chungbuk National University, Korea, 2.National Institute of Crop Science, Rural Development Administration, Korea）

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[P3-34] Death of Roots Retards the Growth Recovery of Common Buckwheat under Waterlogged Conditions

○Shun Murakami[1], Masaaki Hashimoto[2], Hiromitsu Aoki[2], Yasuhiro Hirata[2], Yoshiharu Wada[1,2], Takuya Koyama[1,2]（1.Graduate School of Regional Development and Creativity, Utsunomiya University, Japan, 2.School of Agriculture, Utsunomiya University, Japan）

1:15 PM - 2:00 PM

[P3-35] Effects of Root Aerenchyma Formation and Photosynthetic Activity of Leaves under Submergence on Post-Submergence Recovery in *Oryza sativa* and *O. glaberrima*

○Chiharu Sone, Yuta Echizenya, Daichi Tozawa, Kyoko Toyofuku, Atushi Ogawa（Faculty of Bioresource Sciences, Akita Prefectural University, Japan）

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[P3-36] Hypoxic Tolerance of Four Millets is Attributable to Constitutive Aerenchyma

Formation and Root Hair Development of Adventitious Root

○Asana Matsuura[1], Yasuyuki Kato[1], An Ping[2]
（1.School of Agriculture, Tokai University, Japan, 2.Arid Land Research Center, Tottori University, Japan）

1:15 PM - 2:00 PM

[P3-37] Contrasting Rice Cultivars Responses to Increasing CO_2 Levels and Temperature

○Nene Furukawa[1], Murat Aycan[2], Nahar Lutfun[1], Toshihiro Nagamori[1], Eckart Priesack[3], Bertrand Gakière[4], José Luis Araus[5], Iker Aranjuelo[6], Marouane Baslam[2], Toshiaki Mitsui[1,2]（1.Dept. of Life and Food Sciences, Graduate School of Science and Technology, Niigata University, Japan, 2.Laboratory of Biochemistry, Faculty of Agriculture, Niigata University, Japan, 3.Institute of Biochemical Plant Pathology, Helmholtz Center-Munich, Germany, 4.Institute of Plant Sciences Paris-Saclay (IPS2), CNRS University Paris-Saclay, France, 5.Integrative Crop Ecophysiology Group, University of Barcelona, Spain, 6.Agrobiotechnology Institute, Spanish National Research Council, Spain）

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[P3-38] Introgression of Dormant Gene *Sdr4-k* Improves Grain Quality of Sake Rice

○Shinya Kanazawa[1], Maiko Iwano[1], Marouane Baslam[2], Shigeru Hanamata[2], Murat Aycan[2], Isao Hanashiro[3], Kazuhiko Sugimoto[4], Toshiaki Mitsui[1,2]（1.Graduate School of Science and Technology, Niigata University, Japan, 2.Faculty of Agriculture, Niigata University, Japan, 3.Faculty of Agriculture, Kagoshima University, Japan, 4.Institute of Crop Science, National Agriculture and Food Research Organization, Japan）

1:15 PM - 2:00 PM

[P3-39] Effects of Jasmonic Acids on Rice Flower Opening Time and Fertility under High Temperature Conditions

○Kazuhiro Kobayasi[1], Ramin Taheri[2], Masato Tsurumi[3], Yuki Mizokane[3], Fumihiko Adachi[1], Kazuhiro Ujiie[1], Akio Tanaka[4], Taku Tanogashira[4], Hitoshi Ogiwara[5]（1.Institute of Agricultural and Life Sciences, Shimane University, Japan, 2.Graduate School of Natural Science and Technology, Shimane University, Japan, 3.Faculty of Life and Environmental Sciences, Shimane University, Japan, 4. Kagoshima Prefectural Institute for Agricultural Development, Japan, 5.National Agriculture and Food Research Organization, Japan）

12:15 PM - 1:00 PM

[P3-40] The Effect of N-application on cpHSP70-2 Accumulation to Improve Rice (*Oryza sativa* L.) Grain Chalkiness

○Olusegun Idowu, Tomoyuki Katsube-Tanaka
（Graduate School of Agriculture, Kyoto University, Japan）

1:15 PM - 2:00 PM

[P3-41] Genetic Analysis of Drought Response Index in a *Temperate Japonica* Rice Mapping Population

○Poornima Ramalingam[1,2], Ha-An Thi Nguyen[1], Kamoshita Akihiko[1]（1.Department of Plant Biotechnology, Tamil Nadu Agricultural University, India, 2.Asian Research Center for Bio-Resources and Environmental Sciences, Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 3.Asian Research Center for Bio-Resources and Environmental Sciences, Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

12:15 PM - 1:00 PM

[P3-42] Contribution of the Chromosome 11 of a Salinity-Tolerant Rice Variety Nona Bokra to High Dry Matter Production under Salinity and Its QTL Mapping

○Yumika Yamamoto[1], Masaki Uchida[1], Mana Kano-Nakata[2], Akira Yamauchi[1], Shiro Mitsuya[1]
（1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.International Center for Research and Education in Agriculture, Nagoya University, Japan）

1:15 PM - 2:00 PM

[P3-43] Genotypic Variation in Root Morpho-Anatomical Traits of Rice Cultivars with High and Low Adaptability under Multi-Stress Environment

○Maria Corazon Julaton Cabral[1,2], Via Ann Candelaria Marcelo[3], Roel Rodriguez Suralta[3], Jonathan Manito Niones[3], Antoinette Soriano Cruz[3], Hiroshi Ehara[1,2], Yoshiaki Inukai[1,2], Akira Yamauchi[1], Mana Kano-Nakata[1,2]（1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.International

Center for Research and Education in Agriculture, Nagoya University, Japan, 3.Philippine Rice Research Institute, Philippines）
12:15 PM - 1:00 PM

[P3-44] Heavy Flooding Effects on Productivity of Paddy Rice Cultivar 'Nanatsuboshi'
○Hideki Okamoto[1], Junji Fujikura[2], Katsuhiro Furukawa[2] （1.Tenpoku Sub-centre, Dairy Research Centre, Hokkaido Research Organization, Japan, 2.Kamikawa Agricultural Experiment Station, Hokkaido Research Organization, Japan）
1:15 PM - 2:00 PM

[P3-45] Root Anatomical Traits Related to Root Oxygen Consumption and Transportation between Upland Rice and Lowland Rice Varieties
○Shotaro Tamaru[1], Keita Goto[1], Phanthasin Khanthavong[1], Shin Yabuta[2], Jun-Ichi Sakagami[1,2] （1.The United Graduate School of Agricultural Sciences, Kagoshima University, Japan, 2.Faculty of Agriculture, Kagoshima University, Japan）
12:15 PM - 1:00 PM

[P3-46] Roles of Root Plasticity to Growth and Yield of Quinoa under Different Soil Water Regimes
○Dinh Thi Ngoc Nguyen[1], Cuong Van Pham[1], Thiem Thi Tran[1], Akira Yamauchi[2] （1.Faculty of Agronomy, Vietnam National University of Agriculture, Vietnam, 2.Faculty of Agronomy, Vietnam National University of Agriculture, Vietnam, 3.Faculty of Agronomy, Vietnam National University of Agriculture, Vietnam, 4.Graduate School of Bioagricultural Sciences, Nagoya University, Japan）
1:15 PM - 2:00 PM

[P3-47] Integrated Transcriptome and Proteome Analysis Reveals Complex Regulatory Mechanism of Maize (*Zea mays* L.) in Response to Zinc Deficiency Stress
Jinyao Zhang[1,3], Shuhui Song[1], Yinghong Pan[2], Fangsen Xu[3], ○Hong Wang[1] （1.Institute of Agriculture Resources and Regional Planning, Chinese Academy of Agricultural Sciences, China, 2.The National Key Facility for Crop Gene Resources and Genetic Improvement, Institute of Crop Science, Chinese Academy of Agricultural Sciences, China, 3.College of Resources and Environment, Huazhong Agriculture University, China）
12:15 PM - 1:00 PM

Room 4 (Poster)

Poster Session | Crop Genetics and Physiology | P4: Poster Session

[P4] Crop Genetics and Physiology

12:15 PM - 2:00 PM Room 4 (Poster) (Crop Genetics and Physiology)

[P4-01] Genetic Variation of Rice Germplasm Including *Oryza sativa* and *O. glaberrima* in Guinea
○Yoshimichi Fukuta[1], Seiji Ynagaihara[2], Nhai Nguyen[3], Oanh Nguyen[3], Narry Mamadou[4], Diawara Souleymane[4], Bah Oumar[4] （1.TARF, Japan International Research Center for Agricultural Sciences, Japan, 2.GRPH, Japan International Research Center for Agricultural Sciences, Japan, 3.AGI, Vietnam, 4.IRAG, Guinea）
12:15 PM - 1:00 PM

[P4-02] Genetic Diversities of Traits Associated with Culm Strength Using a *Temperate Japonica* Rice Varieties
○Koki Chigira[1], Natsuko Kojima[1], Masanori Yamasaki[2], Shunsuke Adachi[3], Taiichiro Ookawa[1] （1.Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan, 2.Food Resources Education and Research Center, Graduate School of Agricultural Science, Kobe University, Japan, 3.College of Agriculture, Ibaraki University, Japan）
1:15 PM - 2:00 PM

[P4-03] Histone Acetyltransferase GCN5 Regulates the Expression of *OsRBCS3* and *OsRBCS5*, Rubisco Small Subunit Genes, in Response to Nitrogen Supply in Rice (*Oryza sativa* L.)
○Shicheng Feng[1], Fumiya Miyamoto[2], Sakae Agarie[3], Kazuyuki Saitou[4] （1.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, China, 2.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 3.Faculty of Agriculture (Graduate School), Kyushu University, Japan, 4.Faculty of Agriculture (Graduate School), Kyushu University, Japan）
12:15 PM - 1:00 PM

[P4-04] Visualizing Aleurone Layers in Mature Rice Grains by a Modified Half-Cut Method
○Thi Mai Phuong Nguyen[1], Tomomi Abiko[2], Ohn Mar Khin[3], Toshihiro Mochizuki[2] （1.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 2.Faculty of Agriculture, Kyushu

University, Japan, 3.Department of Agricultural Research, Ministry of Agriculture, Livestock and Irrigation, Myanmar）
1:15 PM - 2:00 PM

[P4-05] Regulation of the Expression of *OsRBCS3*, a Rubisco Small Subunit Gene, by Histone Deacetylase *HDA713* under Nitrogen Deficiency in Rice

○Fumiya Miyamoto[1], Shicheng Feng[2], Sakae Agarie[3], Kazuyuki Saitou[4] （1.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 2.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 3.Faculty of Agriculture(Graduate School), Kyushu University, Japan, 4.Faculty of Agriculture(Graduate school), Kyushu University, Japan）
12:15 PM - 1:00 PM

[P4-06] Estimation of Canopy Transpiration Rate in Rice after Heading Stage by Extracting Leaf Temperature in Thermal Images

○Rintaro Kondo, Yu Tanaka, Tatsuhiko Shiraiwa （Graduare School of Agriculture, Kyoto University, Japan）
1:15 PM - 2:00 PM

[P4-07] Engineering CAM Traits into C3 crops

○Aoi Saito[1], Mie Wakabayashi[2], Shiori Terai[2], Shiori Yamabe[2], Satoko Kobayashi[2], Kazuyuki Saito[3], John C. Cushman[4], Sakae Agarie[3] （1.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 2.Faculty of Agriculture, Kagawa University, Japan, 3.Faculty of Agriculture, Kyushu University, Japan, 4.Department of Biochemistry and Molecular Biology, University of Nevada, United States）
12:15 PM - 1:00 PM

[P4-08] Assessment of Geographical Distribution and Genetic Diversity of Five Sorghum Taxa Collected in Taiwan

○Wei-hsun Hsieh[1], Yi-tzu Kuo[1], Han-hsuan Chin[1], Hsien-chun Liao[2], Chih-hui Chen[2], Yann-rong Lin[1] （1.Agronomy, National Taiwan University, Taiwan, 2.Experimental Stations Research, Endemic Species Research Institute, Taiwan）
1:15 PM - 2:00 PM

[P4-09] Resistant Loci to Physiological Disorder Cupping in Chinese Cabbage (*Brassica rapa* var.*Pekinensis*)

○Haruto Takamori[1], Osamu Kawaide[3], Tokuko Sakaguchi[1], Minami Nakazawa[1], Natsuki Ito[1], Ayuka Furukubo[2], Minami Amaike[2], Takashi Ito[5], Fumio Azuhata[3], Mashiro Okada[2], Seiji Chino[5], Hideo Matsumura[4], Satoshi Niikura[3], Nobuaki Hayashida[2] （1., Shinshu University, Japan, 2.Division of Applied Biology, Faculty of Textile, Shinshu University, Japan, 3.TOHOKU SEED CO., LTD., Japan, 4.Gene Research Center, Shinshu University, Japan, 5.Engineering Department, Faculty of Textile, Shinshu University, Japan）
12:15 PM - 1:00 PM

[P4-10] Genetic Diversity of Foxtail Millet (*Setaria italica*) Landraces of Taiwan

Yen-chiun Chen[1], Yong-pei Wu[2], Yee-ching Chong[1], ○Yann-rong Lin[1] （1.Department of Agronomy, National Taiwan University, Taiwan, 2.Department of Agronomy, Chiayi Agricultural Experiment Station, Taiwan Agricultural Research Institute, Taiwan）
1:15 PM - 2:00 PM

[P4-11] Branched-Chain Amino Acid Aminotransferases (BCATs) Play Important Roles for the Induction of Autophagy in Leaf Senescence of Soybean

○Tung Tuan Do[1,3], Takaaki Ishibashi[2], Takashi Yuasa[2] （1.Interdisciplinary Graduate School of Agriculture and Engineering, University of Miyazaki, Japan, 2.Faculty of Agriculture, University of Miyazaki, Japan, 3.Faculty of Agronomy, Thai Nguyen University of Agriculture and Forestry, Vietnam）
12:15 PM - 1:00 PM

[P4-12] DGAT1s from Different Plant Species Show Different Triacylglycerol Biosynthesis Activities

○Tomoko Hatanaka[1], Wakana Miyashita[1], Kouki Shibutani[2], Daisuke Matsuoka[1], Daisuke Sasayama[1], Hiroshi Fukayama[1], Tetsushi Azuma[1], David F. Hildebrand[3] （1.Graduate School of Agricultural Science, Kobe University, Japan, 2.Faculty of Agriculture, Kobe University, Japan, 3.Department of Plant and Soil Sciences, University of Kentucky, United States）
1:15 PM - 2:00 PM

[P4-13] Genome Wide Association Study for Leaf Photosynthetic Properties in 166 *Temperate Japonica* Rice Cultivars

○Yoshiaki Seki[1], Kentaro Hayami[1], Tomohiro Nomura[1], Yu Tanaka[2], Taiichiro Ookawa[1], Makoto Matsuoka[3], Shunsuke Adachi[1] （1.Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan, 2.Graduate School of Agriculture, Kyoto University, Japan, 3.Bioscience and Biotechnology Center, Nagoya University, Japan）
12:15 PM - 1:00 PM

[P4-14] Assessment of Genetic Diversity and Relatedness in Citrus Fruits Using RAPD Markers

○Nihar Ranjan Saha, Jarina Binte Jalil, Muhammad Shahidul Haque （Department of Biotechnology, Bangladesh Agricultural University, Bangladesh）
1:15 PM - 2:00 PM

[P4-15] Pyramiding of Disease Resistance Genes into Popular Rice Varieties of Bangladesh

○Tapas Kumer Hore, Corinne Mira Marfori-Nazarea, Mary Ann Inabangan-Asilo, Ratna Wulandari, BP Mallikarjuna Swamy （RGDV Platfrom, International Rice Research Institute, Philippines）
12:15 PM - 1:00 PM

[P4-16] Genetic Analysis of Agronomic and Biofortification Traits in Multiple Rice Populations

○Tapas Kumer Hore, Mary Ann Inabangan Asilo, Gaurav Joshi, Amery Amparodo, BP Mallikarjuna Swamy （RGDV Platfrom, International Rice Research Institute, Philippines）
1:15 PM - 2:00 PM

[P4-17] Meta-QTLs and Candidate Genes Associated with Grain Zinc Content in Rice

○Gaurav Joshi[1,2], B. P. Mallikarjuna Swamy[1], Indra Deo Pandey[2], Yan Paing Soe[3], Jose E. Hernandez[4], Chau Thanh Nha[5], Alvin Palanog[6], Mark Ian Calayugan[4], Mary Ann Inabangan Asilo[1], Amery Amparado[1], Tapas Kumer Hore[1] （1.Rice Breeding Innovations, International Rice Research Institute, Philippines, 2.Genetics and Plant Breeding, Govind Ballabh Pant University of Technology and Agriculture, India, 3.Seed Division, Department of Agriculture, Myanmar, 4.Institute of Crop Science, University of the Philippines Los Baños, Philippines, 5.Genetics and Plant Breeding Department, Cửu Long Delta Rice Research Institute, Vietnam, 6.Research and Development, Philippine Rice Research Institute, Philippines）
12:15 PM - 1:00 PM

[P4-18] Global Analysis of a Rice Panel to Identify QTLs and Genotypes Useful for Rice Breeding

○Gaurav Joshi[1,2], B. P. Mallikarjuna Swamy[1], Mona Liza Jubay[1], Indra Deo Pandey[2], Maria Camila Rebolledo[10, 11], Dmytro Chebotarov[1], Kenneth McNally[1], Rakesh Kumar Singh[9], Hei Leung[1], Sunil Kumar Verma[4], Satish B. Verulkar[4], Shuhha Banerjee[4], Hsu Myat Noe Hnin[3], Rollin de Ocampo[1], Federico Molina[5], Bertrand Muller[11], Justine Bonifacio[1], Eliel Petro Paez[10], Adin Blokounon[7], Kazuki Saito[7], Khady Nani Dramé[8], Stephen Klassen[1], Narne Chamundeswari[6], P. V. Satyanarayana[6] （1.Rice Breeding Innovations, International Rice Research Institute, Philippines, 2.Department of Genetics and Plant Breeding, Govind Ballabh Pant University of Technology and Agriculture, Pantnagar, India, 3.Institute of Crop Science, University of the Philippines Los Baños, Philippines, 4.Department of Plant Molecular Biology and Biotechnology, Indira Gandhi Agricultural University, Raipur (Chhattisgarh), India, 5.Rice Breeding, National Institute of Agricultural Research of Uruguay, Uruguay, 6.Plant Breeding, Regional Agricultural Research Station, Maruteru, India, 7.Sustainable Productivity Enhancement Program, Africa Rice Center, Côte d'Ivoire, 8.Capacity Development, Africa Rice Center, Côte d'Ivoire, 9.Crop Diversification and Genetics, International Center for Biosaline Agriculture, United Arab Emirates, 10.Rice Program, International Center for Tropical Agriculture (CIAT), Colombia, 11.Centre de Coopération Internationale en Recherche Agronomique Pour le Développement (CIRAD), France）
1:15 PM - 2:00 PM

[P4-19] A Metabolite Profiling to Explore the Physiological Function of *Short Panicle 1* during Panicle Formation of Rice

Yifan Lin[1], Ryutaro Morita[1], Masaki Okamura[2], Junko Yamagishi[1], ○Naohiro Aoki[1] （1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Central Region Agricultural Research Center, National Agriculture and Food Research Organization, Japan）
12:15 PM - 1:00 PM

[P4-20] Assessment of *Indica* Rice Cultivars for the Use of Whole Crop Silage

Yoshikage Goto, Junko Yamagishi, ○Naohiro Aoki (Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan)

1:15 PM - 2:00 PM

[P4-21] Morphological Characteristics Related to the Accumulation of Non-Structural Carbohydrates in Stems of Rice at Heading Stage

○Yu Wakabayashi, Ryutaro Morita, Junko Yamagishi, Naohiro Aoki (Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan)

12:15 PM - 1:00 PM

[P4-22] Comparative Analysis of Sugar Metabolism in Rice Leaves under Field and Controlled Environments

○Yoichi Hashida[1], Ayumi Tezuka[2], Mari Kamitani[3], Makoto Kashima[4], Yuko Kurita[3], Atsushi J. Nagano[3,5] (1.Faculty of Agriculture, Takasaki University of Health and Welfare, Japan, 2.Research Institute for Food and Agriculture, Ryukoku University, Japan, 3.Faculty of Agriculture, Ryukoku University, Japan, 4.College of Science and Engineering, Aoyama Gakuin University, Japan, 5.Institute for Advanced Biosciences, Keio University, Japan)

1:15 PM - 2:00 PM

[P4-23] A Metabolite Profiling to Seek the Molecular Determinant of Spikelet Number in Rice

○Ryutaro Morita[1], Masaki Okamura[2], Shiori Yabe[3], Hiroe Yoshida[4], Satoru Sukegawa[4], Hiroshi Nakagawa[4], Naohiro Aoki[1] (1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Central Region Agricultural Research Center, National Agriculture and Food Research Organization, Japan, 3.Institute of Crop Science, National Agriculture and Food Research Organization, Japan, 4.Institute for Agro-Environmental Sciences, National Agriculture and Food Research Organization, Japan)

12:15 PM - 1:00 PM

[P4-24] Contribution of Several Source Organs to Dry Matter Accumulation into Panicles after Heading of Hulless Barley Sown at Different Terms

○Takuya Araki[1], Yasuhiro Kondo[2], Takato Yano[2], Ryo Kodani[2], Yukina Sakamoto[2] (1.Graduate School of Agriculture, Ehime University, Japan, 2.Faculty of Agriculture, Ehime University, Japan)

1:15 PM - 2:00 PM

[P4-25] Analysis on the Roles of Vacuolar Invertase Isoform, *OsINV3* in Root Development of Rice

○Natsumi Ueda[1], Ryutaro Morita[1], Tatsuro Hirose[2], Junko Yamagishi[1], Naohiro Aoki[1] (1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Faculty of Agriculture, Takasaki University of Health and Welfare, Japan)

12:15 PM - 1:00 PM

[P4-26] The Purification of Recombinant TGW6, which Limits Grain Size in Rice

○Tatsuki Akabane[1], Nobuhiro Suzuki[2], Wataru Tsuchiya[2], Etsuko Katoh[2], Naoki Hirotsu[1] (1.Graduate School of Life Sciences, Toyo University, Japan, 2.Structural Biology Team, Advanced Analysis Center, National Agriculture and Food Research Organization, Japan)

1:15 PM - 2:00 PM

[P4-27] Analysis of Genotype and Environment Interaction, and the Response of Grain Yield of Lowland Rice (*Oryza sativa* L.) to Nitrogen Application Under Different Environment in the Philippines

○Kim Nyka Caraan Perdiguerra[1,2], Pompe Campoy Sta. Cruz[1], Shiro Mitsuya[2], Akira Yamauchi[2] (1.Institute of Crop Science, College of Agriculture and Food Science, University of the Philippines Los Baños, Philippines, 2.Graduate School of Bioagricultural Sciences, Nagoya University, Japan)

12:15 PM - 1:00 PM

[P4-28] Morphological Characteristics of Mealy and Translucent Endosperm Cells of Hulless Barley (*Hordeum vulgare* var. *nudum*) During the Ripening Stage

○Yuto Hatakeyama[1, 2], Ryo Kotani[3], Yukina Sakamoto[3], Kosuke Haraguchi[3], Nana Matsui[3], Takuya Araki[1] (1.Faculty of Agriculture, Ehime University, Japan, 2.Japan Society for the Promotion of Science Research Fellow, Japan, 3.Graduate School of Agriculture, Ehime University, Japan)

1:15 PM - 2:00 PM

[P4-29] Effect of Silicon Application on Grains of *Sorghum bicolor* under Drought Conditions

○Ryoichi Araki[1], Yuka Takano[1], Hidetoshi Miyazaki[2],

Hiroyuki Ii[3], Ping An[4], Teru Tanaka[5] (1.Faculty of Education, Wakayama University, Japan, 2.Research unit, The Global Environmental Forum, Japan, 3.Faculty of Systems Engineering, Wakayama University, Japan, 4.Arid Land Research Center, Tottori University, Japan, 5.Faculty of Agriculture, Setsunan University, Japan)
12:15 PM - 1:00 PM

[P4-30] Relationship between Non-Destructive Measurement Parameters and Yield in Sweet Potatoes

○Masayuki Kadowaki[1], Tomohiro Araki[2], Risa Umehara[2], Sokichi Shiro[1], Shingo Matsumoto[1] (1.Institute of Agricultural and Life Sciences Academic Assembly, Shimane University, Japan, 2.Faculty of Life and Environmental Science, Shimane University, Japan)
1:15 PM - 2:00 PM

[P4-31] Heat Stress Impact on Heading and Ripening in Major Korean Rice Variety

○Woonha Hwang, Chungkeun Lee, Jaehyeok Jung, Hyeonseock Lee, Seoyeong Yang, Yeonhwa Lim, Myeonggu Choi (Crop Production and Physiology Division, National Institute of Crop Science, Korea)
12:15 PM - 1:00 PM

[P4-32] Genetic Variations of Rhizome Yield, Essential Oil Content and Constituents in *Curcuma* Species and Strains

○Akira Miyazaki[1], Yukari Shiino[1], Hiroshi Hayakawa[2], Yoshito Ohtani[1], Yoshinori Yamamoto[1] (1.Faculty of Agriculture and Marine Science, Kochi University, Japan, 2.Museum of Natural and Environmental History, Shizuoka, Japan)
1:15 PM - 2:00 PM

[P4-33] Relationship between Pre-Harvest Sprouting Variation and Physicochemical Properties in Varieties of Rice Flour

○Chae Min Han, Jong Hee Shin, Jung Bae Kwon, Jong Gun Won (Division of Crops Research, Gyeongsangbuk-do Provincial Agricultural Research & Extension Services, Korea)
12:15 PM - 1:00 PM

[P4-34] Physicochemical Properties of Rice Varieties Adapted to a Mountainous Region in Mid-South Korea

○Chae Min Han, Jong Hee Shin, Jung Bae Kwon, Jong Gun Won (Division of Crop Research, Yeongsangbuk-do Provincial Agricultural Research & Extension Services, Korea)
1:15 PM - 2:00 PM

[P4-35] Marker-Assisted Selection to Develop the High Nutrition Rice, Giant-Golden-Purple Rice, PFR32, and Giant-Golden-Red Rice, RFR13

○Yu-Chia Hsu[1], Yu-Chien Tseng[1], Yu-Chi Cheng[2], Bing-Nan Lin[1], Yong-Pei Wu[2] (1.Department of Agronomy, National Chiayi University, Taiwan, 2.Department of Agronomy, Chiayi Agricultural Experiment Station, Taiwan Agricultural Research Institute, Taiwan)
12:15 PM - 1:00 PM

[P4-36] Genetic and Morphological Mechanisms for Soil-Surface Roots Originated from a New Plant Type Cultivar in Rice (*Oryza sativa* L.)

○Asami Tomita[1,2], Hiroki Saito[2], Yoshimichi Fukuta[2] (1.Graduate School of Environmental and Life Science, Okayama University, Japan, 2.Tropical Agriculture Research Front, Japan International Research Center for Agricultural Sciences, Japan)
1:15 PM - 2:00 PM

[P4-37] Development and Genetic Analysis of Compensatory Growth of Lateral Roots in Rice

○Tsubasa Kawai[1, 3], Misuzu Nosaka-Takahashi[2], Yutaka Sato[2], Yinglong Chen[3], Kadambot H. M. Siddique[3], Hirokazu Takahashi[1], Mikio Nakazono[1], Akira Yamauchi[1], Yoshiaki Inukai[4] (1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.National Institute of Genetics, Japan, 3.The UWA Institute of Agriculture, The University of Western Australia, Australia, 4.International Center for Research and Education in Agriculture, Nagoya University, Japan)
12:15 PM - 1:00 PM

[P4-38] Daytime or Nighttime: When Plant Roots Uptake Nitrogen?

○Md Mehedi Hasan[1], Maya Matsunami[2], Hiroyuki Shimono[2] (1.United Graduate School of Agricultural Sciences, Iwate University, Japan, 2.Faculty of Agriculture, Iwate University, Japan)
1:15 PM - 2:00 PM

[P4-39] Maintaining Higher Leaf Photosynthesis After Heading Stage Contributes to Higher Biomass Accumulation in Rice

○Sotaro Honda[1], Satoshi Ohkubo[2], Nan Su San[2], Anothai Nakkasame[2], Kazuki Tomisawa[2], Keisuke Katsura[2], Taiichiro Ookawa[2], Atsushi J. Nagano[3], Shunsuke Adachi[2,4] （1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan, 3.Faculty of Agriculture, Ryukoku University, Japan, 4.College of Agriculture, Ibaraki University, Japan）

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[P4-40] Genetic Analysis of Root Vascular Traits in a Population from Two *Temperate Japonica* Rice Ecotypes

○Ha-An Thi Nguyen[1], Akihiko Kamoshita[1], Poornima Ramalingam[1,2], Phoura Y[1] （1.Asian Research Center for Bioresources and Environmental Sciences, Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Department of Plant Biotechnology, Tamil Nadu Agricultural University, India）

1:15 PM - 2:00 PM

[P4-41] CO_2-Responsive CCT Protein Interacts with 14-3-3 Proteins and Regulates the Expression of Starch Synthesis-Related Genes

○Fumihiro Miyagawa, Naoki Shibatani, Aiko Koudou, Daisuke Sasayama, Tomoko Hatanaka, Tetsushi Azuma, Hiroshi Fukayama （Graduate School of Agricultural Science, Kobe University, Japan）

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[P4-42] CRISPR/Cas9 — Based Genome Editing of *GCN5*, a Histone Acetyltransferase Gene, in Rice (*Oryza sativa* L.)

○Shu Takakura[1], Fumiya Miyamoto[1], Shicheng Feng[1], Sakae Agarie[2], Kazuyuki Saitou[2] （1.Graduate School of Bioresource and Bioenviroment Sciences, Kyushu University, Japan, 2.Faculty of Agriculture (Graduate School), Kyushu University, Japan）

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[P1] Field Crop Production

Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster) (Field Crop Production)

[P1-01] Seed Size Evaluation of Rice Genotypes for Direct Seeding Development Cultivar

○Ahmad Rifqi Fauzi[1], Ahmad Junaedi[2], Iskandar Lubis[2], Munif Ghulamahdi[3], Hajrial Aswidinnoor[4] (1.Graduate School of Agronomy and Horticulture Study Program, Bogor Agricultural University, Indonesia, 2.Division of Plant Production, Agronomy and Horticulture Department, Faculty of Agriculture, Bogor Agricultural University, Indonesia, 3.Division of Plant Ecophysiology, Agronomy and Horticulture Department, Faculty of Agriculture, Bogor Agricultural University, Indonesia, 4.Division of Plant Genetic and Plant Breeding, Agronomy and Horticulture Department, Faculty of Agriculture, Bogor Agricultural University, Indonesia)

12:15 PM - 1:00 PM

[P1-02] Effects of Seed Drying and Storage Conditions on the Germination Characteristics and Emergence Rates in Early-Winter Direct Seeding of Paddy Rice

○Kensaku Suzuki, Seiji Oikawa, Naoko Aikawa, Hiroyuki Shimono (Department of Plant Biosciences, Faculty of Agriculture, Iwate University, Japan)

1:15 PM - 2:00 PM

[P1-03] Root-Elongated Seeds Can Extend the First Leaf Quickly in Direct-Seeded Rice

○Hiromi Imasu, Hiroyuki Shiratsuchi, Keiko Ito, Masami Furuhata (Tohoku Agricultural Research Center, National Agriculture and Food Research Organization, Japan)

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[P1-04] Effect of Seed Maturity on Seedling Establishment in Early-Winter Direct-Sowing Cultivation In Rice

○Seiji Oikawa, Kensaku Suzuki, Naoko Aikawa, Maya Matsunami, Hiroyuki Shimono (Department of Plant Biosciences, Faculty of Agriculture, Iwate University, Japan)

1:15 PM - 2:00 PM

[P1-05] Effect of Deep Seed Placement on the Crop Establishment and Yield of Dry Direct-Seeded Rice

○Noriko Kanno[1], Kyoko Ito[2], Taiken Nakashima[2], Ricardo Garcia[3], Roel R. Suralta[4], Aurora M. Corales[4], Crisanta S. Bueno[5], Niño P. M. C. Banayo[5], Pompe C. Sta. Cruz[5], Virender Kumar[6], Yoichiro Kato[1] (1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Graduate School of Agriculture, Hokkaido University, Japan, 3.Pangasinan State University Sta Maria, Philippines, 4.Philippine Rice Research Institute, Philippines, 5.University of the Philippines Los Baños, Philippines, 6.International Rice Research Institute, Philippines)

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[P1-06] Identification of Quantitative Trait Loci Controlling Nitrogen Use Efficiency-Related Traits in Rice at the Seedling Stage under Salt Condition by Genome-Wide Association Study

○NhungThi Hong Phan[1,2], Cuong Van Pham[2], Pierre Bertin[1] (1.Earth and Life Institue,

Université Catholique de Louvain, Belgium, 2.Agronomy Faculty, Vietnam National University of Agriculture, Vietnam）

1:15 PM - 2:00 PM

[P1-07] Analysis of the N Uptake Pattern to Improve Increasing Yields of Dry Direct-Seeding Rice in a Cool Climate

○Mari Namikawa[1,2], Toshihiro Hasegawa[1], Takayuki Yabiku[1], Toshinori Matsunami[1] （1.Tohoku Agricultural Research Center, National Agriculture and Food Research Organization, Japan, 2.Crop Science Laboratory, United Graduate School of Agricultural Sciences, Iwate University, Japan）

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[P1-08] Changes in Rice Farming from 2009 to 2019 in Three Rice Ecosystems with Contrasting Water Availability in Cambodia -Labor Saving and Mechanization-

○Rinako Takashima[1,2], Akihiko Kamoshita[2], Sareth Chea[3], Sophornthida Lim[3] （1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Asian Natural Environmental Science Center, The University of Tokyo, Japan, 3.Socioeconomic office, Cambodian Agricultural Research and Development Institute (CARDI), Cambodia）

1:15 PM - 2:00 PM

[P1-09] Effect of Climate on the Yield of 'Ilpum' Rice Cultivar in Gyeongbuk Province, South Korea over the Past 25 Years

○Jong-Hee Shin[1], Chae-Min Han[1], Jung-Bae Kwon[1], Sang-Kuk Kim[2], Yong-Seub Shin[1] （1.Crop Research, Gyeongsangbuk-do Provincial Agricultural Research and Extension Services, Korea, 2., Bioresources Research Institute, Korea）

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[P1-10] Differences in Growth and Physiological Characteristics of Winter Wheat Growth under Various Nitrogen Topdressing Conditions

Jae-Gyeong Jeong[1], Jaeeun Choi[1], Young-Hun Lee[1], Gi-Eun Song[1,2], Jonghan Ko[3], Kyung-Do Lee[4], ○Sang-In Shim[1] （1.Department of Agronomy, Gyeongsang National University, Korea, 2.Division of Applied Life Science (BK21 Plus), Gyeongsang National University, Korea, 3.Department of Applied Plant Science, Chonnam National University, Korea, 4.Climate Change and Agro-Ecology Division, RDA, Korea）

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[P1-11] Importance of Water Resource Conservation in Agriculture of the Aso Region - Lessons from the Kumamoto Earthquake

○Jun Abe[1], Naoki Kato[2], Atsushi Kashimura[1], Hitoshi Kinouchi[1], Chinobu Okamoto[1] （1.School of Agriculture, Tokai University, Japan, 2.Kyushu Okinawa Agricultural Research Center, National Agriculture and Food Research Organization, Japan）

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[P1-12] Cultivar Difference of Iron Toxicity Tolerance in Rice (*Oryza sativa* L.) during Germination and Seedling Stages

○Haruka Aratani[1], Indrastuti A. Rumanti[2], Yoichiro Kato[1] （1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2., Indonesian Center for Rice Research, Indonesia）

1:15 PM - 2:00 PM

[P1-13] Variation in Grain Characteristics of Upland Rice Cultivated in Southeast Sulawesi, Indonesia

○Mayumi Kikuta[1], Yulius Barra Pasolon[2], Fransiscus Suramas Rembon[2], Akira Miyazaki[3], Yoshinori Yamamoto[3] （1.Graduate School of Integrated Sciences of Life, Hiroshima University, Japan, 2.Faculty of Agriculture, Halu Oleo University, Indonesia, 3.Faculty of Agriculture and Marine Science, Kochi University, Japan）

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[P1-14] Combined UAV and Phenotyping Data to Optimize the Growing Status and Management System on Rice Variety, TN11 and NCYU-TN2 in Taiwan

○Yu-Chien Tseng[1], Chun-Yi Wu[1], Wen Lii Huang[1], Wei-Jun Huang[2], Rong-Kuen Chen[3] （1.Agronomy Department, National Chiayi University, Taiwan, 2.Biomechatronic Engineering Department, National Chiayi University, Taiwan, 3.Chiayi Branch Station, Tainan District Agricultural Research and Extension Station, Taiwan）

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[P1-15] On-Farm Assessment on Growth and Yield Response of Maize to Different Planting Methods and Tillage Conditions in Rice-Based Cropping System in the Philippines

Kyoko Ito[1], Noriko Kanno[2], Ricardo Garcia[3], Roel R. Suralta[4], Aurora M. Corales[4], John O. Abon[4], Elmer G. Bautista[4], Crisanta S. Bueno[5], Niño P. M. C. Banayo[5], Pompe C. Sta. Cruz[5], Yoichiro Kato[2], ○Taiken Nakashima[1] （1.Graduate School of Agriculture, Hokkaido University, Japan, 2.The University of Tokyo, Japan, 3.Pangasinan State University Sta Maria, Philippines, 4.Philippine Rice Research Institute, Philippines, 5.University of the Philippines Los Baños, Philippines）

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[P1-16] Assessment of Dual-Purpose Sweet Potato Cultivation in Japan: Effects of Shoot Harvest Regimes and Cultivar Differences

○Kazuki Taguchi （Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

1:15 PM - 2:00 PM

[P1-17] Improved Fertilizer Use Efficiency of Rice by Deep-Place Fertilization Method

○Mumtahina Nabila[1], Keigo Yoshinaga[2], Shin Okamura[3], Tomoya Kumachi[2], Hiroyuki Shimono[2,4], Maya Matsunami[2] （1.United Graduate School of Agricultural Sciences, Iwate University, Japan, 2.Faculty of Agriculture, Iwate University, Japan, 3.Graduate School of Integrated Arts and Sciences, Iwate University, Japan, 4.Agri-Innovation Center, Iwate University, Japan）

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[P1-18] Ex-Ante Analysis of Rice Agroecosystems Areas, Yield and Production in Asia

○Jayson Osopelia Villamor （Department of Crop Science, Central Luzon State University, Philippines）

1:15 PM - 2:00 PM

[P1-19] NB-LRR-Encoding Genes Conferring Susceptibility to Organophosphate Pesticides and Leaf Greenness in Sorghum

○Zihuan Jing[1], Fiona Wacera W[1], Tsuneaki Takami[1], Hideki Takanashi[2], Fumi Fukada[1], Yoji

Kawano[1], Hiromi Kajiya-Kanegae[3], Hiroyoshi Iwata[2], Nobuhiro Tsutsumi[2], Wataru Sakamoto[1]
（1.Institute of Plant Science and Resources, Okayama University, Japan, 2.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 3.Research Center for Agricultural Information Technology, National Agriculture and Food Research Organization, Japan）
12:15 PM - 1:00 PM

[P1-20] Effect of *Phytophthora sojae* Inoculation on Soybean — Mortality as Affected by Environmental Factors and Growth of Survived Plant

○Terufumi Tada, Momo Kato, Chihiro Tanaka, Tatsuhiko Shiraiwa （Graduate School of Agriculture, Kyoto University, Japan）
1:15 PM - 2:00 PM

[P1-21] Effect of Narrow-Row Planting with Inter-Row Strip Tillage by Chisel Plough on Yield and Labor Saving to Soybean Cultivation at Field Converted from Paddy in Shonai-Plane of Japan

○Hiroyuki Takeda[1], Hidefumi Saito[1], Naoto Ikeyama[2], Hiroshi Saito[3] （1.Tohoku Agricultural Research Center, National Agriculture and Food Research Organization, Japan, 2.Faculty of Agriculture, Yamagata University, Japan, 3.Rice Breeding and Crop Science Experiment Station, Yamagata Integrated Agricultural Research Center, Japan）
12:15 PM - 1:00 PM

[P1-22] The Evaluation of Disease Resistance, Agronomic Traits and Yield Among Four Market Types in Peanut (*Arachis hypogaea* L.) Germplasm Collection

○Hsin-I Kuo[1], Hung-Yu Dai[2], Yong-Pei Wu[3], Yu-Chien Tseng[1] （1.Agronomy Department, National Chaiyi University, Taiwan, 2.Agronomy Department, Chiayi Agricultural Experiment Station, Taiwan Agricultural Research Institute, Taiwan, 3.Crop Division, Taiwan Agricultural Research Institute, Taiwan）
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[P1-23] Investigation of the Albinism Derived from Sub-Species Hybridization in Peanuts

○Chuan-You Li[1], Hung-Yu Dai[2], Yu-Chien Tseng[1] （1.Agronomy Department, National Chiayi University, Taiwan, 2.Crop Division, Taiwan Agricultural Research Institute, Taiwan）
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[P1-24] Co-Inoculation of *Bacillus pumilus* TUAT1 and *Bradyrhizobium diazoefficiens* USDA110 on Soybean

○Rifa Fadhilah Munifah Hasibuan, Hinako Sugiura, Minori Miyatake, Naoko Ohkama-Ohtsu, Keisuke Katsura （Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan）
1:15 PM - 2:00 PM

[P1-25] Fodder and Grain Production by Double-Cropping System of Rye

○Masahiro Akimoto[1], Honami Okamoto[2], Taiki Yoshihira[3] （1.Agro-Environmental Science, Obihiro University of Agriculture and Veterinary Medicine, Japan, 2.Plant Science Unit, Obihiro University of Agriculture and Veterinary Medicine, Japan, 3.Collage of Agriculture, Food and Environmental Sciences, Rakuno Gakuen University, Japan）
12:15 PM - 1:00 PM

[P1-26] Anaerobic and High Light Stress-Induced Leaf Abscission in Chili Pepper (*Capsicum* spp.)

○Keita Goto[1], Shotaro Tamaru[1], Peter Balyejusa Ssenyonga[2], Emmanuel Kiprono Bore[2], Shin Yabuta[3], Jun-Ichi Sakagami[3] （1.The United Graduate School of Agricultural Sciences, Kagoshima University, Japan, 2.Graduate School of Agriculture, Forestry and Fisheries, Kagoshima University, Japan, 3.Faculty of Agriculture, Kagoshima University, Japan）

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[P1-27] Leaf Senescence Evaluation of Selected Interspecific Progenies between *O. sativa* and *O. glaberrima*; NERICA Varieties for Stay-Green Characteristics during Grain-Filling Period

○Peter Balyejusa Ssenyonga[1], Shin Yabuta[2], Shotaro Tamaru[3], Jun-Ichi Sakagami[1,2,3] （1.Graduate School of Agriculture, Forestry and Fisheries, Kagoshima University, Japan, 2.Faculty of Agriculture, Kagoshima University, Japan, 3.The United graduate School of Agricultural Sciences, Kagoshima University, Japan）

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12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-01] Seed Size Evaluation of Rice Genotypes for Direct Seeding Development Cultivar

*Nominated for Presentation Awards

○Ahmad Rifqi Fauzi[1], Ahmad Junaedi[2], Iskandar Lubis[2], Munif Ghulamahdi[3], Hajrial Aswidinnoor[4]
(1.Graduate School of Agronomy and Horticulture Study Program, Bogor Agricultural University, Indonesia, 2.Division of Plant Production, Agronomy and Horticulture Department, Faculty of Agriculture, Bogor Agricultural University, Indonesia, 3.Division of Plant Ecophysiology, Agronomy and Horticulture Department, Faculty of Agriculture, Bogor Agricultural University, Indonesia, 4.Division of Plant Genetic and Plant Breeding, Agronomy and Horticulture Department, Faculty of Agriculture, Bogor Agricultural University, Indonesia)

Direct seeding of rice (DSR) system would be potentially giving more efficient rice production which less labor and saving water. An appropriate DSR cultivar will improve DSR systems through early vigor trait that may relate to seed size. This research has objective to evaluate the relationship among seed observed variables, i,e.: seed (whole grain), endosperm and embryo size (area, length, width, perimeter, and length-to-width ratio (LWR)) and its early vigor test. The rice germplasm consists of 55 rice genotypes (50 genotypes originating from the IPB University breeding program and 5 national varieties). Description of rice germplasm indicated that the size of seeds, endosperms, and embryos among tested genotypes are significantly different, and the seed and endosperm size (length, perimeter, and LWR) are positively correlated with 1000-grain weight and length of endosperm and seed have given direct effect by path analysis (R^2 = 42.6%). The rice genotypes are continuously observed for early vigor characters by seed germination test and will be evaluated its relationship with seed size traits. Further evaluation on the growth and development performance in the greenhouse and field experiment of selected potentially rice germplasm will be performed to confirm the early vigor character with agronomical goal of this DSR cultivated system.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-02] Effects of Seed Drying and Storage Conditions on the Germination Characteristics and Emergence Rates in Early-Winter Direct Seeding of Paddy Rice

○Kensaku Suzuki, Seiji Oikawa, Naoko Aikawa, Hiroyuki Shimono (Department of Plant Biosciences, Faculty of Agriculture, Iwate University, Japan)

Large-scale cultivation is necessary for cost reduction and labor saving in paddy rice farming. However, the concentration of demand for machinery and labor during the limited seeding period in spring restricts the scale expansion, especially in snowy areas. Early-winter direct seeding is a promising way to overcome this limitation (Shimono et al. 2012, *Jpn J. Crop Sci.*, **81**, 93-98; Oikawa et al. 2019, *Jpn J. Crop Sci.*, **88**, 259-267), although its practical use requires an improvement in the very low emergence rate in spring. Our recent preliminary studies suggested that seed drying and/or storage conditions may affect the rate: lower drying temperatures appeared to increase the emergence rates of some cultivars. In this study, we tested the combination of three different temperatures (30℃, 40℃ and 50℃) for drying and four different temperatures (-30℃, 4℃, 15℃ and 25℃) for storage, to compare the

germination and emergence rates of a *japonica* rice cultivar "Hitomebore", to help improve the emergence rate in early-winter dry-direct seeding cultivation. The germination rate of stored seeds did not change over the storage period up to spring. However, regardless of the drying temperatures, the longer the storage period or the higher storage temperature tested (except -30℃, where the germination speed did not change), the higher the germination speed. The relationship between the germination speed of stored seeds and emergence rate in the field is discussed.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-03] Root-Elongated Seeds Can Extend the First Leaf Quickly in Direct-Seeded Rice

*Nominated for Presentation Awards

○Hiromi Imasu, Hiroyuki Shiratsuchi, Keiko Ito, Masami Furuhata （Tohoku Agricultural Research Center, National Agriculture and Food Research Organization, Japan）

In direct seeding of rice, rapid elongation of the coleoptile and the first leaf (incomplete leaf) is crucial for seedling establishment. It is reported that root-elongated seeds can grow faster and achieve higher establishment rate than conventionally used pre-germinated seeds because of the fast elongation of the coleoptile. Roots elongate when soaked seeds were put under the warm aerobic condition. To investigate whether this treatment has good effects on the first leaf as well as on the coleoptile, we conducted two experiments. Root-elongated seeds, root-cut seeds and pre-germinated seeds were sown in the pots filled with puddled soil and 1.5cm depth of water at 15° C. The time required for the emergence of the first leaf after the coleoptile had emerged was shorter in the former two seed treatments than in the latter. The same seeds were sown in the submerged agarose medium at 18° C. Until the leaf age of 1.5, leaves of root-elongated seeds and root-cut seeds elongated faster than those of pre-germinated seeds. After then, the speed of the leaf elongation was the same between the all seed treatments. The results show that seed germination under aerobic condition promotes the elongation of the first leaf, and that this is not due to the function of the root. These findings and previous reports suggest that the moderate humidity and oxygen supply during the seed pre-germination promotes the development of the plumule in the embryo, enables the rapid elongation of the coleoptile and the first leaf beneath the flooded soil surface, and improves the seedling establishment.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-04] Effect of Seed Maturity on Seedling Establishment in Early-Winter Direct-Sowing Cultivation In Rice

○Seiji Oikawa, Kensaku Suzuki, Naoko Aikawa, Maya Matsunami, Hiroyuki Shimono （Department of Plant Biosciences, Faculty of Agriculture, Iwate University, Japan）

Early-winter Direct-sowing cultivation in rice is being put to practical use to extend the cropping season in cold regions. We examined the effect of seed maturity on seedling establishment in three rice cultivars ("Akitakomachi", "Hitomebore" and "Koshihikari") using seeds harvested at three different timing (20, 30, 40 days after heading, DAH). Seeds harvested 20DAH had a lower seedling establishment than seeds harvested 40DAH for all cultivars. The dormancy of seeds harvested at 40DAH tended to be

higher than 20DAH in two out of three cultivars. In fact, we found seeds broken their dormancy (50℃, 7days) reduced the seedling establishment. The results showed that the well ripened seeds through the deeper dormancy might be suitable to Early-winter Direct-sowing cultivation in rice than un-ripened seeds.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-05] Effect of Deep Seed Placement on the Crop Establishment and Yield of Dry Direct-Seeded Rice

*Nominated for Presentation Awards

○Noriko Kanno[1], Kyoko Ito[2], Taiken Nakashima[2], Ricardo Garcia[3], Roel R. Suralta[4], Aurora M. Corales[4], Crisanta S. Bueno[5], Niño P. M. C. Banayo[5], Pompe C. Sta. Cruz[5], Virender Kumar[6], Yoichiro Kato[1]
（1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Graduate School of Agriculture, Hokkaido University, Japan, 3.Pangasinan State University Sta Maria, Philippines, 4.Philippine Rice Research Institute, Philippines, 5.University of the Philippines Los Baños, Philippines, 6.International Rice Research Institute, Philippines）

Dry direct seeding is widely employed for rice cultivation where water and labor shortage is an issue in transplanting practices. However, drought during the seedling emergence often causes poor crop establishment. This problem might be solved by deep sowing technique since it utilizes the residual moisture below the soil surface. The objective of this study was to examine the effects of different sowing depths on growths and yields of dry direct-seeded rice. Two trials were conducted in rainfed lowlands; an on-station trial in Tokyo, Japan (35°44'N, 139°32'E) and an on-farm trial in Pangasinan, the Philippines (16°00'N, 120°46'E). Four cultivars (Dular, Dontokoi, Rc10 and Rc348) were grown by seeding at two depths (1 cm and 7 cm) during the summer of 2018 in Japan, and two cultivars (Rc222 and Rc420) at two depths (1 cm and 6 cm) on three sowing dates during the wet season of 2019 in the Philippines. In both trials, deep-sown plots had significantly lower emergence rate than shallow-sown plots (25% vs. 73%). When deep-sown, cultivars with longer mesocotyl and 1st internode emerged better than others. When deep-sown rice had less than 30% of emergence, the yield was 25% to 55% of shallow-sown rice mainly due to reduced panicle number. The compensation effects of increased tillers per hill and grains per panicle were smaller than the negative effect of low plant density caused by deep sowing. The results suggested that securing crop establishment (more than 17 hills m^{-2}) by choosing appropriate cultivar is important in deep sowing technique for dry direct-seeded rice.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-06] Identification of Quantitative Trait Loci Controlling Nitrogen Use Efficiency-Related Traits in Rice at the Seedling Stage under Salt Condition by Genome-Wide Association Study

*Nominated for Presentation Awards

○NhungThi Hong Phan[1,2], Cuong Van Pham[2], Pierre Bertin[1] （1.Earth and Life Institue, Université Catholique de Louvain, Belgium, 2.Agronomy Faculty, Vietnam National University of Agriculture,

Vietnam)

Background: Rice cultivation is facing two severe environmental concerns, salt intrusion and overuse of nitrogen fertilizers. Hence, breeding new varieties aiming to improve nitrogen use efficiency (NUE), especially under salt conditions, is indispensable. However, genetic information related to NUE traits under salt conditions is limited.
Methods: A total of 2,391 rice accessions from the 3K Rice Genome Project were selected to evaluate dry weight under two N concentrations (0.36 mM N - LN and 2.86 mM N - SN) crossed with two NaCl concentrations (0 mM NaCl - 0Na and 60 mM NaCl - 60Na) at the seedling stage. We carried out an association study for shoot dry weight (SDW), root dry weight (RDW), whole plant dry weight (PDW), the ratio of SDW and RDW (SRR), and relative PDWLN0Na-SN0Na, PDWSN60Na-SN0Na, PDWLN60Na-LN0Na, and PDWLN60Na-SN60Na. The GWAS was conducted with 235,210 SNPs and phenotypic data of 2,391 accessions.
Results: A total of 157 QTLs associated with eight tested traits under the four applied treatments were identified by GWAS. Among them, 39, 27, 30, and 31 QTLs were detected under 0SN, 0LN, 60SN, and 60LN treatment, respectively, whereas 12, 5, 4, and 9 QTLs related to the relative PDWLN0Na-SN0Na, PDWSN60Na-SN0Na, PDWLN60Na-LN0Na, and PDWLN60Na-SN60Na were identified. Few QTLs were detected in both treatments of low N and normal N levels or of non-saline and saline conditions. Many QTLs co-located with previously detected QTLs related traits. These results indicated that the false positive probability of the QTLs identified in this study could be very low.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-07] Analysis of the N Uptake Pattern to Improve Increasing Yields of Dry Direct-Seeding Rice in a Cool Climate

*Nominated for Presentation Awards

○Mari Namikawa[1,2], Toshihiro Hasegawa[1], Takayuki Yabiku[1], Toshinori Matsunami[1] (1.Tohoku Agricultural Research Center, National Agriculture and Food Research Organization, Japan, 2.Crop Science Laboratory, United Graduate School of Agricultural Sciences, Iwate University, Japan)

Dry direct-seeded rice (DSR) is a promising alternative to reduce labor costs compared to transplanted rice, but its low nitrogen (N) fertilizer use efficiency is one of the constraints to the efficient management of DSR in a cool climate. To explore reasons for low NUE in northern Japan, we examined the N uptake patterns of DSR under three different fertilizer regimes under three environments: two years in Morioka and one in Hanamaki, Iwate Prefecture, Japan. We used two cultivars ('Akitakomachi' and 'Yumiazusa') in Morioka and one ('Moeminori') in Hanamaki. In all N treatments at both sites, N uptake patterns exhibited the initial exponential growth (phase 1) followed by a linear growth (phase 2) as a function of the accumulated effective thermal index (AETI). These patterns are well characterized by four parameters: N uptake at the 5th leaf age (*NLA5*), Relative Nitrogen Uptake Rate (*RNR*) in phase 1, breakpoint AETI at which the pattern shifts from the exponential to linear phase (*Nbreak+a AETI*), and the constant rate of N uptake in phase 2 (*a*). Nitrogen treatments had significant effects on *NLA5*, *RNR* and *a*. Multiple regression analysis revealed that the three parameters had significantly positive effects on grain yield, but *NLA5* and *RNR* had greater effects than *a*. We, therefore, conclude that the N uptake pattern during the exponential growth phase imposes the major limitation to yield. *NLA5* differed between environments suggesting initial growth/soil conditions also play a role in controlling early growth and thus grain yields.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-08] Changes in Rice Farming from 2009 to 2019 in Three Rice Ecosystems with Contrasting Water Availability in Cambodia -Labor Saving and Mechanization-

*Nominated for Presentation Awards

○Rinako Takashima[1,2], Akihiko Kamoshita[2], Sareth Chea[3], Sophornthida Lim[3] (1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Asian Natural Environmental Science Center, The University of Tokyo, Japan, 3.Socioeconomic office, Cambodian Agricultural Research and Development Institute (CARDI), Cambodia)

Rice farming in Cambodia has changed along with its rapid economic development but the differences across its diverse rice ecosystems have not been systematically studied. In order to assess regional differences in the changes in rice farming from 2009 to 2019 from (i) technology for water management, (ii) rice market opportunity and (iii) agriculture labor availability, a questionnaire survey was conducted in August 2019 in total of 151 households (HH) in 4 regions under 3 different rice ecosystems; 48 HH from Banan in Battambang Province (irrigated rice ecosystem; IR), 37 HH from Sangke in Battambang Province (deep-water rice ecosystem; DW), 34 HH from Kampong Chhnang Province and 32 HH from Takeo Province (rainfed lowland rice ecosystem; RL). Sangke changed from single deepwater rice production during wet season to short duration irrigated double rice production (i.e., dry season rice and early wet season rice) after the big flood damages in 2011. Rice income increased from 2009 to 2019 greater in IR and DW than RL; RL relied higher proportion of income on off-farm jobs. In order to cope with declining agricultural labor availability, mechanization and/or direct seeding played important roles in all the 3 rice ecosystems. Half of the farmers use both combine harvesters and tractors (only in IR and DW) whereas hand tractors and combine harvesters were used in RL. The amount of labor per hectare (person*day/ha) was one-twentieth of the HH with combine harvesters and tractors for direct seeding, compared to the households with only hand tractors for transplanting.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-09] Effect of Climate on the Yield of 'Ilpum' Rice Cultivar in Gyeongbuk Province, South Korea over the Past 25 Years

○Jong-Hee Shin[1], Chae-Min Han[1], Jung-Bae Kwon[1], Sang-Kuk Kim[2], Yong-Seub Shin[1] (1.Crop Research, Gyeongsangbuk-do Provincial Agricultural Research and Extension Services, Korea, 2., Bioresources Research Institute, Korea)

The aim of this study was to analyze the relationship between rice yield of 'Ilpum', the main rice cultivar in Gyeongbuk province, and climate elements in Daegu (southern plain area) and Andong (inland mountainous area) regions in Gyeongbuk, south Korea. Over the past 25 years, rice yield of 'Ilpum' cultivar has increased in both regions. The rice yield in the recent 5 years increased by about 13% and 20%, respectively, compared to that produced in the late 1990s in Daegu and the early 2000s in the Andong region. The number of panicles per hill and grain ripening rate significantly affected rice yield in

'Ilpum' cultivars in Daegu region. The relationship between heading date and rice yield had a negative significant correlation in Andong region. The air temperature is rising and sunshine duration is getting longer from the late 1990s to present in both regions. To understand the effect of climate factors on rice yield, the milled rice yield of 'Ilpum' cultivar produced over the past 25 years (1995-2019) at both locations, Daegu and Andong, were evaluated. The rice yields increased owing to long sunshine duration during the grain filling stage in both regions. In Andong, rising maximum temperature during the vegetative stage increased rice yield. Rising air temperature during reproductive stage also increase rice yield. Especially, long sunshine hours through whole rice growing period increased rice yield of this cultivar in Andong region.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-10] Differences in Growth and Physiological Characteristics of Winter Wheat Growth under Various Nitrogen Topdressing Conditions

Jae-Gyeong Jeong[1], Jaeeun Choi[1], Young-Hun Lee[1], Gi-Eun Song[1,2], Jonghan Ko[3], Kyung-Do Lee[4], ○Sang-In Shim[1] (1.Department of Agronomy, Gyeongsang National University, Korea, 2.Division of Applied Life Science (BK21 Plus), Gyeongsang National University, Korea, 3.Department of Applied Plant Science, Chonnam National University, Korea, 4.Climate Change and Agro-Ecology Division, RDA, Korea)

The experiments with various levels of nitrogen topdressing was conducted to investigate the effects of various nitrogen topdressing conditions on the growth of winter wheat in Jinju, Korea from autumn 2018 to spring 2019. When nitrogen topdressing was applied at 0% of the standard fertilization rate, leaf SPAD value and NDVI were the lowest at 25.5 and 0.5210, respectively, and the plant height, leaf area index and yield-related characteristics were also the lowest. Crude protein content of grain was highest as 13.9% at recommended fertilizer application rate and lowest as 11.08% without nitrogen topdressing. Hyperspectral analysis, a non-destructive method, was performed using a portable hyperspectral camera to know changes in physiological characteristics of crops. As a result of analyzing the hyperspectral reflectance characteristics of winter wheat leaves according to various nitrogen topdressing rates, the difference in the hyperspectral reflectance at booting stage was most remarkable, and the reflectance in the green color region was high at 20% of the recommended N topdressing rate and low at the 80% of recommended N topdressing rate. The results show that the crude protein content in grain is the lowest as 7.81% at 20% nitrogen topdressing rate, which is consistent with the highest as 13.78% at 80% nitrogen topdressing rate.

This study is a part of Cooperative Research Program for Agriculture & Technology Development (Project No. PJ013841032020) from Rural Development Administration, Korea.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-11] Importance of Water Resource Conservation in Agriculture of the Aso Region - Lessons from the Kumamoto Earthquake

○Jun Abe[1], Naoki Kato[2], Atsushi Kashimura[1], Hitoshi Kinouchi[1], Chinobu Okamoto[1] （1.School of Agriculture, Tokai University, Japan, 2.Kyushu Okinawa Agricultural Research Center, National Agriculture and Food Research Organization, Japan）

In April of 2016, Kumamoto Earthquake caused huge disaster to agriculture in the Aso region, which is a large mountainous area in central Kyushu Island of Japan. We interviewed the affected farmers about the actual situation of the damage, focusing on the problem of water supply. In Aso City, which is located in the north of the Aso Caldera and has many large paddy fields, cracks, land irregularities, and liquefaction damaged the paddy fields. In addition, a long-distance underground waterway from the river was damaged and the water supply to the irrigation canal was cut off. In some areas it took three years to recover. Under such circumstances, the irrigation canals that use "natural water" (mountain stream) were less damaged and could be used again immediately. Despite such advantage of "natural water" for paddy irrigation, the supply of natural water has become unstable due to changes in the usage pattern of Mt. Aso and perhaps due to the decrease in snowfall caused by global warming. Natural alternative water sources also played an important role in the field of livestock. Dairy cow farmers helped cows by bringing water daily from nearby springs for months to a year and a half. Although traditional beef cattle grazing is declining, conservation of Aso grasslands should be important for a stable water supply.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-12] Cultivar Difference of Iron Toxicity Tolerance in Rice (*Oryza sativa* L.) during Germination and Seedling Stages

*Nominated for Presentation Awards

○Haruka Aratani[1], Indrastuti A. Rumanti[2], Yoichiro Kato[1] （1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2., Indonesian Center for Rice Research, Indonesia）

Iron (Fe) toxicity is a major constraint for rice production on acid sulfate soils in tropical deltas, where development of Fe toxicity-tolerant cultivars is prerequisite. In this study, genotype screening systems for Fe toxicity tolerance during germination and seedling stages were examined. For the screening during the germination stage, hydroponic and soil cultures and the use of agar medium were evaluated. Hydroponic and soil cultures proved suitable for large scale screening due to their simplicity and rapidity, while uniform seeding and water depth was critical in soil culture. In the screening during the seedling stage with hydroponic culture, varying Fe levels (0-400 mg L^{-1}) were compared, and we found that significant shoot biomass reduction occurs with more than 300 mg L^{-1} Fe. Our results also showed that the effect of pH was small in the range of pH 4-5, compared to that of Fe level in the range of 0-800 mg L^{-1}. Among seven cultivars (Cilamaya Muncul, DV85, INPARA2, INPARA5, IR64, Mahsuri and Taichung 65) grown at 500 mg L^{-1} Fe, Taichung 65 showed least shoot biomass reduction and the lowest shoot Fe concentration. This result suggested that Taichung 65 has root-based tolerant mechanism, possibly by preventing Fe from permeating the root or inhibiting the Fe transport from the root to the shoot. In conclusion, genotype screening systems for Fe toxicity during germination and seedling stages were established and Taichung 65 showed tolerance in the seedling stage, possibly by operating its root-based tolerant mechanism.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-13] Variation in Grain Characteristics of Upland Rice Cultivated in Southeast Sulawesi, Indonesia

*Nominated for Presentation Awards

○Mayumi Kikuta[1], Yulius Barra Pasolon[2], Fransiscus Suramas Rembon[2], Akira Miyazaki[3], Yoshinori Yamamoto[3] (1.Graduate School of Integrated Sciences of Life, Hiroshima University, Japan, 2.Faculty of Agriculture, Halu Oleo University, Indonesia, 3.Faculty of Agriculture and Marine Science, Kochi University, Japan)

Farms in Southeast Sulawesi Province, Indonesia, historically grow upland rice crops that utilize the slash-and-burn farming system. However, little is known about grain quality and the differences between upland rice varieties in this region. Ten traditional upland rice varieties were collected from the fields, and one upland variety was collected at a market in Kendari located within the province. Grain appearance was investigated. Amylose and protein content in brown rice were determined. These traditional varieties were highly varied in terms of grain appearance and grain quality-related factors. Grain color was white in six varieties, brown in four varieties, and blackish in one variety. The 1000-grain weight ranged from 20.7 to 33.5 g between the 11 rice varieties. The protein content in the 11 varieties ranged from 7.8% to 10.7%, with average of 8.7 %. Two rice varieties were characterized as glutinous with 0% amylose content. Amylose content in the eight varieties ranged from 14.8% to 19.7%, and they were characterized as non-glutinous. Additionally, we found one non-glutinous variety with extremely low amylose content (5.6%), which is a unique characteristic. These results indicate that this region contains valuable upland rice varieties, and this information is useful for future genetic resource studies.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-14] Combined UAV and Phenotyping Data to Optimize the Growing Status and Management System on Rice Variety, TN11 and NCYU-TN2 in Taiwan

○Yu-Chien Tseng[1], Chun-Yi Wu[1], Wen Lii Huang[1], Wei-Jun Huang[2], Rong-Kuen Chen[3] (1.Agronomy Department, National Chiayi University, Taiwan, 2.Biomechatronic Engineering Department, National Chiayi University, Taiwan, 3.Chiayi Branch Station, Tainan District Agricultural Research and Extension Station, Taiwan)

Rice (*Oryza sativa* L.) is one of the most important crop in the world. Climate changes increase the risk of rice production and decrease the yield. Also, the population aging problem in agriculture makes it difficult to have enough labor resources. The goal of the study is to combine UAV (unmanned aerial vehicle) data with phenotyping data in the field. By analyzing both data, to build a decision system and help researchers/farmers manage the production system in time and at early stage. On this study, rice cultivar TN11 and NCYU-TN2 were utilized. TN11 is the most popular cultivar in Taiwan and has the largest planted acreage. NCYU-TN2 is the drought tolerance cultivar derived from a population of *japonica* rice and Taiwanese rice landrace. The experiment included four nitrogen treatment (70, 140, 210, 280 ton/ha). UAV with multi spectrum camera was implemented four times during the season (initial stage, tiller develop stage, grain-fill stage and prior to harvest). The phenotype investigation was

conducted in the field at the same time. The UAV results were analyzed using Pix4D software and three values were mainly used, including NDVI (Normalized Difference Vegetation Index), NBI (Nitrogen Balance Index) and NDRE (Normalized Difference Red Edge Index). The results showed the nitrogen amount had positive correlation with plant height and NCYU-TN2 was taller than TN11, however, TN11 had more tiller numbers than NCYU-TN2. The tiller develop stage had the largest SPAD value on both cultivars. The regression analysis was conducted between yield/NDVI, yield/NBI, and yield/NDRE on different stages and both cultivars. NDVI and NDRE have better fitness than NBI on both cultivars. NCYU-TN2 showed R^2 =0.70 (r=0.84) between NDRE and yield on grain-fill stage.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-15] On-Farm Assessment on Growth and Yield Response of Maize to Different Planting Methods and Tillage Conditions in Rice-Based Cropping System in the Philippines

Kyoko Ito[1], Noriko Kanno[2], Ricardo Garcia[3], Roel R. Suralta[4], Aurora M. Corales[4], John O. Abon[4], Elmer G. Bautista[4], Crisanta S. Bueno[5], Niño P. M. C. Banayo[5], Pompe C. Sta. Cruz[5], Yoichiro Kato[2], ○Taiken Nakashima[1] (1.Graduate School of Agriculture, Hokkaido University, Japan, 2.The University of Tokyo, Japan, 3.Pangasinan State University Sta Maria, Philippines, 4.Philippine Rice Research Institute, Philippines, 5.University of the Philippines Los Baños, Philippines)

Maize (Zea mays L.) is the second most produced cereal crop in the Philippines. In many areas, it is grown in rice-based multiple cropping system. With the declining labor availability in rural areas, a labor-saving maize production is needed. Hence a hand tractor-mounted multiple-purpose (MP) seeder has been developed as a low-cost mechanized planting option for rice, maize and mung beans. In this study, we performed an on-farm experiment in Northwestern Luzon, the Philippines in 2019-2020 dry season to evaluate growth and yield response of maize to varying combinations of planting methods and tillage intensities. Three planting methods used were mechanized planting with MP Seeder (MP), manually operated local farmers' practice (FP), and high precision manual planting (PP) in combination with two tillage conditions; single and triple passes of rotavation for minimum (MT) and heavy tillage (HT), respectively. In MP, the time and labor costs for planting were drastically reduced compared to FP and PP. In contrast, higher plant density and lower variation in within-row distance were observed in both FP and PP. The yield was not significantly different among planting methods indicating a compensation growth in MP. No significant differences between MT and HT were detected in any parameters above. These results suggest that the use of MP seeder with minimal tillage can reduce labor and seed costs while maintaining yield level similar to the current farmers' practices, although there is still some room for improvement in MP seeder in terms of its seeding precision.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-16] Assessment of Dual-Purpose Sweet Potato Cultivation in Japan: Effects of Shoot Harvest Regimes and Cultivar Differences

*Nominated for Presentation Awards
○Kazuki Taguchi （Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

Sweet potato (*Ipomoea batatas* L.) is often cultivated for dual purposes by resource-poor farmers, and both tuberous root and shoot are harvested. Leaves are important as nutrient sources as they are rich in minerals and protein. The objectives of this study were to evaluate the effect of timing and intensity of mid-season harvest of shoot on tuberous root yield and total shoot yield, and cultivar differences in the response to mid-season harvest of shoot.
Two field trials were conducted at the upland farm of the University of Tokyo, Japan in the summer of 2020. In Trial 1, seven treatments (50%45DAP, 50%75DAP, 50%45DAP&75DAP, 100%45DAP, 100%75DAP, 20%45DAP&60DAP&75DAP, control) were compared, where 50%45DAP means 50% of shoot were harvested at 45 days after transplanting (DAP). In Trial 2, three cultivars (Beniazuma, Koganesengan and Suiou) were grown with mid-season harvest of shoot.
In Trial 1, total shoot yield was highest in 100%75DAP and least in 100%45DAP. Tuberous root yield was highest in control, while not significantly different from 50%45DAP. In Trial 2, total shoot yield was highest in Suiou, while Koganesengan for tuberous root yield. The total amount of iron in edible part (leaf + tuberous root) significantly increased by mid-season harvest of shoot.
The results showed that total shoot yield, tuberous root yield and crops' nutrient contents in dual-purpose sweet potato cultivation depend on the timing and intensity of shoot harvest. Suitable cultivars should possess both vigorous shoot recovery from mid-season harvest and genetic potential of high tuberous root yield.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-17] Improved Fertilizer Use Efficiency of Rice by Deep-Place Fertilization Method

*Nominated for Presentation Awards
○Mumtahina Nabila[1], Keigo Yoshinaga[2], Shin Okamura[3], Tomoya Kumachi[2], Hiroyuki Shimono[2,4], Maya Matsunami[2] （1.United Graduate School of Agricultural Sciences, Iwate University, Japan, 2.Faculty of Agriculture, Iwate University, Japan, 3.Graduate School of Integrated Arts and Sciences, Iwate University, Japan, 4.Agri-Innovation Center, Iwate University, Japan）

Deep-Place Fertilization (DPF) method is known to increase rice productivity than the conventional broadcast fertilization method in paddy field with improving nutrient use efficiency. However, no information is available for root traits suitable for DPF method. The present study evaluated the effects of DPF on root growth and nitrogen(N) use efficiency by field and root box experiments using rice cultivar Akitakomachi. Ammonium sulphate, slow-release N fertilizer used as N source. Nutrient mixed in soil used as control whereas nutrient ball placed in 7cm (DP1), 7cm and 15cm (DP2) depth of soil was the treatment condition. In DP2 treatment, fertilizer used in half amount in each position. At heading stage, greater root length, root surface area found at both DPF conditions compared to control especially at deep soil layer (below 10cm from soil surface). Increased surface area of deeper roots allowed plants to uptake more N during the ripening period. At maturity, N accumulation in above-ground parts found higher in DPF treatments and this resulted in higher yield production. The allocation of root to deeper position was supported by root box experiment. Increased root accumulation was found just below the fertilizer position in DPF conditions which indicates that DPF method induced root growth toward fertilizer. Taken together, deep fertilization induces the root growth to the lower layer of soil which

improves N use efficiency and yield production.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-18] Ex-Ante Analysis of Rice Agroecosystems Areas, Yield and Production in Asia

*Nominated for Presentation Awards

○Jayson Osopelia Villamor （Department of Crop Science, Central Luzon State University, Philippines）

Asian continent is home to more than half of the world's population which is at approximately 4.6 B as of 2018. It covers one-tenth of the global land areas. Rice is the major crop and staple food of most Asian people. Rice agroecosystems is the dominant landscape that is sustaining the food source of its inhabitants. With the use of FAOSTAT rice datasets and utilisation of data science vital information on areas devoted to rice crop, its yield and production were derived in this study. The whole of Asian continent was sub-divided per region namely: Central, Eastern, Southern, South-eastern and Western. Results showed that wider land areas were planted to rice as well as higher yields were recorded in Eastern, Southern and South-eastern regions. In consideration of the average per capita consumption for rice among Asians at 96 kg/person/year, the continent is experiencing a downward trend that could lead to rice production insufficiency. Possible adverse impacts of changing climatic conditions, ageing farmers and the overall declining rice yield despite the advances in rice production technologies. These issues can be mitigated by giving preferential attention by head of states, government regulatory or laws and policy implementing bodies as well as by all concerned stakeholders. Identified strategies proven by science and even by indigenous knowledge should be used and implemented accordingly to sustain life and wellness of the Asian populations.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-19] NB-LRR-Encoding Genes Conferring Susceptibility to Organophosphate Pesticides and Leaf Greenness in Sorghum

*Nominated for Presentation Awards

○Zihuan Jing[1], Fiona Wacera W[1], Tsuneaki Takami[1], Hideki Takanashi[2], Fumi Fukada[1], Yoji Kawano[1], Hiromi Kajiya-Kanegae[3], Hiroyoshi Iwata[2], Nobuhiro Tsutsumi[2], Wataru Sakamoto[1] （1.Institute of Plant Science and Resources, Okayama University, Japan, 2.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 3.Research Center for Agricultural Information Technology, National Agriculture and Food Research Organization, Japan）

In crops, leaf greenness or injury can be monitored for optimal growth and photosynthesis capacity, but developmental and environmental factors can influence leaf greenness negatively. Leaves may experience cell death following the application of organophosphate pesticides leading to growth defects, similar to pathogen infection. To understand organophosphate pesticide sensitivity (OPS) and leaf greenness in sorghum, we conducted QTL analysis in a recombinant inbred line derived from the Japanese cultivar NOG, which exhibits OPS. Assessment of leaf greenness in natural conditions allowed us to detect several QTLs, although the appearance of these QTLs was not fully reproducible over multiple years. However, mapping OPS in this population identified a prominent QTL on chromosome 5, which

corresponded to *Organophosphate-Sensitive Reaction (OSR)* reported previously in other mapping populations. The *OSR* locus included a cluster of three genes potentially encoding nucleotide-binding leucine-rich repeat (NB-LRR, NLR) proteins, among which *NLR-C* was considered to be responsible for OPS in a dominant fashion. *NLR-C* was functional in NOG, whereas the other resistant parent, BTx623, had a null mutation caused by the deletion of promoter sequences. Our finding of *OSR* as a dominant trait is important not only in understanding the diversified role of NB-LRR proteins in cereals but also in securing sorghum breeding free from OPS.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-20] Effect of *Phytophthora sojae* Inoculation on Soybean — Mortality as Affected by Environmental Factors and Growth of Survived Plant

*Nominated for Presentation Awards

○Terufumi Tada, Momo Kato, Chihiro Tanaka, Tatsuhiko Shiraiwa （Graduate School of Agriculture, Kyoto University, Japan）

Loss of soybean production due to Phytophthora stem and root rot (PSR) is serious, but the information on cultivation methods to reduce the PSR damages is limited. The objectives of this study were (1) to investigate major factors on the mortality rate due to PSR, and (2) to evaluate the effect of the pathogen existence and flooding on the traits of survived plants. (1) The seedlings of soybean cultivar 'Enrei' were inoculated with two *Phytophthora sojae* isolates (Ps060626-4-1 and Ps060710-3-1) in three different ways, like compulsory inoculation to injured hypocotyl under high relative humidity (CIH), or that under low humidity (CIL), or exposing uninjured plant to inoculum suspension under low humidity (EIL). The ratio of dead plants was highest in CIH (0.81) followed by CIL (0.65), and EIL (0.38). This result suggested that the mortality of soybean could be promoted by injury and high relative humidity. (2) The seedlings of soybean cultivar 'Enrei' were inoculated with the two pathogen isolates under non-flooded and flooded conditions and its effects on the growth of the plants were quantitatively evaluated. In all nine experiments except one, the inoculation caused maximum root length (MRL) to be significantly shorter. The interaction between inoculation and flooding influenced MRL and shoot dry weight. The results indicated that soybean seedlings grew more poorly when the plants survived from *P. sojae* attack compared to plants without the pathogen inoculation.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-21] Effect of Narrow-Row Planting with Inter-Row Strip Tillage by Chisel Plough on Yield and Labor Saving to Soybean Cultivation at Field Converted from Paddy in Shonai-Plane of Japan

○Hiroyuki Takeda[1], Hidefumi Saito[1], Naoto Ikeyama[2], Hiroshi Saito[3] （1.Tohoku Agricultural Research Center, National Agriculture and Food Research Organization, Japan, 2.Faculty of Agriculture, Yamagata University, Japan, 3.Rice Breeding and Crop Science Experiment Station, Yamagata Integrated

Agricultural Research Center, Japan）

It has become difficult to manage soybean cultivation because of insufficient labor against to increasing cropping area although soybean cultivation converted from paddy has been increased in Shonai-plain at the side of Japan Sea of Tohoku region in Japan. To reduce labor on conventional cultivation (CC) and to increase yield we introduced a sowing machine developed in NARO which could not only be planted in narrow row without preliminary tillage and ridge making but also be kept soil moisture suitable by the inter-row strip tillage with chisel plough. For the experiment, soybean cv. Satonohohoemi was cultivated on farm-owned field located at Shonai-plane in 2016 - 2018. There was no significant difference in average soybean yield among three years between narrow-row cultivation (NRC) and CC. The maximum yield was got at the case of cultivation including at field just converted after paddy, which in NRC were 273 g/m2 by hand harvesting or 227 kg/10 a by combine harvester. Total working time in NRC was 7.4 hours per 10 a which was equivalent to about 20 percent decrease against CC. Total cost per 10 a on NRC was 64.3 thousand-yen witch equivalent to 4 percent decrease to CC in spite of the induction of new sowing machine. Among 3-year experimentation, NRC with inter-row strip tillage by chisel plough of soybean has no superiority on the yield than in CC, however it was contributed to the reduction of total working time in CC.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-22] The Evaluation of Disease Resistance, Agronomic Traits and Yield Among Four Market Types in Peanut (*Arachis hypogaea* L.) Germplasm Collection

○Hsin-I Kuo[1], Hung-Yu Dai[2], Yong-Pei Wu[3], Yu-Chien Tseng[1] （1.Agronomy Department, National Chaiyi University, Taiwan, 2.Agronomy Department, Chiayi Agricultural Experiment Station, Taiwan Agricultural Research Institute, Taiwan, 3.Crop Division, Taiwan Agricultural Research Institute, Taiwan）

Peanut (*Arachis hypogaea* L.) is allotetraploid (AABB, 2n=4x=40) legume with high oil and protein content. It is classified into four market types (Virginia, Runner, Valencia and Spanish). Virginia and Runner belong to the subspecies (ssp), *hypogaea*; Spanish and Valencia belong to ssp. *fastigiata*. In this study, we randomly selected 150 peanut accessions from National Plant Genetic Resources Center in Taiwan, including 74 Spanish types, 21 Valencia types, 24 Virginia types and 31 Runner types. They were planted in the field with standard management protocol in spring and fall, 2019. There are four disease (rust, leaf spot, witches' broom and stem rot) evaluated at the late stage of the growth. Several agronomic traits (pod length, pod width, 50-pods weight, shelling percentage and 100-seeds weight) and yield were also measured after harvest. The results of Pearson correlation analysis showed yield was significantly negatively related to rust resistance and significantly positively related to 50-pods weight and 100-seeds weight. Combined ANOVA of market types with correlation analysis, our findings suggest that Virginia and Runner, these two market types are more resistant to rust and stem rot disease, however, Valencia and Spanish are more resistant to leaf spot and have higher shelling percentage, 50-pods weight and yield. In future breeding program, it is a goal to combine rust and stem rot resistant lines (Virginia and Runner) with high yield lines (Valencia and Spanish) using molecular markers and backcross selection.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-23] Investigation of the Albinism Derived from Sub-Species Hybridization in Peanuts

○Chuan-You Li[1], Hung-Yu Dai[2], Yu-Chien Tseng[1] (1.Agronomy Department, National Chiayi University, Taiwan, 2.Crop Division, Taiwan Agricultural Research Institute, Taiwan)

Peanut (*Arachis hypogaea* L.) is a crop grown in the tropical and subtropical areas. It is classified as a grain legume. There are four market types in peanuts, including Runner, Virginia, Spanish and Valencia. Both Runner and Virginia belong to the subspecies (ssp), *hypogaea*; Spanish and Valencia belong to ssp. *fastigiata*. The albinism can be observed during sub-species hybridization. It is very common to utilize sub-species hybridization to deliver the desired traits from one subspecies to another in peanut breeding programs. In this study, we used 10 albino lines (F_4 generation), which came from a cross between PI599592 (Runner) and PI599345 (Spanish). They were planted using complete randomized design (CRD) with three replicates. Also, two parental lines, PI599592 and PI599345 plus two commercial cultivars, TN14 and TNS9 were included in this experiment. According to the results, we find the albino lines have significant lower plant height and fewer leafs compared to TN14, TNS9, PI599592 and PI599345. Since albino peanuts have slower growth rate, the flowering times are also delayed. The SPAD and spectrophotometer show chlorophyll contents in albino lines are lower than the normal peanuts. The results of albino lines are just a beginning. Future work will be focused on observing the parents' chromosome structure in pollens and the albino chloroplast structure by using microscope. The results will help researchers understand more about the albinos from subspecies hybridization, and how to avoid albinism in peanut breeding.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-24] Co-Inoculation of *Bacillus pumilus* TUAT1 and *Bradyrhizobium diazoefficiens* USDA110 on Soybean

*Nominated for Presentation Awards

○Rifa Fadhilah Munifah Hasibuan, Hinako Sugiura, Minori Miyatake, Naoko Ohkama-Ohtsu, Keisuke Katsura (Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan)

Application of bio-fertilizer is vital to find inoculation methodology that do not inhibit symbiosis between rhizobium and plants. However, co-inoculation of rhizobium with different microorganism on legumes generally inhibit interdependency with rhizobia. The present study was conducted to find the ideal inoculation method of the bio-fertilizer "Yumebio" containing *Bacillus pumilus* TUAT1 which have plant growth promoting activity without inhibiting rhizobial infection to soybean. Soybean plants were inoculated with *Bradyrhizobium diazoefficiens* USDA110 on the timing of sowing seeds, then 3 treatments were prepared. Simultaneous inoculation of "Yumebio" with rhizobia (SI), Inoculation of "Yumebio" 1 week after rhizobia inoculation (I), and no inoculation of "Yumebio" (NI). Biomass dry weight (shoot and root) and nitrogenase activity based on acetylene reduction assay (ARA) measured at four weeks after sowing. Both ARA per plant and nodule weight were increased significantly with "I" treatment compared to those with "NI". However, there were no significant differences between "SI" and "NI" for shoot biomass and ARA per plant. Nodule numbers were decreased by "SI" compared to "NI". This study suggests that simultaneous inoculation of "Yumebio" and rhizobia inhibits nodule development, and inoculation of "Yumebio" 1 week after inoculation of rhizobia is ideal timing to promote soybean growth

without inhibiting rhizobium infection to soybean.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-25] Fodder and Grain Production by Double-Cropping System of Rye

○Masahiro Akimoto[1], Honami Okamoto[2], Taiki Yoshihira[3] (1.Agro-Environmental Science, Obihiro University of Agriculture and Veterinary Medicine, Japan, 2.Plant Science Unit, Obihiro University of Agriculture and Veterinary Medicine, Japan, 3.Collage of Agriculture, Food and Environmental Sciences, Rakuno Gakuen University, Japan)

To establish double-cropping system of rye in which productions of course feed in the first crop and grain in the second crop are performed, proper harvesting time for the first crop was studied. Rye variety 4R-507 was grown at Obihiro, Japan in 2018-2019 and 2019-2020. Plant bodies were harvested as the first crop at three different growth stages, boot stage (BT-plants), initial heading stage (IH-plants), and heading stage (HE-plants), then, the grains on the aftermath were harvested as the second crop. Dry-matter yield and nutritional value of the first crops and grain yield of the second crops were compared among three plants. In both experimental periods, dry-matter yield of the first crop was higher in order of HE-plants, IH-plants, and BT-plants. The nutritional values such as content rates of unstructured organic matters and digestible fibers tended to be higher in the first crop harvested at earlier growth stage, and the highest total digestible nutrients was observed in BT-plants. Vigorous regrowth was achieved after the harvest of the first crop in the plants mowed in earlier growth stage, and BT-plants developed large aftermath with many new tillers than other plants. BT-plants showed the highest grain yield about half of the value of conventionally grown plants (single-cropping rye). The aftermath regrew from the stubbles mowed after panicle heading could produce meager grains. In conclusion, proper harvesting time for the first crop should be boot stage for practicing double-cropping system of rye.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-26] Anaerobic and High Light Stress-Induced Leaf Abscission in Chili Pepper (*Capsicum* spp.)

*Nominated for Presentation Awards

○Keita Goto[1], Shotaro Tamaru[1], Peter Balyejusa Ssenyonga[2], Emmanuel Kiprono Bore[2], Shin Yabuta[3], Jun-Ichi Sakagami[3] (1.The United Graduate School of Agricultural Sciences, Kagoshima University, Japan, 2.Graduate School of Agriculture, Forestry and Fisheries, Kagoshima University, Japan, 3.Faculty of Agriculture, Kagoshima University, Japan)

Photosynthetically active organs in plant leaf must achieve a delicate balance between the leaf water status or the light energy harvested by chlorophyll, and their photosynthetic capacity to convert light into chemical energy as ATP and $NADPH_2$ (Reinbothe et al., 1996; Huq et al., 2004). As one of the responses to abiotic stress, chili pepper (*Capsicum* spp.) induced the expression of genes that respond to ethylene and ROS, and induced H_2O_2 production at the abscission zone, which preceded leaf abscission (Munné-Bosch and Alegre, 2004; Sakamoto et al., 2008). Present study aimed to provide the significance

of leaf abscission as a survival and adaptive strategy to environment by analyzing leaf physiological and biochemical parameters in chili pepper grown under different soil water status (well-drain and flood) and light conditions (non-shade and 60% shade). Leaf nitrogen status (SPAD) and maximum quantum yield (F_v/F_m) were investigated at respective 5 leaf positions divided as position 1 (P1), P2, P3, P4 and P5 from top to the lowest parts of the plant. Results demonstrated leaf abscission occurred in anaerobic and high light stressed plants. These plants abscised leaves at P4 or P5 (larger old leaf), but not at all in P1 to P3 (smaller young leaf). Additionally, they maintained higher SPAD and F_v/F_m at P1. Thereby, it can be suggested that abiotic stress-induced leaf abscission in chili pepper contributes to nutrient remobilization during stress and to avoid large loss through transpiration.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 1 (Poster))

[P1-27] Leaf Senescence Evaluation of Selected Interspecific Progenies between *O. sativa* and *O. glaberrima*; NERICA Varieties for Stay-Green Characteristics during Grain-Filling Period

*Nominated for Presentation Awards

○Peter Balyejusa Ssenyonga[1], Shin Yabuta[2], Shotaro Tamaru[3], Jun-Ichi Sakagami[1,2,3] (1.Graduate School of Agriculture, Forestry and Fisheries, Kagoshima University, Japan, 2.Faculty of Agriculture, Kagoshima University, Japan, 3.The United graduate School of Agricultural Sciences, Kagoshima University, Japan)

The stay-green ability in rice plants is an important factor for plant survival in especially stressful environments. The characteristic has shown potential function for additional dry matter production in some cereal varieties. Leaf greenness directly impact leaf activity in terms of photosynthesis performance main source of energy for plant organs growth. In this experiment, we evaluated the leaf chlorophyll content (SPAD) in flag leaf sections under incubation conditions to ascertain varietal senescence performance differences during the grain-filling period for stay-green characterization. In the glasshouse six NERICAs (1, 4, 10, 19, 41 and 60) varieties were grown and were evaluated from heading, 20 days and 40 days after flowering (DAH). The flag leaf, a center section of 5 cm length was incubated in dark at 35^0C and daily SPAD reading was recorded. There was a drastic decline in the SPAD value of the flag leaf of NERICA 19 and 41, followed by NERICA 60 in the glasshouse. The period SPAD value reduced by 50% (T_{50}); NERICA 1 and 10 at 20 DAH was superior with 6.7 and 5.1 days longer, respectively. NERICA 1 and 4 at 40 DAH scored higher with 4.9 and 3.1 days, respectively compared to other varieties. NERICA 1 and 4 showed a strong negative correlation between flag leaf SPAD value of plant and section incubation at both 20 and 40 DAH. The preliminary findings suggest NERICA 1 to be a candidate variety for stay-green characterization due to prolonged leaf senescence with further physiological growth and environmental assessments.

[P2] Farming System

Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster) (Farming System)

[P2-01] Soil Fertility Decline by Repeated Cropping of Rice for Whole Crop Silage – A Case of Mifune Town in Kumamoto Prefecture, Japan

○Naoki Moritsuka[1], Kaori Matsuoka[2], Kosuke Baba[1] (1.Faculty of Agriculture and Marine Science, Kochi University, Japan, 2.Institute of Agro-Environmental Sciences, National Agriculture and Food Research Organization, Japan)

12:15 PM - 1:00 PM

[P2-02] A Case Study of Learning to Work on a Farm in a Special Need Education School for Children with Intellectual Disabilities – Focusing on the Cultivation of Rice Plant

○Izumi Oh-E (Retired, Tohoku Agricultural Research Center, National Agriculture and Food Research Organization, Japan)

1:15 PM - 2:00 PM

[P2-03] Growth and Yield of Rice, and Soil Enzyme Activites in Super Low External-Input Paddy Rice Field

○Taichi Tsujimoto[1], Kazuhiro Hosoya[1], Hideto Ueno[1], Yo Toma[1], Yoichi Yamashita[2], Masataka Adachi[2], Takayuki Kono[2] (1.Graduate School of Agriculture, Ehime University, Japan, 2.Faculty of Agriculture, Ehime University, Japan)

12:15 PM - 1:00 PM

[P2-04] Nitrogen and Water Demands for Maximum Growth of *Solanum tuberosum* under Doubled CO_2: Interaction with Phosphorus Based on the Demands

○Yan Yi, Daisuke Sugiura, Katsuya Yano (Graduate School of Bioagricultural Sciences, Nagoya University, Japan)

1:15 PM - 2:00 PM

[P2-05] An Evaluation on *Glycine tabacina* for Being a Cover Crop

○Kuan-Huang Lin, Yuan-Ching Tsai (Department of Agronomy, National Chiayi University, Taiwan)

12:15 PM - 1:00 PM

[P2-06] Different Tillage Systems rather than Winter Cropping Affect the Corn Growth and Yield, and the Community Composition of Arbuscular Mycorrhizal Fungi

○Yuya Tatewaki[1], Ryo Matsuno[2], Koya Nakamura[1], Kengo Wada[1], Masao Higo[2], Katsunori Isobe[2] (1.Graduate School of Bioresource Sciences, Nihon University, Japan, 2.College of Bioresource Sciences, Nihon University, Japan)

1:15 PM - 2:00 PM

[P2-07] Decomposition of Hairy Vetch Mulch under Snow and Its Effect on Nitrogen Dynamics in Soil

○Toshiyuki Hirata[1], Taishi Uchibayashi[2], Atsushi Matsumura[3] (1.Field Science Center for Northern Biosphere, Hokkaido University, Japan, 2.Graduate School of Environmental Science, Hokkaido University, Japan, 3.Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Japan)

12:15 PM - 1:00 PM

[P2-08] Effect of Peanut Residues on Nitrogen and Phosphorus Uptake of the Succeeding Wheat Grown in the Paddy-Converted Upland Field

○Haruki Masuda[1], Yuko Michiyama[1], Daisuke Yoshimura[1], Takuji Seo[1], Toru Kira[1], Atsushi Matsumura[2], Hiroyuki Daimon[1] （1.Faculty of Agriculture, Ryukoku University., Japan, 2.Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Japan）

1:15 PM - 2:00 PM

[P2-09] Effect of Shoot Cutting and Mulching of Hairy Vetch during Flowering Stage on the Yield and N Content of Wheat in the Mixed Cropping System

○Kan Tamaki[1], Daisuke Yoshimura[1], Takuji Seo[1], Toru Kira[1], Atsushi Matsumura[2], Arata Tarui[2], Hiroyuki Daimon[1] （1.Faculty of Agriculture, Ryukoku University, Japan, 2.Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Japan）

12:15 PM - 1:00 PM

[P2-10] DNA Barcoding of Weed Species in Hokkaido and Application to *ex-situ* Evaluate of Their Abundance

○Maria Stefanie Dwiyanti[1], Toshiyuki Hirata[2], Hironori Nagano[1], Junya Yamagishi[3], Masahiro Akimoto[4] （1.Research Faculty of Agriculture, Hokkaido University, Japan, 2.Field Science Center for Northern Biosphere, Hokkaido University, Japan, 3.Research Center for Zoonosis Control, Hokkaido University, Japan, 4.Department of Agro-environmental Science, Obihiro University for Agriculture and Veterinary Medicine, Japan）

1:15 PM - 2:00 PM

[P2-11] Climate Impact on Yield and Cultivation Area of Rainfed Rice in Central Benin, West Africa

○Joji Miyazawa, Akira Miyazaki （Faculty of Agriculture and Marine Science, Kochi University, Japan）

12:15 PM - 1:00 PM

[P2-12] Cropping System Which Consists of Potato in Winter Season, Green Manure and Sugarcane under Kunigami Merge Soil in Northern Part of Okinawa Island

○Hideyuki Mochida （Innovation creation section, Bio-Oriented Technology Research Advancement Institution, Japan）

1:15 PM - 2:00 PM

[P2-13] Evaluation of Crop Performance under Different Nitrogen Regimes in Rice-Ratoon Rice Systems in Central Japan

○Weiyi Xie, Yoichiro Kato （Graduate School of Agricultural Sciences, The University of Tokyo, Japan）

12:15 PM - 1:00 PM

[P2-14] Grain Yield and Biodiversity in Lowland Rice Ecosystems: Comparison between Conventional and Organic Management Practices

○Haruki Okuda, Yoichiro Kato （Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

1:15 PM - 2:00 PM

[P2-15] Using a High Density Seedling Mat Reduces Transplanted Rice (*Oryza sativa* L.) Production Costs: A Case Study in Vietnam

○Kazunori Sawamoto[1], Ngo Quang Hieu[2], Truong Chi Thanh[3] （1.Development Division, Yanmar Agribusiness Co., Ltd., Japan, 2. Can Tho University, Vietnam, 3.Yanmar Agricultural Research Institute, Vietnam）

12:15 PM - 1:00 PM

[P2-16] Evaluation of the Differences in Yield Response to Organic Fertilizer between Two Soybean High-Yielding Lines 'Toiku 273' and 'Tokei1335' by Hierarchical Bayesian Model

○Yuichi Nagasaki[1], Hiroyuki Tsuji[1], Satoshi Kobayashi[2], Hideki Kurosaki[3] （1.Hokkaido Agricultural Research Center, National Agriculture and Food Research Organization, Japan, 2.Agricultural Research Department Tokachi Agricultural Experiment Station, Hokkaido Research Organization, Japan, 3.Agricultural Research Department Central Agricultural Experimental Station, Hokkaido Research Organization, Japan）

1:15 PM - 2:00 PM

[P2-17] Effect of Varieties and Organic Manures on Rice Yield and Methane Emission under Water Management

○Ei Phyu Win[1], Kyaw Kyaw Win[2], Kyaw Ngwe[3], Than Da Min[4], Hla Than[5] （1.Department of Agronomy, Yezin Agricultural University, Myanmar, 2.Department of Agronomy, Yezin Agricultural University, Myanmar, 3.Department of Soil and Water Science, Yezin Agricultural University, Myanmar, 4.Department of Agronomy, Yezin Agricultural University, Myanmar, 5.Department of Agronomy, Yezin Agricultural University, Myanmar）

12:15 PM - 1:00 PM

[P2-18] Soil Temperature, Growth and Yield of Rhizome by Different Mulching Treatments of Chinese Artichoke (*Stachys sieboldii* Miq.)

○Yeongmi Jang, Bumsik Choi, Sharavdorj Khulan, Jin-Woong Cho （College of Agricultural and Life Sciences, Chungnam National University, Korea）

1:15 PM - 2:00 PM

[P2-19] Effect of Different Types of Mulching on Soil Temperature, Growth and Rhizome Yield of Lycopi Herba (*Lycopus lucidus* Turcz.)

○Yeongmi Jang, Bumsik Choi, Sharavdorj Khulan, Jin-Woong Cho （College of Agricultural and Life Sciences, Chungnam National University, Korea）

12:15 PM - 1:00 PM

[P2-20] Effect of Flood and Drip Irrigation and Difference of Organic Material Input on Morphological and Physiological Traits in Rice Root

○Jiabin Bian[1], Kanchana Chomsang[2], Masahiro Morokuma[3], Masanori Toyota[3] （1.College of Agronomy & Resources and Environment, Tianjin Agricultural University, China, 2.United Graduate School of Agricultural Science, Ehime University, Japan, 3.Faculty of Agriculture, Kagawa University, Japan）

1:15 PM - 2:00 PM

[P2-21] *In Vitro* Screening and Morphological Trait Assisted Selection for Salinty Tolerance in Wheat Genotypes at Seedling Stage

○Mohammad Hasanuzzaman[1], Nihar Ranjan Saha[1], Sayma Farabi[1], Muhammad Monirul Islam[2], Muhammad Shahidul Haque[1] （1.Department of Biotechnology, Bangladesh Agricultural University, Bangladesh, 2.Biotechnolohy Division, Bangladesh Institute of Nuclear Agriculture, Bangladesh）

12:15 PM - 1:00 PM

[P2-22] Verification of Effects of "Three-dimensional farming system" on Soybean Cultivation in a Converted Paddy Field in a Temperate Zone

○Irumi Shimizu[1], Yuto Seno[2], Tesshu Tamai[2] （1.Graduate School of Agriculture, Ryukoku University, Japan, 2.Faculty of Agriculture, Ryukoku University, Japan）

1:15 PM - 2:00 PM

[P2-23] Production of Nitrogen Fixed Nutrient Solution for Hydroponic Culture by Flow Plasma System

○Tesshu Tamai[1], Ryoji Iyo[1], Yuya Yokoyama[1], Yoshiteru Mizukoshi[2], Yoshimi Nishimura[3], Chiaki Terashima[4] （1.Faculty of Agriculture, Ryukoku University, Japan, 2.Future Technology Research Laboratory, ULVAC, Inc., Japan, 3.Kurita Manufacturing Co., Ltd, Japan, 4.Photocatalysis International Research Center, Tokyo University of Science, Japan）

12:15 PM - 1:00 PM

[P2-24] Alternative Usage of Poultry Litter Ash for Phosphorus and Potassium Fertilizer in Forage Rice Cultivation

○Yuka Sasaki[1], Keishiro Sato[1,2], Takayuki Tokuhashi[1,3], Ken-ichi Kakuda[1] （1.Faculty of Agriculture, Yamagata University, Japan, 2., Agro-Kanesho Co., Ltd., Japan, 3.Niigata Central Union of Agricultural Cooperatives, Japan）

1:15 PM - 2:00 PM

[P2-25] Effects of Shading by Solar Panels on Growth and Yield of C_3 and C_4 Crops

○Masahiro Morokuma, Masanori Toyota （Faculty of Agriculture, Kagawa University, Japan）

12:15 PM - 1:00 PM

[P2-26] Effects of Proximity to Missing and Poorly Growing Plants on Cabbage Head Size

○Hiroyuki Tsuji （Division of Farming System Research, Hokkaido Agricultural Research Center, National Agriculture and Food Research Organization, Japan）

1:15 PM - 2:00 PM

[P2-27] Three-Dimensional Analysis of Soybean Grain Shapes Using a Flatbed Scanner

○Dan Eiju[1,2], Masataka Wakayama[1], Fumiko Namiwa[3], Masaru Tomita[1,2] （1.Institute for Advance Biosciences Keio University, Japan, 2.Faculty of Environment and Information Studies, Keio University, Japan, 3.Horticulture Science, Yamagata Integrated Agricultural Research Center, Japan）

12:15 PM - 1:00 PM

[P2-28] Satellite-Based Assessment of Soybean Plant Density by Using UAV Imagery and Machine Learning Algorithm

○Luthfan Nur Habibi[1], Tsutomu Matsui[2], Takashi Tanaka[2,3] （1.Graduate School of Natural Science and Technology, Gifu University, Japan, 2.Faculty of Applied Biological Sciences, Gifu University, Japan, 3.Artificial Intelligence Advanced Research Center, Gifu University, Japan）

1:15 PM - 2:00 PM

[P2-29] Effect of Environmental Differences on Empirical Regression Models for Estimating Leaf Area Index Using Vegetation Indices in Rice

○Tomoaki Yamaguchi[1], Daniel Menge[2], Emily Gichuhi[2], Peprah Clement Oppong[1], Megumi Yamashita[1], Daigo Makihara[3], Keisuke Katsura[1] （1.Graduate School of Agriculture, Tokyo

University of Agriculture and Technology, Japan, 2., Kenya Agricultural and Livestock Research Organization, Kenya, 3.International Center for Research and Education in Agriculture, Nagoya University, Japan）

12:15 PM - 1:00 PM

[P2-30] Detection of Lodging Area in a Paddy Field from a Digital Surface Model (DSM)

○Tadashi Tsukaguchi[1], Fumio Uno[2], Yoichi Fujihara[1] （1.Faculty of bioresources and environmental sciences, Ishikawa Prefectural University, Japan, 2.Ishikawa Agriculture and Forestry Research Center, Japan）

1:15 PM - 2:00 PM

[P2-31] Nitrogen Dynamics in Paddy Fields under Different Rice Bran Levels

○Mchuno Alfred Peter, Tasuku Eigen, Ami Shimomura, Beno Anton Kiwale, Kunio Watanabe, Nobuhito Sekiya （Graduate School of Bioresources, Mie University, Japan）

12:15 PM - 1:00 PM

[P2-32] Do New Rice Cultivars Respond to Chemical Fertilizers Better than Old Cultivars?

○Beno Anton Kiwale, Asaka Murai, Mchuno Alfred Peter, Nobuhito Sekiya （Graduate School of Bioresources, Mie University, Japan）

1:15 PM - 2:00 PM

[P2-33] A Case Study on Labor Productivity of Paddy Rice Seed Production in Japan

○Mizuho Fujii, Akihiko Kamoshita （Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

12:15 PM - 1:00 PM

[P2-34] Selection of Sorghum Growth Indicators for the Development of Smart Farm of Field Food Crops

○Kang-Su Kwak, Si-Young Rho （Division of Smart Farm Development, Department of Agricultural Engineering, National Institute of Agricultural Sciences, Rural Development Administration, Korea）

1:15 PM - 2:00 PM

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[P2-01] Soil Fertility Decline by Repeated Cropping of Rice for Whole Crop Silage – A Case of Mifune Town in Kumamoto Prefecture, Japan

○Naoki Moritsuka[1], Kaori Matsuoka[2], Kosuke Baba[1] (1.Faculty of Agriculture and Marine Science, Kochi University, Japan, 2.Institute of Agro-Environmental Sciences, National Agriculture and Food Research Organization, Japan)

Production of rice for whole crop silage (WCS rice) is popular in southern Kyushu, especially in Kumamoto. At Mifune town in Kumamoto, WCS rice has been grown with a lower fertilizer input than edible rice, although both panicle and straw of WCS rice are removed from the field. This study aimed to evaluate the effects of repeated cropping of WCS rice on soil properties and rice productivity. From 2014, a monitoring survey has been carried out at 8 adjacent fields (39 sites) managed by the same farmer. WCS rice (Minamiyutaka) has been grown in 4 fields from around 2008 and edible rice (Hinohikari) has been grown in the other 4 fields. The balances of N, P, K and Si during the rice cropping in 2016 were estimated to be positive in edible rice fields and negative in WCS rice fields. Compared to the soil properties in the edible rice fields, the topsoil in WCS rice fields showed lower concentrations for exchangeable K (28-54%), hot HNO_3-extractable K (61-69%), available Si (69-73%), mineralizable N (76-84%), and available P (77-80%). The dry matter weight of rice seedlings grown in small pots filled with the surface soils collected from 39 monitoring sites in 2018 was positively correlated with the concentration of available N ($r = 0.85$), exchangeable K ($r = 0.74$), and available Si ($r = 0.72$) in the soil. A nutrient omission pot experiment using a surface soil collected from one of the WCS rice fields further revealed that the dry matter weight of rice at milk ripe stage was decreased by about 40% by either N or K omission.

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[P2-02] A Case Study of Learning to Work on a Farm in a Special Need Education School for Children with Intellectual Disabilities – Focusing on the Cultivation of Rice Plant

○Izumi Oh-E (Retired, Tohoku Agricultural Research Center, National Agriculture and Food Research Organization, Japan)

The purpose of this study was to explore the development of agricultural work learning using rice, a key crop in Japan, at a special need education school for children with intellectual disabilities. Rice, soybean, adzuki bean, and sesame were cultivated in a special need education high school for children with intellectual disabilities. The crops cultivated in the work study were given cooking training at the end of the year. The students enjoyed the cooking training and were able to work actively on the activities. In the cooking training, sesame and roasted soybean flour rice cake were made through work processes such as making rice cake, boiling adzuki bean, roasting and crushing sesame and soybean, and the student's evaluation was high. Some students were able to understand the flow of production, processing and distribution (consumption), saying that they can understand by themselves making different forms of crops at the time of harvest and after processing. When companies in different industries enter the agricultural field, there is an increasing movement to stabilize employment and business, taking into

account the connection between agriculture and welfare. Therefore, it was thought that the study of farm work at the special needs school contributed more to the child's career after graduation.

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[P2-03] Growth and Yield of Rice, and Soil Enzyme Activites in Super Low External-Input Paddy Rice Field

*Nominated for Presentation Awards

○Taichi Tsujimoto[1], Kazuhiro Hosoya[1], Hideto Ueno[1], Yo Toma[1], Yoichi Yamashita[2], Masataka Adachi[2], Takayuki Kono[2] (1.Graduate School of Agriculture, Ehime University, Japan, 2.Faculty of Agriculture, Ehime University, Japan)

Sustainable crop production has been required worldwide against resource depletion and environmental pollution. We have been cultivated paddy rice only with white clover as green manure for more than 10 years. In this study, we investigated the dynamics of nutrients and enzyme activities in the soil as well as the growth and of rice to clarify the mechanism of this cultivation system.In 2018, three rice varieties, Koshihikari (*Oryza sativa*L. cv. Kosihikari), Akitakomachi, and Matsuyamamii were cultivated. The green manure (GM) plot was applied with only white clover incorporation, and that in the control (C) was applied with a slow-release chemical fertilizer at 4.2:4.2:4.2 g m^{-2} ($N:P_2O_5:K_2O$).There was no significant difference in the yield the both polts had around 400g m^{-2}, comparable to the local farmer's yield. Taste quality index were 70 or more in all plots. Soil available N decreased until mid-drying and then increased. On the whole GM kept 30 mg N $kg^{-1}$and was higher than C. The β-glucosidase and protease activity had more than 2 times higher in GM than C by 3-4 weeks after transplantation, and phosphatase activity had more than 2 times higher in GM than C in the whole season. Leaf color in C was stable around 30, however, unstable and fluctuated in GM. From the above, it was assumed that GM application increased the activity of microorganisms, and enhances the metabolism of N and P in the soil, made it possible to supply N and P equivalent to C, and resulting the same yield of the conventional.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster))

[P2-04] Nitrogen and Water Demands for Maximum Growth of *Solanum tuberosum* under Doubled CO_2: Interaction with Phosphorus Based on the Demands

*Nominated for Presentation Awards

○Yan Yi, Daisuke Sugiura, Katsuya Yano (Graduate School of Bioagricultural Sciences, Nagoya University, Japan)

Crop growth promotion utilizing elevated carbon dioxide concentrations (e[CO_2]) may be limited by soil nutrient availability. Although numerous studies have suggested the importance of nitrogen (N) for the promotion of growth under e[CO_2], N requirement for maximum growth is rarely examined. We have found that increase in potato (*Solanum tuberosum* L.) biomass depends on phosphorus (P) under e[CO_2]. To address whether the N requirement for maximum growth under e[CO_2] is dependent on P or not, we quantified potato growth and water consumption in response to five N supply rates at low P (LP) and

high P (HP). A pot experiment was conducted in controlled-environment chambers with ambient [CO_2] (a[CO_2]) and e[CO_2]. Foliar critical N concentration per area (critical [N]area), the minimum N requirement for 90% maximum plant growth, was similar (1.43 g N m^{-2}) regardless of [CO_2] under LP. Under HP, however, the critical [N]area increased under e[CO_2] (1.65 g N m^{-2}) compared with a[CO_2] (1.52 g N m^{-2}). Water use did not change with e[CO_2] under HP, whereas it decreased with e[CO_2] under LP despite the increase in biomass owing to higher water-use efficiency (WUE). Although WUE with e[CO_2] or HP was independent of N supply, biomass increment with e[CO_2] or HP depended on N supply. We concluded that N and water required by potato plants under e[CO_2] would be dependent on P supply. Although under HP, e[CO_2] increased N but not water required to obtain maximum growth, N demand was unchanged and water demand decreased by e[CO_2] under LP, probably owing to growth limited by P availability.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster))

[P2-05] An Evaluation on *Glycine tabacina* for Being a Cover Crop

*Nominated for Presentation Awards

○Kuan-Huang Lin, Yuan-Ching Tsai （Department of Agronomy, National Chiayi University, Taiwan）

Glycine tabacina is a perennial wild specie of genus *Glycine*. It can be found in seashore, cemetery and lawn of school in Penghu, Kinmen and Taiwan. As the government encouraged the ecofriendly farming, cover crops are used to improve soil health and reduce using of herbicide in management schemes that make it possible. *Glycine tabacina* which is perennial, creeper and has stronger recover ability was noticed. The salt, drought and heat tolerance are also expected. In addition, *G. tabacina* has the symbiosis rhizobium for nitrogen fixation which is unique for Fabaceae and can present a physical barrier to reduce weed emergence. So it may worth to promote *G. tabacina* as a cover crop for seashore and barren orchard in Taiwan.

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[P2-06] Different Tillage Systems rather than Winter Cropping Affect the Corn Growth and Yield, and the Community Composition of Arbuscular Mycorrhizal Fungi

*Nominated for Presentation Awards

○Yuya Tatewaki[1], Ryo Matsuno[2], Koya Nakamura[1], Kengo Wada[1], Masao Higo[2], Katsunori Isobe[2]
（1.Graduate School of Bioresource Sciences, Nihon University, Japan, 2.College of Bioresource Sciences, Nihon University, Japan）

Several studies have reported that different types of tillage and winter cropping can impact the community structure of arbuscular mycorrhizal fungi (AMF). However, it is unclear that the combined effects of tillage and winter cropping change the AMF communities. Therefore, this study investigated how combined different tillage and winter cropping systems affect the community composition of AMF in the roots of subsequent corn (*Zea mays* L.). In this study, the effects of six treatments consisting of three single winter cover cropping (hairy vetch, daikon radish, and fallow) with rotary tillage or no tillage on the soil biochemical properties, AMF colonization, and growth performance of subsequent corn

were evaluated. Our results showed that the dry matter weight and P uptake of corn at the 6 weeks after sowing was higher in the rotary tillage than the no tillage. The AMF colonization in the corn was also higher in the rotary tillage than the no tillage. Moreover, the tillage systems significantly changed the AMF community compositions in the roots. In the rotary tillage, the relative abundance of genus *Scutellospora* was higher than the no tillage. In contrast, the relative abundance of Glomeromycetes was higher in the no tillage than the rotary tillage. These results showed that the AMF compositions were shaped by tillage systems rather than winter cropping. Additionally, the differences in the AMF communities may be one of the factors for affecting the P uptake and yield of corn. Acknowledgement: This work was supported by JSPS KAKENHI Grant Number JP19K06005.

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[P2-07] Decomposition of Hairy Vetch Mulch under Snow and Its Effect on Nitrogen Dynamics in Soil

○Toshiyuki Hirata[1], Taishi Uchibayashi[2], Atsushi Matsumura[3] (1.Field Science Center for Northern Biosphere, Hokkaido University, Japan, 2.Graduate School of Environmental Science, Hokkaido University, Japan, 3.Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Japan)

Hairy vetch, a leguminous cover crop, is known to have a high nitrogen content and a strong weed suppression ability by covering and allelochemicals, Hairy vetch is generally used after cultivation of the main crop. However, in a cool area with a long snowfall period, such as Hokkaido, there is a problem that the growth period of hairy vetch was limited by snow cover. In this study, we examined the decomposition of hairy vetch under snow and the effect on soil nitrogen dynamics by them. A field examination and mineralization test were conducted. In the field test, hairy vetch was sown in August. Soil samples were collected and measured nitrogen contents every month from November to April. In the culture test, the amount of nitrogen from hairy vetch was measured under the temperature conditions of 2℃ and 25℃. In the field test, total inorganic nitrogen in the hairy vetch plot was increased from February, and in March rapidly before snowmelt. Further, the portion of ammonia nitrogen in the hairy vetch plot was higher than other cover crop plots. In the culture condition, the maximum value of total inorganic nitrogen was exhibited the 7th day after culturing at 25℃, and 56th day after culturing at 2℃. The amount of ammonium nitrogen was decreased after 7 DAC at 25℃, while the concentration of nitrate-nitrogen was low during culturing period at 2℃. It is considered that the high level of ammonia nitrogen derived from hairy vetch works effectively as a nitrogen resource in spring and a weed-suppressing substance just before snow melting.

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[P2-08] Effect of Peanut Residues on Nitrogen and Phosphorus Uptake of the Succeeding Wheat Grown in the Paddy-Converted Upland Field

*Nominated for Presentation Awards

○Haruki Masuda[1], Yuko Michiyama[1], Daisuke Yoshimura[1], Takuji Seo[1], Toru Kira[1], Atsushi Matsumura[2], Hiroyuki Daimon[1] (1.Faculty of Agriculture, Ryukoku University., Japan, 2.Graduate School of Life and

Environmental Sciences, Osaka Prefecture University, Japan）

In upland field converted from the paddy, a depletion of soil fertility due to the continuous degradation of organic matters occurred under aerobic condition should be complemented to maintain the crop productivity. We reported that incorporation of green manure legumes, such as Crotalaria and Sesbania, might be effective in maintaining soil fertility. However, the growers fundamentally desire to introduce cash crops in the crop rotation. In this study, crop residues of peanut, which contains considerable amounts of N and P in the shoots at harvesting time, were quantitatively evaluated in the nutrients supply to the succeeding wheat. Two peanut cultivars, "Ohmasari" and "Chibahandachi", were tested in the field experiment conducted in 2018 - 2019 at the Ryukoku University Farm in Ohtsu, Japan. The shoots as peanut residue were cut into less than 10 cm and then incorporated using a cultivator up to a depth of 20 cm of the plots in autumn 2018. Seeds of wheat cv. "Minaminokaori" were sown on 28 November 2018 and harvested on 12 July 2019. The amount of N and P incorporated as crop residues was 5.3 kg N/10 a and 0.5 kg P/10 a in "Ohmasari" and 2.4 kg N/10 a and 0.3 kg P/10 a in "Chibahandachi", and the ratio of C/N and C/P of the residues was 21 and 24 and 242 and 194, respectively in each cultivar. Contribution of peanut residue to N and P absorption of the succeeding wheat differed between two cultivars. Analysis of nutrient recycling through soil microbial communities after incorporation of the residues is now in progress.

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[P2-09] Effect of Shoot Cutting and Mulching of Hairy Vetch during Flowering Stage on the Yield and N Content of Wheat in the Mixed Cropping System

○Kan Tamaki[1], Daisuke Yoshimura[1], Takuji Seo[1], Toru Kira[1], Atsushi Matsumura[2], Arata Tarui[2], Hiroyuki Daimon[1] （1.Faculty of Agriculture, Ryukoku University, Japan, 2.Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Japan）

Mixed cropping with leguminous crop is effective approach to reduce N input for gramineous crop production. In the growth of bread wheat, which significantly requires N fertilizer input in top dressing, the N transferred from winter legumes to wheat in mixed cropping should be evaluated to reduce the N fertilizer rate. In this study, we estimated the amounts of N uptake of wheat grown with hairy vetch, that might release N from the root nodules collapsed by cutting the aboveground parts during flowering stage. A field experiment was conducted in 2019 - 2020 at the Experimental Farm of Ryukoku University in Ohtsu, Shiga, Japan, with two treatments; 1) single cropping of wheat cv. "Minaminokaori", consisted of five rows, 2) mixed cropping of wheat and hairy vetch "Kantaro", in which four rows of wheat and three rows of hairy vetch were made. Effect of cutting shoots of hairy vetch on flowering stage on N uptake of wheat was evaluated from the following points; 1) removing the shoots from the plot, 2) mulching them on the bottom of wheat stands. No fertilizer N was applied, and P and K fertilizers were applied at 10 kg/10 a, respectively. In early spring, the SPAD value of the upper leaves and N content of wheat in mixed cropping were higher than those in single cropping, indicating that the mixed cropping with hairy vetch enhanced the N uptake of the associated wheat. A quantitative evaluation of N transference from hairy vetch to wheat is now in progress.

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[P2-10] DNA Barcoding of Weed Species in Hokkaido and Application to *ex-situ* Evaluate of Their Abundance

○Maria Stefanie Dwiyanti[1], Toshiyuki Hirata[2], Hironori Nagano[1], Junya Yamagishi[3], Masahiro Akimoto[4]
（1.Research Faculty of Agriculture, Hokkaido University, Japan, 2.Field Science Center for Northern Biosphere, Hokkaido University, Japan, 3.Research Center for Zoonosis Control, Hokkaido University, Japan, 4.Department of Agro-environmental Science, Obihiro University for Agriculture and Veterinary Medicine, Japan）

In order to manage weeds efficiently, it is necessary to understand their occurrence and distribution patterns. Field investigation of weed population was usually based on morphological traits and spectral data such as Normalized Difference Vegetation Index (NDVI). However, the field observation for weed species identification was difficult in emerging populations in spring and often not suitable for analysis over a vast region. In this study, we constructed a DNA database for Hokkaido weed species and attempted to establish a new method for evaluating weed communities using next-generation sequencer (NGS). The *trnL* (UAA) intron region, which is a hypervariable region of the chloroplast genome, was determined for 40 weed species collected from Hokkaido University Biological Production Research Farm and 48 species from Obihiro Livestock University Farm. For the NGS-based evaluation, we used barnyardgrass (Japanese name 'Inubie' , *Echinochloa crus-galli*) and 'Ezonogishi-gishi' (*Rumex obtusifolius*). Total DNA was extracted from 0.3, 0.5, 1, 1.5 and 3 g of leaf by the CTAB method, and the *trnL* region was amplified by PCR. PCR amplicons were sequenced using Miseq. To compare DNA extraction efficiency and PCR amplification efficiency, an equal amount of rice DNA was added to each sample during or after weed DNA extraction. Rice DNA read count was used as reference to count read data of each weed species. Based on the results, we plan to further investigate biomass estimation methods using NGS.

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[P2-11] Climate Impact on Yield and Cultivation Area of Rainfed Rice in Central Benin, West Africa

*Nominated for Presentation Awards

○Joji Miyazawa, Akira Miyazaki （Faculty of Agriculture and Marine Science, Kochi University, Japan）

Demands for rice have been increasing in West Africa, however, the majority of rice is cultivated in the rainfed ecology, resulting in low yields. The changes of rice yield and production area in rainfed culture were surveyed in the town of Glazoue in central Benin, where rice is commonly cultivated in both upland and lowland conditions. According to the survey conducted during 2014-2016 with 12 farmers, rice is grown between June-November, after preceding crops such as cowpea and maize which are grown between April-July. Rice yields decreased in accordance to low rainfall, with 1.8 t ha $^{-1}$ under 866 mm in 2014, 1.1 t ha $^{-1}$ under 552 mm in 2013 and 0.3 t ha $^{-1}$ under 430 mm in 2015. Rice cultivation area of the farmers decreased 90% from 1.15 ha $^{-1}$ in 2013 to 0.12 ha $^{-1}$ in 2016. Farmers with less than 2 t ha $^{-1}$ in 2014 (LYF) greatly decreased their rice fields in 2015 and halted rice cultivation in 2016, whereas, farmers with more than 2 t ha $^{-1}$ in 2014 (HYF) did not greatly decrease their rice fields in 2015 and continued rice in 2016. LYF tended to grow rice on slopes where water retention was low, resulting in delayed sowing of 13 days and significantly lower yields. These results suggested that the minimum yield of 2 t ha $^{-1}$ under adequate seasonal rainfall was regarded as the criteria for stable and continued rice

production, regardless of suboptimal conditions in other years. Therefore, it is necessary for farmers to carefully select fields that support this level of production.

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[P2-12] Cropping System Which Consists of Potato in Winter Season, Green Manure and Sugarcane under Kunigami Merge Soil in Northern Part of Okinawa Island

○Hideyuki Mochida （Innovation creation section, Bio-Oriented Technology Research Advancement Institution, Japan）

Upland farming which consists of sugar cane is established settled in traditionally in the Okinawa Island. It is main crop in the upland farming because it results in relatively high profitability. However, because its early growth is slow, and topsoil is exposed for a long term, a large quantity of erosion out of the field by heavy rain, and the sugar cane invites terrible erosion followed by the decline of soil production capacity. Green manure is effective to reduce decline of soil fertility because it prevents soil erosion to cover topsoil by a green manure and increase of organic matter by its plowing-in. Green manure plowing-in gives good effect on physical and chemical characteristics of the soil. In that case soil gas phase rate is improved remarkably. Guinea grass with much biomass has most efficient. Plowing-in of Crotalaria juncea among Crotalaria species was effective in improvement of available nitrogen compared with Guinea grass, which was closely related with the increase of yield and of the starch value of potato. In addition, the crop rotation with the sugarcane increases available nitrogen and potato yield. On the other hand, it was revealed that the crop rotation had a repressive effect the same as resistant variety. Bacterial wilt for potato decreases by taking crop rotation with sugarcane and a long-term rotation. Besides, bacterial wilt might occur frequently by the crop rotation including Guinea grass. Therefore, the choice of the green manure as the preceding crop was important.

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[P2-13] Evaluation of Crop Performance under Different Nitrogen Regimes in Rice-Ratoon Rice Systems in Central Japan

*Nominated for Presentation Awards

○Weiyi Xie, Yoichiro Kato （Graduate School of Agricultural Sciences, The University of Tokyo, Japan）

Ratoon rice cultivation is the practice of obtaining a second harvest from tillers regenerating from rice stubbles. The objectives of this study were to compare the annual rice productivity of the rice-ratoon rice and single rice cropping systems and identify appropriate nitrogen management in the rice-ratoon rice system in central Japan. Field experiments were conducted at the Institute of Sustainable Agro-ecosystem Services, The University of Tokyo (35°43'N, 139°32'E) in 2019 and 2020. First, The annual productivity of rice-ratoon rice systems (cvs. Akihikari in 2019 and Akitakomachi in 2020) were compared with conventional single-rice cropping systems using high-yielding hybrid and inbred *japonica* cultivars (cvs. Hybrid Togo3 and Yamadawara). The annual productivity of the rice-ratoon rice system (7.6-7.9 t ha^{-1} yr^{-1}) was less than that of single rice cropping systems (8.5 to 10.2 t ha^{-1} yr^{-1}), indicating

the importance of nutrient management and the choice of appropriate short-duration cultivars to achieve high yield of ratoon rice. Second, the effect of the timing of N (nitrogen) topdressing on the crop growth in the rice-ratoon rice system was evaluated. Applying N at 5 days after heading of main rice promotes tiller bud regeneration and accelerates canopy re-establishment after the harvest of main rice, which is mediated not by the change in the availability of nonstructural carbohydrates but by the improved plant N nutrition at harvest of main rice. However, applying N around main rice heading stage also increased the grain N concentration, potentially lowering the palatability of *japonica* rice.

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[P2-14] Grain Yield and Biodiversity in Lowland Rice Ecosystems: Comparison between Conventional and Organic Management Practices

*Nominated for Presentation Awards

○Haruki Okuda, Yoichiro Kato （Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

There is a growing interest in sustainable agro-ecosystem management aiming at biodiversity conservation. Previous works on flora and fauna in rice ecosystems have focused on two aspects: biotic constraint to yield and biodiversity loss. Meanwhile, attempts to harmonize crop productivity and biodiversity are still limited. The objective of this study was to clarify the effects of weeding and fertilizer application regimes on rice growth and biodiversity in lowland fields with conventional and organic management practices. Field trials were conducted at the Institute for Sustainable Agro-ecosystem Services, the University of Tokyo, Tokyo, Japan in the summer of 2020. Four treatments were compared in lowland fields with conventional and organic management practices: control, additional N topdressing, intensive mechanical weeding, and mild mechanical weeding. In organic management, weed biomass at heading was greatest in control. But there was no difference in N concentration in rice plants among the treatments, suggesting that there was little competition between rice and weeds for N. Threatened species were detected only in organic management, suggesting that the use of agrochemicals promotes biodiversity loss in lowland rice ecosystems. There was no difference in the rice yield and brown rice quality among treatments and management practices. Our results suggested that it is possible to avoid yield loss without herbicide application where weed biomass is less than 150 g m^{-2} at heading and the target yield is less than 7 t ha^{-1}.

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[P2-15] Using a High Density Seedling Mat Reduces Transplanted Rice (*Oryza sativa* L.) Production Costs: A Case Study in Vietnam

○Kazunori Sawamoto[1], Ngo Quang Hieu[2], Truong Chi Thanh[3] （1.Development Division, Yanmar Agribusiness Co., Ltd., Japan, 2. Can Tho University, Vietnam, 3.Yanmar Agricultural Research Institute, Vietnam）

Planting seedlings using high density rice seedling mats requires fewer trays, reducing the costs of producing seedlings by decreasing the necessary materials and labor. To identify if this method impacted growth and yield, experiments were carried out from November 2016 to March 2017 on a farm in Long An province, Vietnam using the rice (*Oryza sativa* L.) variety IR4525. Twice the conventional amount of dry seed, 250 g, were sown per tray at a high density and left to germinate for 16 days. From each high density seedling mat, 4–6 seedlings were picked per hill and planted by a rice transplanting machine. The machine used was a seven-row planter with 25 cm rows, and it was optimized to select a small area of the seedling mat. Two planting density sizes at the paddy field, 25 × 16 cm and 25 × 22 cm, were tested. As a result, each seedling's leaf age were 3.2 - 3.5, and the height of seedlings was 12–18 cm at the time of planting. The number of high density seedling mats used for transplanting were 134 and 106 per ha, respectively, which is about half of the number of seedling mats used in conventional transplanting. Grain yields were 8,052 and 7,707 kg per ha for the 25 × 16 cm and 25 × 22 cm planting density trays, respectively, which did not differ from conventional method yields. Given these results, the average yield of the high density transplanting method is similar to conventional method yield. Furthermore, this new methodology does not change conventional nursery management or require new nursery materials.

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[P2-16] Evaluation of the Differences in Yield Response to Organic Fertilizer between Two Soybean High-Yielding Lines 'Toiku 273' and 'Tokei1335' by Hierarchical Bayesian Model

○Yuichi Nagasaki[1], Hiroyuki Tsuji[1], Satoshi Kobayashi[2], Hideki Kurosaki[3] (1.Hokkaido Agricultural Research Center, National Agriculture and Food Research Organization, Japan, 2.Agricultural Research Department Tokachi Agricultural Experiment Station, Hokkaido Research Organization, Japan, 3.Agricultural Research Department Central Agricultural Experimental Station, Hokkaido Research Organization, Japan)

The purpose of this study is to evaluate the differences in yield response between the two high-yielding lines, 'Toiku 273' and 'Tokei 1335', observed in our previous study. Organic fertilizer under narrow row condition increased the yield of Toiku 273 but did not that of Tokei 1335 (Nagasaki et al. 2020, 249th CSSJ meeting). Here we compared the response to yield components with the same hierarchical Bayesian model as in the previous study, which is very flexible to estimate the effect of each type of treatment on each line.
Field experiments were conducted at Hokkaido Agricultural Research Center with four treatments: standard rows (66 cm), narrow rows (33 cm), densely planted narrow rows, and organic fertilizer under the narrow rows. Both fixed and random effects of 100-seed weight and fertile pod number were estimated. To estimate the posterior distribution of the parameters, the Markov chain Monte Carlo method was implemented using "Stan."
In the narrow row condition, the fertile pod number of Toiku 273 was larger than that of Tokei 1335; conversely, the 100-seed weight was smaller. The application of organic fertilizer increased the 100-seed weight of both lines. However, its effect on fertile pod number was unclear for both lines. These results suggest that organic fertilizer under narrow row condition was mainly effective during seed filling. This indicates that the highest yield in this experiment (Toiku 273 with organic fertilizer under the narrow row) is attributed to the larger sink size and enhanced source amount by organic fertilizer.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster))

[P2-17] Effect of Varieties and Organic Manures on Rice Yield and Methane Emission under Water Management

○Ei Phyu Win[1], Kyaw Kyaw Win[2], Kyaw Ngwe[3], Than Da Min[4], Hla Than[5] (1.Department of Agronomy, Yezin Agricultural University, Myanmar, 2.Department of Agronomy, Yezin Agricultural University, Myanmar, 3.Department of Soil and Water Science, Yezin Agricultural University, Myanmar, 4.Department of Agronomy, Yezin Agricultural University, Myanmar, 5.Department of Agronomy, Yezin Agricultural University, Myanmar)

To assess the effect of different organic manure and varieties on methane emission, the pot experiment was conducted at Yezin Agricultural University in wet season, 2016. Organic manures (control-no manure, compost and cowdung), and the two rice varieties (Manawthukha-135 days and IR 50-115 days), were tested. The results showed that in both rice varieties, high grain yield was observed in control compared with manure amendments and the minimum grain yield was observed in cowndung treatment. The rate and cumulative amount of CH_4 emissions in Manawthukha was higher than that in IR 50 in accord with yield because of longer growth duration. Although no significant, numerically lowest methane emission was observed in cowdung manure treatment (68.6 g CH_4 m^{-2}) for Manawthukha and in cowdung and control treatment (44.6 and 43.4 g CH_4 m^{-2}) for IR 50 variety. Based on these results, the field experiment was conducted at Madaya township during the dry and wet seasons, 2017 to find out the water management and different rate of cowdung manure on methane emission and yield of IR 50 rice variety. The higher methane emission was recorded in CF as compared with AWD. In both seasons, the higher grain yields (1.8% in dry and 7.6% in wet) was recorded in AWD than in CF. The higher methane emission was recorded from OM3 and the lower emission from OM0 in both water management practices. In AWD, the methane emission was restricted in the aerated soil condition although higher amount of cowdung manure was added.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster))

[P2-18] Soil Temperature, Growth and Yield of Rhizome by Different Mulching Treatments of Chinese Artichoke (*Stachys sieboldii* Miq.)

○Yeongmi Jang, Bumsik Choi, Sharavdorj Khulan, Jin-Woong Cho (College of Agricultural and Life Sciences, Chungnam National University, Korea)

The Chinese artichoke (*Stachys sieboldii* Miq.) is a perennial herbaceous plant of the Lamiaceae family and geophyte plant in the ground. In this study, we attempted to find the effect of mulching material in Chinese artichoke.
The study was located at the experimental site of College of Agriculture and Life Science, CNU in Korea (latitude:36°36″, Longitude: 127°35″). We selected four treatments (Non-mulched, Black-PE, Green-PE, and Clear-PE) to find most suitable mulching material. Plant space was performed by the randomized block design at 60cm× 30cm. The seeding date was April 9, 2019 and the rhizome were harvested in early

December,2019.
The highest plant height occured at Black-PE 56cm and Non-mulched was 44.7 cm, which was significantly lower than the mulching treatments. In LAI, highest value was observed with Black-PE and lowest value was in Non-mulched. The SPAD index showed between 25 and 40 on average. For Photosynthesis, the highest was Clear-PE and the lowest was Black-PE. The highest dry weight was 822.1g of the Black-PE but Non-mulching was the lowest with 336.0g. Dry weight of rhizome, the Clear-PE was highest with 176.6g, followed by Non-mulched 148.7g, Green-PE with 134.3g, and Black-PE at 108.1g. The number of the rhizome was highest with Non-mulched (813), followed by (782) in the Clear-PE. Through this, it was confirmed that Non-mulched product had a high yield, but the product quality was poor. It is considered that Clear-PE was high quantity and weight of the rhizome is showing that, Clear-PE is most suitable for this plant.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster))

[P2-19] Effect of Different Types of Mulching on Soil Temperature, Growth and Rhizome Yield of Lycopi Herba (*Lycopus lucidus* Turcz.)

○Yeongmi Jang, Bumsik Choi, Sharavdorj Khulan, Jin-Woong Cho （College of Agricultural and Life Sciences, Chungnam National University, Korea）

The Lycopi Herba (*Lycopus lucidus* turcz.) is a perennial herbaceous plant of the Lamiaceae family, and geophyte plant in the ground. Objective of study is : to investigate the effects of mulching material during the growth and development of harvest in Lycopi Herba.
The study was conducted at the experimental site of Chungnam National University (latitude:36°36″, Longitude: 127°35″). For experiment, we applied four types of treatment to find the appropriate mulching material which were: Non-mulched, Black-PE, Green-PE, and Clear-PE. Plant spacing was performed by the randomized block design with three replications at plant density of 60cm× 30cm. The seedling date was April 10th, 2019 and the rhizome were harvested at the end of November,2019.
In plant height, Clear-PE was the highest at 107.2 cm, followed by Green-PE 102.6 cm, Non-mulched 99.1 cm and Black-PE 96.6 cm, respectively, and for the LAI, highest was Clear-PE with 13.2, and the lowest was Non-mulched at 8.3. The SPAD index, found between 30 and 45 on average. The Black-PE the SPAD index was highest until the August comparing than the other treatments. The photosynthesis was highest under Black-PE and followed by Clear-PE, Non-mulched and Green-PE. The dry weight was highest with 2774.2g of Clear-PE, and the dry weight of rhizome, the Black-PE was highest with 680.0 g. The highest number of the rhizome was occurred in Black-PE. As the final results showing that highest number and weight of rhizome was observed in Black-PE treatment which is showing the most suitable mulching material.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster))

[P2-20] Effect of Flood and Drip Irrigation and Difference of Organic Material Input on Morphological and Physiological Traits in Rice Root

○Jiabin Bian[1], Kanchana Chomsang[2], Masahiro Morokuma[3], Masanori Toyota[3] （1.College of Agronomy & Resources and Environment, Tianjin Agricultural University, China, 2.United Graduate School of Agricultural Science, Ehime University, Japan, 3.Faculty of Agriculture, Kagawa University, Japan）

We investigate the effects of irrigation method (drip or flood) and different management of organic material on root morphological characteristics and its distribution and physiological functions of the rice cultivar Hinohikari. Experiments were conducted in the paddy field in the University farm (input organic materials every year) for both drip and flood irrigation and the paddy and upland field (no input organic material) in the campus of the Faculty (Campus) under flood and drip irrigation, respectively. The planting density was 13.8 and 16.7 hills m^{-2} for Farm and Campus, respectively. Plant root was sampled with a core sampler (ø 5cm × 30cm) and root length and surface area were determined using image analysis. Yield in flood was significantly higher than in drip irrespective of the site. The increase of dry weight, bleeding rate and specific root length during the ripening stage were significantly higher in flood than in drip. The root depth index at the heading stage was significantly deeper in drip than in flood. All root morphological characteristics were larger in Farm than in Campus, though the difference between site was not significant excepting that length and surface area of root at heading were significantly higher in Farm than those in Campus. These results indicated that the root diameter is thicker, and root distribution is deeper in drip than in flood. It also suggested that the farm soil which was applied organic materials every year is more conducive to root growth.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster))

[P2-21] *In Vitro* Screening and Morphological Trait Assisted Selection for Salinty Tolerance in Wheat Genotypes at Seedling Stage

○Mohammad Hasanuzzaman[1], Nihar Ranjan Saha[1], Sayma Farabi[1], Muhammad Monirul Islam[2], Muhammad Shahidul Haque[1] （1.Department of Biotechnology, Bangladesh Agricultural University, Bangladesh, 2.Biotechnolohy Division, Bangladesh Institute of Nuclear Agriculture, Bangladesh）

Salinity is the primary threat to wheat production in the world. Genetic diversity is a pre-requisite to creating new varieties for salt tolerance. Therefore, this experiment was operated to evaluate the level of genetic diversity among 44 (22 Bangladeshi and 22 exotic) wheat genotypes for salinity tolerance at seedling stage in Hydroponic culture. All the genotypes were examined at 12 dS/m and 15 dS/m NaCl stress. ESWYT accession P-37 is the most salts tolerant at 12dS/m NaCl stress, whereas BAW accession 1262 and BAW accession 1284 are the most salts tolerant at 15dS/m NaCl stress. High heritability and positive phenotypic-genotypic correlations suggested that all the 6 morphological trait are associated with salt tolerance and could be used as selection criteria. In another experiments, we studied the in vitro response of three highly regenerative wheat genotypes viz., BARI Gom-27, BARI Gom-31 and BARI Gom-32 for salt tolerance selection. Callus was initiated in MS medium with 3 mg/l 2,4-D and different concentration of NaCl (0, 9, 12 and 15 dS/m) were added with the medium to create salt stress. Among the three genotypes studied BARI Gom-27 was significantly superior for callus induction with 41.2 per cent. When the callus for genotypes were transferred to regeneration media in the same level of NaCl stress highest level of regeneration was showed in BARI Gom-27 (51.6 per cent). The genotypes identified as salt-tolerant in this study may be used as parents to incorporate salt tolerance in the future wheat breeding program.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster))

[P2-22] Verification of Effects of "Three-dimensional farming system" on Soybean Cultivation in a Converted Paddy Field in a Temperate Zone

*Nominated for Presentation Awards

○Irumi Shimizu[1], Yuto Seno[2], Tesshu Tamai[2] (1.Graduate School of Agriculture, Ryukoku University, Japan, 2.Faculty of Agriculture, Ryukoku University, Japan)

Kozui Otani (1876-1948) introduces a strange farming technique named "three-dimensional farming system" in his book "Tropical Agriculture". "Three-dimensional farming system" means a farming method that digs a deep trench (180cm or more) between ridges and promotes growth of crops. We verified if this method was effective for soybean (*Glycine max* L. cv. Kotoyutaka) cultivation in a converted paddy field in a temperate zone. In order to reproduce the farming system, trenches with a depth of about 100 cm were dug at both ends of the ridge, and soybean was transplanted in the ridge. The growth and yield of soybean were investigated during the flowering and full-ripe stages. As a result, in the flowering stage, the shoot dry weight was about twice, the root dry weight was about 1.6 times, and the number of nodules was about twice those of the control by the farming system. In the full-ripe stage, even though significant increases of the main stem length, the stem diameter, and the shoot dry weight were observed by the farming system, the number of pods set, coarse grain weight, and 100 grain weight increased only slightly. It was suggested that nutrient translocation from the foliage to the grain was not performed successfully. Moreover, by the farming system, the soil temperature became strongly affected by the atmospheric temperature, and the drainage property of the soil was improved. However, no clear difference could be confirmed for EC. It also became clear that the microflora of cultivated soil greatly changed especially in the deep part.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster))

[P2-23] Production of Nitrogen Fixed Nutrient Solution for Hydroponic Culture by Flow Plasma System

○Tesshu Tamai[1], Ryoji Iyo[1], Yuya Yokoyama[1], Yoshiteru Mizukoshi[2], Yoshimi Nishimura[3], Chiaki Terashima[4] (1.Faculty of Agriculture, Ryukoku University, Japan, 2.Future Technology Research Laboratory, ULVAC, Inc., Japan, 3.Kurita Manufacturing Co., Ltd, Japan, 4.Photocatalysis International Research Center, Tokyo University of Science, Japan)

The flow plasma system we have developed can fix atmospheric nitrogen as nitric acid in water. If this plasma-treated water can be used as a nutrient solution, the amount of nitrogen required for crop cultivation can be supplied anytime and anywhere when needed, realizing agriculture with a low environmental load. In order to verify this possibility, leaf lettuce (*Lactuca sativa* var. *crispa*) was hydroponically cultivated using this plasma-treated water, and its growth and components were investigated. As a result, a large amount of nitrogen was taken into the plant grown in nutrient solution containing the plasma-treated water, and the size and weight of the plant increased significantly. These indicates that the plasma-treated water can be a nitrogen fertilizer. However, it was clarified that Mo in the electrodes eluted into the plasma-treated water and was accumulated in high concentration in the plant. In addition, Mo in the nutrient solution inhibited the absorption of S and Fe into the plant, while

was not affected that of other minerals. Since the large amount of Mo and the inability to ingest S and Fe are harmful to the human body, it is necessary to modify the composition of the nutrient solution and improve the electrodes. On the other hand, it was shown that the plasma-treated water had a bactericidal effect on *Escherichia coli* and algae. Controlling this system might bring the nutrient solution with sterilizing capacity while supplying nitrogen.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster))

[P2-24] Alternative Usage of Poultry Litter Ash for Phosphorus and Potassium Fertilizer in Forage Rice Cultivation

○Yuka Sasaki[1], Keishiro Sato[1,2], Takayuki Tokuhashi[1,3], Ken-ichi Kakuda[1] (1.Faculty of Agriculture, Yamagata University, Japan, 2., Agro-Kanesho Co., Ltd., Japan, 3.Niigata Central Union of Agricultural Cooperatives, Japan)

Forage rice cultivation is needed to enhance productivity while reducing production cost. The highest blending ratio of forage rice in feed is used for broiler. Broiler litter is useful if it is burned in a boiler connecting with floor heating system of chicken house, and its residue is poultry litter ash (PLA). PLA is inexpensive and unutilized resource and in high phosphorus (P) and potassium (K). The objective of this study was to investigate the efficacy of PLA for alternative usage of P and K fertilizer in forage rice cultivation. A field experiment was conducted in 2017 and 2018 in a paddy field of Field Science Center, Faculty of Agriculture, Yamagata University, Japan. The field had two area: P fertilizer had not been applied (No-P) and K fertilizer had not been applied (No-K) since 1999. Treatments were the application of PLA burned at about 500℃, PLA burned at about 800℃, and NPK fertilizer in both area and NK fertilizer in No-P area and NP fertilizer in No-K area. Both PLA contained P in more than 90% of citric acid-soluble form while less than 1% of water-soluble form; K in more than 90% of citric acid-soluble form and about 30% of water-soluble form. Yield and P uptake did not differ significantly among treatments in No-P. Thus, we could not conclude the efficacy of PLA for alternative usage of P fertilizer. Yield and K uptake were significantly lower in NP treatment than the others and did not differ significantly among NPK and two PLA treatments in No-K. Thus, both PLA can replace K fertilizer. K fertilizer efficiency of PLA to NPK treatment was about 80%.

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[P2-25] Effects of Shading by Solar Panels on Growth and Yield of C_3 and C_4 Crops

○Masahiro Morokuma, Masanori Toyota (Faculty of Agriculture, Kagawa University, Japan)

It is spreading to locate the solar panels at crop cultivation field. At that field, we can get the sell power income by solar panels with the agricultural income. However, we do not have enough information about the effects of shading by solar panels on the growth and yield of crops. In the present study, we have demonstrated that the effects of shading by solar panels on the growth and yield of C_3 and C_4 crops. We compared the growth and yield of crops grown under solar panels (solar plot) with those of crops grown at control field (control plot). The experiments were conducted in 2018 and 2019 at the farmer's field in Kagawa Prefecture, Japan. The average percentage of shading by solar panels during

growth periods was about 30%. Experimental materials were maize (C_4) and soybean, sweet potato, radish (C_3). The fresh weight of corn grain in solar plot was not significantly different than that in control plot. The main stem length of soybean in solar plot was significantly longer than that in control plot. The grain yield of soybean in solar plot was significantly higher than that in control plot. There were no significant difference between each plot in the yield of sweet potato and radish. In conclusion, the yield of C_3 and C_4 crops grown under the shading by solar panels during growth periods were not significantly influenced .

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster))

[P2-26] Effects of Proximity to Missing and Poorly Growing Plants on Cabbage Head Size

○Hiroyuki Tsuji (Division of Farming System Research, Hokkaido Agricultural Research Center, National Agriculture and Food Research Organization, Japan)

The objective of this study was to characterize the weight variation of cabbage heads in the field by estimating cabbage size variation and the number of cabbages that were larger than the standard size from the rates of missing and poorly growing plants in the same field. Cabbage seedlings were transplanted on May 24, 2019, in Experiment 1 and on July 8, 2019, in Experiment 2. Three weeks after planting, the positions of missing plants and poorly growing plants were recorded. The results of Experiment 1 categorized plants into six groups as follows: plants that grew poorly at 3 weeks after planting and had a head weight at harvest (1) less than the threshold, i.e., average −2SD (P1), or (2) more than the threshold (P2); and plants with normal growth at 3 weeks after planting and were next to (3) missing plants (Nm), (4) poorly growing plants (Np), (5) normal plants with a head weight at harvest less than the threshold weight (NN1), and (6) normal plants with a head weight more than the threshold weight (NN2). The average values and coefficients of variation were determined. In Experiment 2, cabbage head weight and plant numbers were investigated. The plant number of each group and distribution of head weight in Experiment 2 were estimated from the number of missing and poorly growing plants in Experiment 2, and the parameters corresponded to the results of Experiment 1. Accordingly, we could successfully determine the exact number of cabbage heads bigger than the standard size.

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[P2-27] Three-Dimensional Analysis of Soybean Grain Shapes Using a Flatbed Scanner

*Nominated for Presentation Awards

○Dan Eiju[1,2], Masataka Wakayama[1], Fumiko Namiwa[3], Masaru Tomita[1,2] (1.Institute for Advance Biosciences Keio University, Japan, 2.Faculty of Environment and Information Studies, Keio University, Japan, 3.Horticulture Science, Yamagata Integrated Agricultural Research Center, Japan)

Soybeans are classified by grain shape, color, and the hilum color. Although rice shape can analyze using grain analyzer, methods of analyzing soybean properties were insufficient. Here, we aimed to develop new methods for analyzing the soybean shape and color. Using the methods, we have characterized

soybean morphologies among various species.

One hundred of soybean seeds were set into grid-like partitioned board (soybean grid board). XY bean shape information was obtained using flatbed scanner. As Z-axis information (thickness) was difficult to obtain, we set the soybean grid board and scanner vertically on the desk and scanned. The images were processed by ImageJ software. For extracting soybean outline from images, the appropriate color spaces were selected.

For soybean outline extraction, the Lab color space was suitable than other color space.
L-values which indicate brightness discriminate between i) brown, red and black, ii) green iii) yellow varieties. a-values (green and redness component) were suitable for brown, red and black. Using L and a-values, soybean color characteristics could be discriminated.

Positive and strong correlations were found between grain weight and volume (R = 0.84), major axis (R = 0.76), and minor axis (R = 0.74), respectively. While, the correlation between grain weight and grain thickness (R = 0.49), aspect ratio (major axis / minor axis) (R = 0.30) and the flatness (long axis/grain thickness) (R = -0.12) were very low. Using those characteristics, the soybean species characteristics were discriminable among variety of

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1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster))

[P2-28] Satellite-Based Assessment of Soybean Plant Density by Using UAV Imagery and Machine Learning Algorithm

*Nominated for Presentation Awards

○Luthfan Nur Habibi[1], Tsutomu Matsui[2], Takashi Tanaka[2,3] (1.Graduate School of Natural Science and Technology, Gifu University, Japan, 2.Faculty of Applied Biological Sciences, Gifu University, Japan, 3.Artificial Intelligence Advanced Research Center, Gifu University, Japan)

Stable seedling establishment of soybean is an essential component for high crop yield; thus, the prediction of plant density would be a valuable information to develop more effective agronomic practices. A current development of remote sensing and machine learning algorithm may enable us to examine plant density effectively. The objective of this study was to develop a model for predicting the number of established soybean plants using machine learning algorithm (YOLOv3) and UAV-based imageries. The YOLOv3 model trained with a dataset of 450 images and confidence threshold of 0.65 scored the highest predicting capability with R^2 value of 0.912 and RMSE of 0.84 plants m^{-2}. Furthermore, we examined the possibility of predicting plant density using satellite imageries through a linear mixed effect model analysis. Normalized difference vegetation index data derived from PlanetScope imageries was treated as a fixed effect, and sowing date was treated as a random effect. Different sowing dates were assumed to affect the following development of soybean canopy; thus, it might influence the plant density. Consequently, the model with variable slopes and intercepts according to the sowing dates showed the highest accuracy with RMSE of 1.64 plant m^{-2} and smallest value of Akaike information criterion. This result indicated that the model that did not incorporate the effect of sowing dates might lead to unreliable results. To improve the model capability, we should include other factors such as soil and weather condition data in further studies.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster))

[P2-29] Effect of Environmental Differences on Empirical Regression Models for Estimating Leaf Area Index Using Vegetation Indices in Rice

*Nominated for Presentation Awards

○Tomoaki Yamaguchi[1], Daniel Menge[2], Emily Gichuhi[2], Peprah Clement Oppong[1], Megumi Yamashita[1], Daigo Makihara[3], Keisuke Katsura[1] （1.Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan, 2., Kenya Agricultural and Livestock Research Organization, Kenya, 3.International Center for Research and Education in Agriculture, Nagoya University, Japan）

Leaf area index (LAI) is an important parameter for monitoring rice growth, and various empirical models to predict LAI using vegetation indices (VIs) have been proposed. Most of the models, however, were developed based on data collected from a single location, which makes it difficult to apply these models to other environmental conditions. The objective of this study was to compare two empirical models for predicting LAI using VIs that were developed using data from Japan and Kenya with Basmati 370 as a common rice variety, and to reveal the physiological factors causing differences between the models. Spectral reflectance of rice canopies was measured using a hyper-spectral sensor just before destructive measurement of LAI at 2-week intervals from transplanting to heading. Simple ratio (SR) was one of the best VIs to predict LAI in a linear regression model. However, there was a significant difference in the slope coefficients of the regression curves of the developed models for the two locations. As the SR increased, the change in LAI was more pronounced in Japan than in Kenya, which means the rice plants in Kenya could develop leaf area efficiently with less mutual shading. In Kenya, plant length increased at a slower rate than in Japan probably because of lower temperature, hence plants were able to distribute smaller and more erect leaves. In order to develop a universal model to predict rice growth using VIs, further understanding of the interaction effects between genotypic and environmental factors on rice morphology is necessary.

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[P2-30] Detection of Lodging Area in a Paddy Field from a Digital Surface Model (DSM)

○Tadashi Tsukaguchi[1], Fumio Uno[2], Yoichi Fujihara[1] （1.Faculty of bioresources and environmental sciences, Ishikawa Prefectural University, Japan, 2.Ishikawa Agriculture and Forestry Research Center, Japan）

Images acquired by a camera mounted on a UAV (unmanned aerial vehicle) can be processed to reconstruct 3D structure as a DSM. Through the use of this technique, areas where lodging has occurred can be detected by gauging the degree of lodging as the difference in relative elevation between heading and maturity, or delta plant height. The association between the degree of lodging and a vegetation indices (VIs) at various growth stages is useful for the setting of the target VI value at a certain growth stage for local topdressing. The objective of this study was to estimate the degree of lodging by using a DSM and to associate it with the values of VIs before heading. We recorded paddy fields where a rice cultivar Koshihikari was grown with various rates of nitrogen application to 2 crops a year in 2019 and 2020. Images were periodically taken by a multispectral camera mounted on a UAV and by an RGB camera mounted on another UAV. We processed the multispectral images to VI maps and the RGB images to a

DSM. We created 1-m cells on the VI maps and DSM of the fields and calculated the mean values of VIs and the difference in the mean relative elevation, or delta plant height, between heading and maturity in each cell. We found highly significant associations between VIs and delta plant height. In addition to lodging, such associations could be used for determining local topdressing rates or for detecting unevenness of the soil surface or fertility in the field. This work was partly supported by Contracting Research on Policy for Agriculture, Forestry and Fisheries.

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[P2-31] Nitrogen Dynamics in Paddy Fields under Different Rice Bran Levels

*Nominated for Presentation Awards

○Mchuno Alfred Peter, Tasuku Eigen, Ami Shimomura, Beno Anton Kiwale, Kunio Watanabe, Nobuhito Sekiya （Graduate School of Bioresources, Mie University, Japan）

The application of organic material (OM) is essential for sustainable rice production, and understanding decomposability is important for the effective use of OM. We hypothesize that easily-decomposable OM such as rice bran (RB) sharply increases inorganic nitrogen (IN) as plant growth begins, and the mineralization ceases in advance of plant maturity. To test this hypothesis, the mineralization, leaching, and plant uptake of nitrogen were investigated from winter to summer in rice fields where early-maturing cultivar Natsuhikari was applied with 0, 40, 80, and 160kgNha^{-1} of RB. NH_4- and NO_3-nitrogens were quantified in soils at 0-2, 2-10, 10-20, and 20-25cm depths for estimation of mineralization, and soil water pressure was measured at 15 and 30cm depths for assessment of leaching. Aboveground biomass was collected at five growth stages for estimation of nitrogen uptake. Mineralization started long before irrigation at low temperatures and prolonged until plant maturity. Soil nitrogen was the primary source for plants throughout the growth period; it contributed 69.4% of total nitrogen uptake. RB contribution was estimated at 3.9%, 31.5%, and 37.3% in 40, 80, and 160kgNha^{-1}, respectively. A sharp decline of mineralized nitrogen was observed, implying the occurrence of immobilization despite the low C/N ratio (19) of RB. The concentration of IN was three times higher at harvest than at the start of the experiment. These results indicate that a gradual increase in temperature linearly increases nitrogen mineralization, and larger amounts of RB application allow continuous mineralization of nitrogen throughout the growth period with potential involvement of immobilization.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster))

[P2-32] Do New Rice Cultivars Respond to Chemical Fertilizers Better than Old Cultivars?

*Nominated for Presentation Awards

○Beno Anton Kiwale, Asaka Murai, Mchuno Alfred Peter, Nobuhito Sekiya （Graduate School of Bioresources, Mie University, Japan）

Nitrogen is the most important nutrient for rice growth, and rice's responsiveness to nitrogen application is cultivar-specific. We hypothesize that improved cultivars (Bekoaoba and Momiroman) increase biomass more than old cultivars (Yuminariho and Yamadanishiki) when chemically fertilized; the

old cultivars increase biomass more than new cultivars when organically fertilized. The four cultivars with two controls (Koshihikari and Nipponbare) were subjected to five nitrogen levels (80 and 160KgN/ha in the form of organic and chemical and non-fertilized as control) applied once before transplanting. Biomass was collected at four active tillering, panicle initiation heading and maturity stages. At maturity, contrary to our expectation, old cultivars increased biomass in chemically fertilized plots than unfertilized control, while new cultivars' responses to chemical fertilizer were insignificant except for Bekoaoba in the 80kgN/ha. When chemically fertilized, Yuminariho and Yamadanishiki increased biomass during reproductive and ripening, respectively. Also, chemically fertilized Bekoaoba at 80kgN/ha lately increased biomass due to nitrogen immobilization during active tillering stage (biomass was higher in unfertilized than in chemically fertilized plots). Irrespective of genetic background, organic fertilizer had insignificant or even adverse effects on biomass at maturity than unfertilized control, implying occurrence of nitrogen immobilization throughout growth period. The results infer that cultivar's responsiveness to nitrogen application is influenced by soil organic matter or immobilization capacity of soils.

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[P2-33] A Case Study on Labor Productivity of Paddy Rice Seed Production in Japan

*Nominated for Presentation Awards

○Mizuho Fujii, Akihiko Kamoshita （Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

In Japan, paddy rice seeds are mainly produced by seed producing farmers who are designated by prefectures. At present, shortage of successors of seed producing farmers is getting serious due to the heavy labor load and difficulty in acquiring technical skills for seed production. While seed producing farmers have the advantage of higher selling price of seed rice than food rice, more labor is required to meet the quality standard as seeds such as genetic purity, sanitary, high germinability, no contamination with other varieties nor weeds. If the labor load can be reduced and labor productivity can be shown to increase, more new seed farmers can join. The purpose of this study is to clarify the factors behind the differences in labor productivity among farmers. We compared seed production technology among farmers in 3 prefectures; (1) S seed association in Toyama prefecture, which has the largest sales of seeds outside the prefecture in Japan, (2) C seed association in Hokkaido, which has the largest management scale, and (3) T seed association in Gunma prefecture, which purchases seeds outside the prefecture. The working hours for removal of off-type plants and cleaning of machines were long in all the 3 groups. Labor productivity was highest in C seed association in Hokkaido, where the working hours per area for works such as removal of off-type plants, cleaning of machines, and pest control were shortest. Gross profits were highest in S seed association in Toyama because of the higher producer prices of the seeds.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 2 (Poster))

[P2-34] Selection of Sorghum Growth Indicators for the Development of Smart Farm of Field Food Crops

○Kang-Su Kwak, Si-Young Rho （Division of Smart Farm Development, Department of Agricultural Engineering, National Institute of Agricultural Sciences, Rural Development Administration, Korea）

Digital agriculture is a useful solution to improve the productivity and quality of agricultural products, also to solve the aging problem in rural areas. Meanwhile, image analysis is a very important tool for the development of smart farm technology. Moreover, research on growth indicators to understand the growth situation of crops should be preceded for the development of image-based smart farm technology. We chose sorghum as a test crop for the image analysis because it makes us easy to acquire growth images due to its simple plant shape. Sorghum(var. Noeulchal) was sown in a tray sowing box and seedling was raised for 9days, then it was transplanted into the main field. And, we created fertilizer(control, heavy, no) and soil moisture(control, excess, drought) treatment plots to select key growth indicators with large growth changes among treatments, and investigated total 11 growth indicators(culm length, plant height, stem diameter, leaf age, internode length 1~2, 2~3, 3~4, ear length, ear width, upper leaf color, lower leaf color) every week after transplanting. As a result of the experiment, we selected meaningful key growth indicators through ANOVA variance analysis and DMRT as follows; (Fertilizer section) Culm length, plant length, stem diameter and upper leaf color at no fertilizer plot during the vegetation stage; Plant length during the reproductive stage. (Irrigation section) Upper leaf color at excess moisture plot during the vegetation stage; Stem diameter, upper leaf color and lower leaf color at excess moisture plot; Upper leaf color and lower leaf color at drought plot during the reproductive stage. We are currently pursuing an image analysis experiment using the YOLO algorithm.

[P3] Abiotic Stress for Crop Production

Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster) (Abiotic Stress for Crop Production)

[P3-01] Influence of Low Temperature at Booting Stage on Growth and Yield in Fall and Spring Sown Wheat

Jaeeun Choi[1], Jae-Gyeong Jung[1], Young-Hun Lee[1], Ki-Eun Song[1,2], Jonghan Ko[3], Kyung-Do Lee[4], ○Sang-In Shim[1] (1.Department of Agronomy, Gyeongsang National University, Korea, 2.Division of Applied Life Science (BK21 Plus), Gyeongsang National University, Korea, 3.Department of Applied Plant Science, Chonnam National University, Korea, 4.Climate Change and Agro-Ecology Division, Rural Development Administration, Korea)

12:15 PM - 1:00 PM

[P3-02] Selection of Transcripts Relating to Chlorophyll Content of Rice Seedlings at Low Temperature Using RNA-Sequencing Data

○Akari Fukuda[1], Tatsuro Hirose[2], Yoichi Hashida[2], Naohiro Aoki[3], Atsuhi J. Nagano[4] (1.Institute of Crop Science, National Agriculture and Food Research Organization, Japan, 2.Faculty of Agriculture, Takasaki University of Health and Welfare, Japan, 3.Graduate School of Agricultural and Life Science, The University of Tokyo, Japan, 4.Faculty of Agriculture, Ryukoku University, Japan)

1:15 PM - 2:00 PM

[P3-03] Membrane Lipid Unsaturation Confers Cold Germination Ability to Seeds of Upland Cotton (*Gossypium hirsutum*)

Lakhvir Kaur Dhaliwal[1], Junghyun Shim[1], Masoud Zabet[2], Benildo G. de los Reyes[1], ○Rosalyn B. Angeles-Shim[1] (1.Department of Plant and Soil Science, College of Agricultural Sciences and Natural Resources, Texas Tech University, United States, 2.Center for Biotechnology and Genomics, Texas Tech University, United States)

12:15 PM - 1:00 PM

[P3-04] Characteristics of Photoassimilates Distribution in the Resistant Variety to the High-Temperature Damage to Rice Grain Ripening

○Saki Yoshino[1], Chiharu Sone[2,3], Kyoko Toyofuku[2,3], Fumiaki Takakai[2,3], Takato Mizumoto[2], Yoko Ishikawa[2,3], Atsushi Ogawa[2,3] (1.Graduate School of Bioresource Sciences, Akita Prefectural University, Japan, 2.Faculty of Bioresource Sciences, Akita Prefectural University, Japan, 3.Japan Science and Technology Agency, Core Research for Evolutionary Science and Technology Project, Japan)

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[P3-05] Comparison of Drought Resistance of NERICA, Asian Rice and African Rice and Effects of Phosphorus Fertilizer

○Michihiko Fujii (Faculty of Education, Shizuoka University, Japan)

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[P3-06] The Effects of Arbuscular Mycorrhizal Symbiosis on the Growth, Yield and Drought Resistance of Foxtail Millets (*Setaria italica*)

○Wei-Yi Lin, Ou-Chi Chang, Yi-An Chen, Ting-Chen Chang (Department of Agronomy, National Taiwan University, Taiwan)

1:15 PM - 2:00 PM

[P3-07] The Effect of Ultra-Fine Bubble on Soybean Growth under Osmotic Stress Condition

○Kaito Yamashita[1], Yoshihiro Hirooka[1], Yoshikatsu Ueda[2], Koji Yamane[1], Chikashi Kamimura[3], Morio Iijima[1] （1.Graduate School of Agriculture, Kindai University, Japan, 2.Research Institute for Sustainable Humanosphere, Kyoto University, Japan, 3.Eatech Co. Ltd, Japan）

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[P3-08] Simple Model for Root Distribution across Soil Depth in Rice (*Oryza sativa* L.) under Fluctuating Soil Moisture Conditions

Hien Thi Thanh Nguyen, Tohru Kobata, ○Kuniyuki Saitoh （Graduate School of Environmental and Life Science, Okayama University, Japan）

1:15 PM - 2:00 PM

[P3-09] Diurnal Changes in Chloroplast Positioning and Photosynthesis in Finger Millet

○Eri Maai[1], Kazusa Nishimura[2], Rihito Takisawa[3], Tetsuya Nakazaki[2] （1.Faculty of International Agriculture and Food Studies, Tokyo University of Agriculture, Japan, 2.Graduate School of Agriculture, Kyoto University, Japan, 3.Faculty of Agriculture, Ryukoku University, Japan）

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[P3-10] Effect of Seed Hydro-Priming on Initial, Middle, and Late Growth Stage of Rice under the Different Soil Moisture Conditions

○Yoshihiro Nakao[1], Minoru Yoshino[2], Kisho Miyamoto[2], Aki Houshiyama[1], Eri Ishikawa[1], Jun-Ichi Sakagami[1] （1.Faculty of Agriculture, Kagoshima University, Japan, 2.Japan International Cooperation Agency, Japan）

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[P3-11] Differences in Aquaporin Expression and Their Response to Osmotic Stress among Component Roots in a Rice Root System

○Yumika Watanabe[1, 2], Shiro Mitsuya[1], Akira Yamauchi[1] （1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.School of Biological Sciences, The University of Western Australia, Australia）

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[P3-12] Does Plasticity of Anatomical Traits Influence Water Stress Tolerance in Rice?

○Manikanta Ch L N[1], Beena R[2], Rejeth R[3] （1.Department of Plant Physiology, Kerala Agricultural University, India, 2.Department of Plant Physiology, Kerala Agricultural University, India, 3.Department of Plant Physiology, Kerala Agricultural University, India）

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[P3-13] Crops Response to Water Stress Combination with Temperature Like—Rainfed Condition in Cereal

○Phanthasin Khanthavong[1,3], Shin Yabuta[2], Jun-Ichi Sakagami[1,2] （1.The United Graduate School of Agricultural Sciences, Kagoshima University, Japan, 2.Faculty of Agriculture, Kagoshima University, Japan, 3.Maize and Cash Crops Research Center, National Agriculture and Forestry Research Institute, Laos）

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[P3-14] Root and Leaf Plasticity in Response to Soil Moisture Fluctuation in Rice

○Yasutaka Noda[1,2], Mana Kano-Nakata[2], Shiro Mitsuya[1], Akira Yamauchi[1] （1.Graduate School

of Bioagricultural Sciences, Nagoya University, Japan, 2.International Center for Research and Education in Agriculture (ICREA), Nagoya University, Japan）

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[P3-15] Combination of GGE and BLUP Models in the Selection of Rice Varieties Adapted to the Rainfed Lowlands

○Via Ann Marcelo[1], Maria Corazon Cabral[2], Jonathan Niones[3], Roel Suralta[4], Mana Kano-Nakata[2], Akira Yamauchi[2] （1.Plant Breeding and Biotechnology Division, Philippine Rice Research Institute, Philippines, 2.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 3.Genetic Resources Division, Philippine Rice Research Institute, Philippines, 4.Crop Biotechnology Center, Philippine Rice Research Institute, Philippines）

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[P3-16] Absorption and Physiological Treatment Mechanism of Cesium under High NaCl Conditions in Quinoa (*Chenopodium quinoa* Willd.)

○Kengo Wada[1], Katsunori Isobe[2], Masao Higo[2], Yoshihiro Kawamura[1], Yuya Tatewaki[1], Koya Nakamura[1] （1.Graduate School of Bioresource Science, Nihon University, Japan, 2.College of Bioresource Science, Nihon University, Japan）

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[P3-17] Differences in the Strategies of Salinity Tolerance between Two Different Genotypic Groups of Quinoa (*Chenopodium quinoa* Willd.)

○Mire Hong[1], Yasunari Fujita[2], Yasuo Yasui[3], Keisuke Katsura[1] （1.Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan, 2.Biological Resourse and Post-harvest Division, Japan International Research Center for Agriculture Sciences, Japan, 3.Graduate School of Agriculture, Kyoto University, Japan）

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[P3-18] Mapping of Salinity Tolerance in Rice Through Genome-Wide Association Study (GWAS) at Seedling and Reproductive Stages

○Marjorie Punzalan de Ocampo[1,2], Bui Phuoc Tam[1,3], JamesA. Egdane[1], Shiro Mitsuya[2], Akira Yamauchi[2], Amelia Henry[1], Abdelbagi M. Ismail[1] （1.Strategic Innovation-Systems Physiology, International Rice Research Institute, Philippines, 2.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 3.CuuLong Delta Rice Research Institute, Vietnam）

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[P3-19] NaCl-Stimulated ATP Synthesis in a Halophyte (*Mesembryanthemum crystallinum* L.)

○Ryoma Sato[1], Kazuki Yoshida[1], Ayako Konishi[2], Dan Q. Tran[3], Kazuyuki Saito[4], John C. Cushman[5], Sakae Agarie[4] （1.Graduate school of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 2.Faculty of Agriculture, Kagawa University, Japan, 3.The United Graduate School of Agricultural Sciences, Ehime University, Japan, 4.Faculty of Agriculture, Kyushu University, Japan, 5.Department of Biochemistry and Molecular Biology, University of Nevada, United States）

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[P3-20] Expression Analysis of Genes Involved in Removal of Na^+ and Cl^- by Leaf Sheath in Rice

○Sarin Neang[1,3], Nicola Stephanie Skoulding[1], Joyce A. Cartagena[1], Mana Kano-Nakata[2], Akira Yamauchi[1], Shiro Mitsuya[1] （1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.International Center for Research and Education in Agriculture, Nagoya University,

Japan, 3.Department of Agro-Industry, Ministry of Agriculture, Forestry and Fisheries, Cambodia）

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[P3-22] Evaluation of Salinity Tolerance in Rice Lines Carrying Overlapping Chromosome Segments of *Oryza longistaminata* in a Genetic Background of Kernel Basmati

○Rena Tomita[1], Emily Waringa Gichuhi[2], Daniel Makori Menge[2], Mayumi Kikuta[3], Daigo Makihara[4] （1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.Industrial Crops Research Institute, Kenya Agricultural and Livestock Research Organization, Kenya, 3.Graduate School of Integrated Sciences for Life, Hiroshima University, Japan, 4.International Center for Research and Education in Agriculture, Nagoya University, Japan）

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[P3-23] Identification of Rice Varieties Showing Superior Salt Removal Ability in Leaf Sheath and Its Contrasting Varieties

○Itsuki Goto, Akira Yamauchi, Shiro Mitsuya （Graduate School of Bioagricultural Sciences, Nagoya University, Japan）

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[P3-24] Transcriptional Regulation of the Stress-Inducible Photosynthesis in the Common Ice Plant, *Mesembryanthemum crystallinum* L.

○Sakae Agarie[1], Kento Kuroda[2], Kasumi Nishikawa[2], Nanako Isshiki[2], Yoko Ide[3], Kazuyuki Saito[1], John C. Cushman[4] （1.Faculty of Agriculture, Kyushu University, Japan, 2.Faculty of Agriculture, Kagawa University, Japan, 3.Faculty of Agriculture, Saga University, Japan, 4.Department of Biochemistry and Molecular Biology, University of Nevada, Reno, United States）

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[P3-25] Morphological Characterization of Calcium Oxalate Crystals and Effect of Growth-Medium Calcium Levels on Morphology of the Crystals in Tubers and Roots of Chinese Yam

○Michio Kawasaki[1,2], Ryotaro Shibata[2], Shinichiro Ito[2] （1.Faculty of Agriculture, Setsunan University, Japan, 2.Faculty of Agriculture and Life Science, Hirosaki University〔previous affiliation〕, Japan）

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[P3-26] Root Type-Specific Transcriptome Diversity in Salinity Tolerant and Sensitive Rice Varieties

○Joyce Cartagena[1], Yao Yao[1], Shiro Mitsuya[1], Takashi Tsuge[2] （1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.Department of Biological Chemistry, Chubu University, Japan）

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[P3-27] Breeding for Submergence-Tolerant Rice by Marker Assisted Backcross

○Yu-Chien Tseng[1], Yu-Chia Hsu[1], Yu-Chin Chang[2], Yong-Pei Wu[2] （1.Agronomy Department, National Chiayi University, Taiwan, 2.Agronomy Department, Chiayi Agricultural Experiment Station, Taiwan Agricultural Research Institute, Taiwan）

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[P3-28] Seed-Flooding Tolerance in Soybean is Related to Germination Ability under Water

○Shinjiro Ootsuka, Ryutaro Morita, Junko Yamagishi, Naohiro Aoki （Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

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[P3-30] Utilization of *SEMIDWARF1* for Vigorous Growth, Weed Competitiveness and Deep-Water Resistance in Rice Varieties for Organic Farming

○Marina Iwasa, Keisuke Katsura, Takashi Motobayashi, Taiichiro Ookawa （Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan）

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[P3-31] Naked Waxy Barley Yield and Grain β-glucan Affected by Soil Heterogeneity in Different Arable Lands

○Atsushi Matsumura[1], Takuya Morishita[2], Syuusuke Nakai[2], Hiroyuki Masumoto[1], Masanori Yanase[1] （1.Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Japan, 2.College of Life, Environment and Advanced Sciences, Osaka Prefecture University, Japan）

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[P3-32] Transitional Oxygen Point (TOP), a Physiological Indicator to Evaluate Waterlogging Tolerance in Crops

○Yutaro Oba[1], Akihiro Nose[1], Makoto Tokuda[2], Shao Hui Zheng[1] （1.Tropical Crop Science, Agriculture, Saga University, Japan, 2.Systems Ecology, Agriculture, Saga University, Japan）

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[P3-33] Comparative Transcriptome Analysis in Sorghum (*Sorghum bicolor* L.) Leaves during Vegetative Stage under Waterlogging Stress

○Ku Hyun Kwon[1], Sang-Heon Choi[1], Ju-Young Choi[1], Soo-Jeong Kwon[1], Hyen-Chung Chun[2], Dong-Gyu Lee[1], Seong-Hyun Yu[1], Tae-Woong Yun[1], Sun Hee Woo[1] （1.Department of Crop Science, Chungbuk National University, Korea, 2.National Institute of Crop Science, Rural Development Administration, Korea）

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[P3-34] Death of Roots Retards the Growth Recovery of Common Buckwheat under Waterlogged Conditions

○Shun Murakami[1], Masaaki Hashimoto[2], Hiromitsu Aoki[2], Yasuhiro Hirata[2], Yoshiharu Wada[1,2], Takuya Koyama[1,2] （1.Graduate School of Regional Development and Creativity, Utsunomiya University, Japan, 2.School of Agriculture, Utsunomiya University, Japan）

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[P3-35] Effects of Root Aerenchyma Formation and Photosynthetic Activity of Leaves under Submergence on Post-Submergence Recovery in *Oryza sativa* and *O. glaberrima*

○Chiharu Sone, Yuta Echizenya, Daichi Tozawa, Kyoko Toyofuku, Atushi Ogawa （Faculty of Bioresource Sciences, Akita Prefectural University, Japan）

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[P3-36] Hypoxic Tolerance of Four Millets is Attributable to Constitutive Aerenchyma Formation and Root Hair Development of Adventitious Root

○Asana Matsuura[1], Yasuyuki Kato[1], An Ping[2] （1.School of Agriculture, Tokai University,

Japan, 2.Arid Land Research Center, Tottori University, Japan）

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[P3-37] Contrasting Rice Cultivars Responses to Increasing CO_2 Levels and Temperature

○Nene Furukawa[1], Murat Aycan[2], Nahar Lutfun[1], Toshihiro Nagamori[1], Eckart Priesack[3], Bertrand Gakière[4], José Luis Araus[5], Iker Aranjuelo[6], Marouane Baslam[2], Toshiaki Mitsui[1,2]（1.Dept. of Life and Food Sciences, Graduate School of Science and Technology, Niigata University, Japan, 2.Laboratory of Biochemistry, Faculty of Agriculture, Niigata University, Japan, 3.Institute of Biochemical Plant Pathology, Helmholtz Center-Munich, Germany, 4.Institute of Plant Sciences Paris-Saclay (IPS2), CNRS University Paris-Saclay, France, 5.Integrative Crop Ecophysiology Group, University of Barcelona, Spain, 6.Agrobiotechnology Institute, Spanish National Research Council, Spain）

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[P3-38] Introgression of Dormant Gene *Sdr4-k* Improves Grain Quality of Sake Rice

○Shinya Kanazawa[1], Maiko Iwano[1], Marouane Baslam[2], Shigeru Hanamata[2], Murat Aycan[2], Isao Hanashiro[3], Kazuhiko Sugimoto[4], Toshiaki Mitsui[1,2]（1.Graduate School of Science and Technology, Niigata University, Japan, 2.Faculty of Agriculture, Niigata University, Japan, 3.Faculty of Agriculture, Kagoshima University, Japan, 4.Institute of Crop Science, National Agriculture and Food Research Organization, Japan）

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[P3-39] Effects of Jasmonic Acids on Rice Flower Opening Time and Fertility under High Temperature Conditions

○Kazuhiro Kobayasi[1], Ramin Taheri[2], Masato Tsurumi[3], Yuki Mizokane[3], Fumihiko Adachi[1], Kazuhiro Ujiie[1], Akio Tanaka[4], Taku Tanogashira[4], Hitoshi Ogiwara[5]（1.Institute of Agricultural and Life Sciences, Shimane University, Japan, 2.Graduate School of Natural Science and Technology, Shimane University, Japan, 3.Faculty of Life and Environmental Sciences, Shimane University, Japan, 4. Kagoshima Prefectural Institute for Agricultural Development, Japan, 5.National Agriculture and Food Research Organization, Japan）

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[P3-40] The Effect of N-application on cpHSP70-2 Accumulation to Improve Rice (*Oryza sativa* L.) Grain Chalkiness

○Olusegun Idowu, Tomoyuki Katsube-Tanaka（Graduate School of Agriculture, Kyoto University, Japan）

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[P3-41] Genetic Analysis of Drought Response Index in a *Temperate Japonica* Rice Mapping Population

○Poornima Ramalingam[1,2], Ha-An Thi Nguyen[1], Kamoshita Akihiko[1]（1.Department of Plant Biotechnology, Tamil Nadu Agricultural University, India, 2.Asian Research Center for Bio-Resources and Environmental Sciences, Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 3.Asian Research Center for Bio-Resources and Environmental Sciences, Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

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[P3-42] Contribution of the Chromosome 11 of a Salinity-Tolerant Rice Variety Nona Bokra to High Dry Matter Production under Salinity and Its QTL

Mapping

○Yumika Yamamoto[1], Masaki Uchida[1], Mana Kano-Nakata[2], Akira Yamauchi[1], Shiro Mitsuya[1]
（1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.International Center for Research and Education in Agriculture, Nagoya University, Japan）

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[P3-43] Genotypic Variation in Root Morpho-Anatomical Traits of Rice Cultivars with High and Low Adaptability under Multi-Stress Environment

○Maria Corazon Julaton Cabral[1,2], Via Ann Candelaria Marcelo[3], Roel Rodriguez Suralta[3], Jonathan Manito Niones[3], Antoinette Soriano Cruz[3], Hiroshi Ehara[1,2], Yoshiaki Inukai[1,2], Akira Yamauchi[1], Mana Kano-Nakata[1,2]（1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.International Center for Research and Education in Agriculture, Nagoya University, Japan, 3.Philippine Rice Research Institute, Philippines）

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[P3-44] Heavy Flooding Effects on Productivity of Paddy Rice Cultivar 'Nanatsuboshi'

○Hideki Okamoto[1], Junji Fujikura[2], Katsuhiro Furukawa[2]（1.Tenpoku Sub-centre, Dairy Research Centre, Hokkaido Research Organization, Japan, 2.Kamikawa Agricultural Experiment Station, Hokkaido Research Organization, Japan）

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[P3-45] Root Anatomical Traits Related to Root Oxygen Consumption and Transportation between Upland Rice and Lowland Rice Varieties

○Shotaro Tamaru[1], Keita Goto[1], Phanthasin Khanthavong[1], Shin Yabuta[2], Jun-Ichi Sakagami[1,2]
（1.The United Graduate School of Agricultural Sciences, Kagoshima University, Japan, 2.Faculty of Agriculture, Kagoshima University, Japan）

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[P3-46] Roles of Root Plasticity to Growth and Yield of Quinoa under Different Soil Water Regimes

○Dinh Thi Ngoc Nguyen[1], Cuong Van Pham[1], Thiem Thi Tran[1], Akira Yamauchi[2]（1.Faculty of Agronomy, Vietnam National University of Agriculture, Vietnam, 2.Faculty of Agronomy, Vietnam National University of Agriculture, Vietnam, 3.Faculty of Agronomy, Vietnam National University of Agriculture, Vietnam, 4.Graduate School of Bioagricultural Sciences, Nagoya University, Japan）

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[P3-47] Integrated Transcriptome and Proteome Analysis Reveals Complex Regulatory Mechanism of Maize (*Zea mays* L.) in Response to Zinc Deficiency Stress

Jinyao Zhang[1,3], Shuhui Song[1], Yinghong Pan[2], Fangsen Xu[3], ○Hong Wang[1]（1.Institute of Agriculture Resources and Regional Planning, Chinese Academy of Agricultural Sciences, China, 2.The National Key Facility for Crop Gene Resources and Genetic Improvement, Institute of Crop Science, Chinese Academy of Agricultural Sciences, China, 3.College of Resources and Environment, Huazhong Agriculture University, China）

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[P3-01] Influence of Low Temperature at Booting Stage on Growth and Yield in Fall and Spring Sown Wheat

Jaeeun Choi[1], Jae-Gyeong Jung[1], Young-Hun Lee[1], Ki-Eun Song[1,2], Jonghan Ko[3], Kyung-Do Lee[4], ○Sang-In Shim[1] (1.Department of Agronomy, Gyeongsang National University, Korea, 2.Division of Applied Life Science (BK21 Plus), Gyeongsang National University, Korea, 3.Department of Applied Plant Science, Chonnam National University, Korea, 4.Climate Change and Agro-Ecology Division, Rural Development Administration, Korea)

Due to global climate change, winter temperatures are getting warmer and, in addition, low-temperature damage often occurs in late March and early April in overwintering crops. In this study, we compared changes in fall and spring sown wheat (cv. Jokyeong) cultivated in Jinju, Korea in 2017-2018 season (no low temperature damage) and 2018-2019 season (low temperature outbreak at booting stage). In the growth and yield-components analysis, the total biomass of fall sown wheat was 13,694 kg· ha^{-1} in 2018 and 20,461 kg· ha^{-1} in 2019. Grain yield was 5,370 kg· ha^{-1} in 2018 and 4,918 kg· ha^{-1} in 2019. In case of spring sown, it was found that the total biomass and grain yield was higher in 2018-2019 season by 6,513 kg· ha^{-1} and 3,411 kg· ha^{-1}, respectively, than in 2017-2018 season. Protein content showed different results, crude protein content of grains was higher in the fall sown wheat in the 2018-2019 season, however, the content was higher in spring sown wheat in 2017-2018 season. In the case of abnormal low temperature damage occurs at booting stage, spring sowing was better in terms of the grain yield, but protein content was better in fall sowing.

This study is a part of Cooperative Research Program for Agriculture & Technology Development (Project No. PJ0138412021) from Rural Development Administration, Republic of Korea.

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[P3-02] Selection of Transcripts Relating to Chlorophyll Content of Rice Seedlings at Low Temperature Using RNA-Sequencing Data

○Akari Fukuda[1], Tatsuro Hirose[2], Yoichi Hashida[2], Naohiro Aoki[3], Atsuhi J. Nagano[4] (1.Institute of Crop Science, National Agriculture and Food Research Organization, Japan, 2.Faculty of Agriculture, Takasaki University of Health and Welfare, Japan, 3.Graduate School of Agricultural and Life Science, The University of Tokyo, Japan, 4.Faculty of Agriculture, Ryukoku University, Japan)

The seedlings of an *indica* rice cultivar, Kasalath, showed chlorosis symptoms at 18℃; although the leaves of a *japonica* cultivar, Arroz da Terra, remained green at 18℃. In this study, transcripts relating to the chlorophyll content of rice seedlings at 18℃ were investigated using RNA sequencing (RNA-seq) data. Differential expression analysis revealed that the expression levels of photosynthetic genes were repressed in Kasalath seedlings at 18℃ compared to the seedlings grown at 25℃. However, stress-responsive genes were expressed at higher levels at 18℃ than at 25℃ in the Kasalath seedlings. Furthermore, the transcripts whose expression levels were related to chlorophyll content were statistically selected using the RNA-seq data of 21 F_2 plants derived from a cross between Arroz da Terra and Kasalath. For the regression models, frequently selected genes included photosynthetic and

stress responsive genes. The expression levels of the photosynthetic genes in the high-frequently selected genes had significant positive correlations with chlorophyll content in 95 F_2 plants at 18℃. Contrastingly, the expression levels of stress-responsive genes had significantly negative correlations with chlorophyll content, suggesting that low temperature-sensitive lines expressed more stress-responsive genes than tolerant lines at 18℃.

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[P3-03] Membrane Lipid Unsaturation Confers Cold Germination Ability to Seeds of Upland Cotton (*Gossypium hirsutum*)

Lakhvir Kaur Dhaliwal[1], Junghyun Shim[1], Masoud Zabet[2], Benildo G. de los Reyes[1], ○Rosalyn B. Angeles-Shim[1] (1.Department of Plant and Soil Science, College of Agricultural Sciences and Natural Resources, Texas Tech University, United States, 2.Center for Biotechnology and Genomics, Texas Tech University, United States)

The rapid influx of water during imbibition of a mature, dry seed triggers cell membrane re-organization from the hexagonal to the lamellar phase. During this transition, the cell membrane becomes highly permeable, resulting in cytoplasmic leakage and ultimately to poor seed germination. Membrane unsaturation has been reported to reduce cell membrane permeability by increasing its flexibility during reorganization in water-imbibing seeds. We screened cotton mutants with varying fatty acid (FA) profiles for their ability to germinate at 12℃ and 15℃. FA mutants with lower palmitic acid and higher linoleic acid content (LP/HL) showed a higher and more uniform germination at both low temperatures compared to the wild type. Hydropriming at 30℃ prior to cold treatment resulted in the faster and more uniform germination of the wild type, although the observed improvements were not at par with the cold germination ability of non-imbibed LP/HL mutants. Electrolyte leakage was higher in the wild type than in the LP/HL mutants after imbibition at 12℃ and 15℃ for up to 4 hours. Phospholipidomic studies showed higher incorporation of unsaturated linoleic acid in membrane lipids of the LP/HL mutants compared to the wild type. Results of the study indicate that the higher proportions of unsaturated fatty acids in the seeds of the LP/HL mutants enhanced the fluidity of cell membrane during reorganization, allowing the rapid restoration of cellular functions at low temperatures and facilitating the faster and higher germination of seeds.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-04] Characteristics of Photoassimilates Distribution in the Resistant Variety to the High-Temperature Damage to Rice Grain Ripening

*Nominated for Presentation Awards

○Saki Yoshino[1], Chiharu Sone[2,3], Kyoko Toyofuku[2,3], Fumiaki Takakai[2,3], Takato Mizumoto[2], Yoko Ishikawa[2,3], Atsushi Ogawa[2,3] (1.Graduate School of Bioresource Sciences, Akita Prefectural University, Japan, 2.Faculty of Bioresource Sciences, Akita Prefectural University, Japan, 3.Japan Science and Technology Agency, Core Research for Evolutionary Science and Technology Project, Japan)

Due to the rise in temperature caused by global warming in recent years, deterioration of the appearance quality of rice called "high-temperature damage to rice grain ripening" has frequently occurred in Japan. The purpose of this study was to clarify the characteristics of carbon distribution of resistant variety to the high-temperature damage to rice grain ripening under high temperature conditions from the heading stage to the ripening stage. As varieties, "Fusaotome", a resistant variety to the high-temperature damage to rice grain ripening, and "Akitakomachi", a sensitive variety, were tested. The heading time of these two varieties was the same. High temperature treatment and normal temperature treatment were set after the heading period. Compared to Akitakomachi, high-temperature treatment produced less immature grains in Fusaotome, and the deterioration of appearance quality due to high temperature was suppressed. The photosynthetic rate of Fusaotome was maintained higher than that of Akitakomachi regardless of the growth stage. The dry weight of the roots was heavier in Fusaotome than in Akitakomachi. Carbon dioxide labeled with stable isotope ^{13}C was exposed during the heading period, and the effect of high temperature on assimilation was investigated. During the heading period, the distribution ratio of assimilated products to the ears was higher in Fusaotome than in Akitakomachi. Based on these results, it was considered that Fusaotome, a variety resistant to high-temperature ripening disorders, maintains photosynthesis and water absorption from the roots even under high-temperature conditions during the heading period, and increases the rate of translocation to the ears to prevent deterioration in appearance quality.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-05] Comparison of Drought Resistance of NERICA, Asian Rice and African Rice and Effects of Phosphorus Fertilizer

○Michihiko Fujii （Faculty of Education, Shizuoka University, Japan）

Recently NERICA was developed by a crossing of African rice and Asian rice and is considered to be drought resistant, but drought resistance of NERICA is not clarified enough. In this research, NERICA (four cultivars and two lines), Asian rice (three cultivars and parent of NERICA) and African rice (parent of NERICA) were cultivated in the field under drought and traits relevant to drought resistance, stomatal conductance, soil water content, SPAD values and leaf thickness, were measured and compared with dry matter production and yield. Effects of phosphorus fertilizer were also compared among two NERICAs. One NERICA cultivar, one NERICA line and two Asian rice cultivars showed higher top dry weight and one Asian rice cultivar, one NERICA line and one NERICA cultivar showed higher yield. In one NERICA phosphorus fertilizer tended to increase top dry weight and yield. Asian rice cultivars tended to show higher stomatal conductance than NERICA. Cultivar and line differences in yield (ear weight) were significantly correlated with those in stomatal conductance (average: r=0.679**, first measurement: r=0.796**) and in Asian rice and NERICA with those in leaf thickness (r=0.662**). Cultivar and line differences in stomatal conductance were significantly correlated with those in leaf thickness (r=0.633*) and cultivar and line differences in leaf thickness were significantly correlated with SPAD value (r=0.643**) on similar date. Importance of maintaining high stomatal conductance and high leaf thickness, and effects of phosphorus fertilizer under drought condition was suggested.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-06] The Effects of Arbuscular Mycorrhizal Symbiosis on the Growth, Yield and Drought Resistance of Foxtail Millets (*Setaria italica*)

○Wei-Yi Lin, Ou-Chi Chang, Yi-An Chen, Ting-Chen Chang （Department of Agronomy, National Taiwan University, Taiwan）

Arbuscular mycorrhizal fungi (AMF) are the beneficial endosymbionts which can enhance nutrient uptake and stress resistance of host plants. These fungi are able to associate with more than 80% of land plant species, including foxtail millets. Foxtail millets (*Setaria italica*) is wildly grown in the world, however, it is still not clear about the potential of applying AMF on millet production and the stress tolerance. We selected two millet landraces collected in Taiwan (line 110) and India (line 209), respectively, and examined the effects of AMF on their growth responses, phosphate concentration and drought tolerance. Phosphate concentration was significantly increased in both lines with AMF treatment, compared to mock-treatment, although the growth was not promoted. It is noteworthy that the thousand grain weight was significantly increased in AMF-treated line 110. Under drought treatment, AMS enhanced the drought tolerance of line 110, while for lines 209, both mock- and AMF-treated plants were strongly tolerant to drought. Furthermore, the low level of malondialdehyde content in both mock- and AMF-treated line 209 and the decreased level in AMF-treated line 110, compared to mock-treated plants, supported the drought-tolerance phenotype that we observed. Taken together, our finding showed that AMF has great potential for improving foxtail millets production. We also observed the effects of host plant genotype on the benefits of AMS. Further study is required to reveal the effects of genotype on AMS and the mechanism of drought tolerance in millets.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-07] The Effect of Ultra-Fine Bubble on Soybean Growth under Osmotic Stress Condition

*Nominated for Presentation Awards

○Kaito Yamashita[1], Yoshihiro Hirooka[1], Yoshikatsu Ueda[2], Koji Yamane[1], Chikashi Kamimura[3], Morio Iijima[1]
（1.Graduate School of Agriculture, Kindai University, Japan, 2.Research Institute for Sustainable Humanosphere, Kyoto University, Japan, 3.Eatech Co. Ltd, Japan）

Ultrafine bubbles (UFB) exhibit a number of unique physical characteristics; however, reports on plant growth enhancement by UFB application are controversial. In the series of our former studies, we proved that the nutrient condition of plant growth medium is the key factor to govern the effects of UFB on young soybean seedlings. When no nutrients were supplied, positive effects of UFB water were evident, but low nutrition reduced UFB water-mediated growth enhancement and high nutrition totally obliterated any growth enhancement by UFB water. The purpose of this presentation is to clarify whether the UFB application mitigates the effects of drought stress on soybean plants. A simple experimental system based on hydroponic culture was used to evaluate the effect of UFB on the early growth of soybean seedlings under higher osmotic stress environment. In conclusion, UFB water-induced growth enhancement was eff ective and signifi cant under the nutrient defi cit and osmotic stress. Additional research is necessary to analyze drought stress and UFB application using soil cultured plants.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-08] Simple Model for Root Distribution across Soil Depth in Rice (*Oryza sativa* L.) under Fluctuating Soil Moisture Conditions

Hien Thi Thanh Nguyen, Tohru Kobata, ○Kuniyuki Saitoh (Graduate School of Environmental and Life Science, Okayama University, Japan)

A simple method for describing rice root distribution under fluctuating soil moisture conditions was developed. Four rice cultivars with different levels of drought tolerance were grown in pots with a diameter/height of 0.30/0.85 m, and watering was terminated at the booting stage. The distribution of root length density (RLD) at maturity was described by a quadratic function of soil depth (D_S) in each cultivar under moist and desiccated soil conditions. The equation resulted in three parameters indicating the root distribution traits of each cultivar: the RLD at half the observed D_S($RLD_{0.5}$) and the reduction rate, expressed as RLD per D_S (slope) and the maximum rate at D_S=0 (intercept) in the differentiated equation. Cultivars with high $RLD_{0.5}$ absorbed large amounts of water from deep D_S. Higher intercept and $RLD_{0.5}$ values accompanied higher slope values, and the same trends were observed for diverse rice cultivars and growth stages. This simple model is convenient for use in evaluating root distribution traits in rice.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-09] Diurnal Changes in Chloroplast Positioning and Photosynthesis in Finger Millet

*Nominated for Presentation Awards

○Eri Maai[1], Kazusa Nishimura[2], Rihito Takisawa[3], Tetsuya Nakazaki[2] (1.Faculty of International Agriculture and Food Studies, Tokyo University of Agriculture, Japan, 2.Graduate School of Agriculture, Kyoto University, Japan, 3.Faculty of Agriculture, Ryukoku University, Japan)

Finger millet is an important cereal crop cultivated in the arid and semi-arid regions and often experiences high-intensity light during the day. Mesophyll (M) chloroplasts in finger millet are known to aggregate to the bundle sheath side when leaves are constantly irradiated with extremely high-intensity light. This aggregative movement of M chloroplasts is also observed in the natural environment, but whether a natural light regime is effective in inducing the response remains unclear. Abscisic acid is reported to trigger not only the aggregative movement but also stomatal closure, but photosynthetic responses accompanying the aggregative movement also remain unknown. We investigated changes in chloroplast positioning and photosynthetic traits under diurnal patterns of light, mimicking the natural light environment. M chloroplasts showed the aggregative movement with increasing light intensity whether it frequently fluctuated or not, and kept their aggregative positions in the early afternoon. With decreasing light intensity, M chloroplasts returned to the random position in the evening. These results suggest that M chloroplasts often rearrange their intracellular positions during the daytime and the chloroplast aggregative movement can be induced by a natural regime of light. The chloroplast aggregative movement was observed with increasing stomatal conductance, suggesting that stomatal closure seems not crucial to trigger the chloroplast response.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-10] Effect of Seed Hydro-Priming on Initial, Middle, and Late Growth Stage of Rice under the Different Soil Moisture Conditions

*Nominated for Presentation Awards

○Yoshihiro Nakao[1], Minoru Yoshino[2], Kisho Miyamoto[2], Aki Houshiyama[1], Eri Ishikawa[1], Jun-Ichi Sakagami[1] (1.Faculty of Agriculture, Kagoshima University, Japan, 2.Japan International Cooperation Agency, Japan)

Low soil moisture causes poor plant emergence and establishment which leads decreasing the upland rice yield. Hydro-priming technique is known as the treatment which promotes enzyme activity, starch degradation, and accumulation of dry resistance substances and improves plant emergence and growth. In resent research, it has been found that the priming effect is not fully appeared under some soil moisture conditions. Therefore, we investigated details of hydro-priming effect on rice growth and yield under different soil moisture conditions. In first experiment, plant emergence and early growth parameter (plant height, root length and dry weight) under the wide range of soil moisture conditions were examined by using small planting pot. In second experiment, primed and untreated seed were cultivated in different soil moisture conditions and priming effect on the middle and late growth stage was examined. This study showed that root growth was increased significantly in primed seed compered to untreated seeds under the dry condition at the initial growth stage. This trait may enhance subsequent plant growth of primed seed under the dry soil moisture condition. During middle and late growth stage, leaf age of primed seed proceeded in advance in primed seed than in untreated seed under dry soil moisture condition. Therefore, it was suggested that priming treatment make growth period short under the dry condition which leads to reduce plant injury caused by less rainfall in late growth stage.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-11] Differences in Aquaporin Expression and Their Response to Osmotic Stress among Component Roots in a Rice Root System

*Nominated for Presentation Awards

○Yumika Watanabe[1, 2], Shiro Mitsuya[1], Akira Yamauchi[1] (1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.School of Biological Sciences, The University of Western Australia, Australia)

A rice root system consists of component roots including seminal root, nodal root, and L-type and S-type lateral root. These roots have different morphological and anatomical structures, and show different responses to the environmental stresses such as drought. Our previous studies showed a possibility that S-type lateral root may have the highest contribution to water uptake among the component roots in a whole root system based on the relationship between hydraulic conductivity of the whole root system and surface area of each component root (Watanabe et al., 2020). Additionally, aquaporin genes have

been reported to regulate water transport across the cell membrane in the radial direction of a root. However, the differences in aquaporin contribution among those component roots are still unknown. This study, therefore, aimed to compare aquaporin expression levels among component roots. Plants were hydroponically grown with and without osmotic stress. Among the 33 aquaporin gene family, we measured the expression level of PIP2;4 and PIP2;5 which were reported to be involved in water transport in rice root using Real-time PCR. The results showed the expression levels of PIP2;4 and PIP2;5 in lateral roots were higher than nodal roots. In addition, osmotic stress treatment significantly increased the expression level in S-type and L-type lateral roots with branching for PIP2;4. These results indicate that the aquaporin function may differ among component roots, and also with ages.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-12] Does Plasticity of Anatomical Traits Influence Water Stress Tolerance in Rice?

*Nominated for Presentation Awards

○Manikanta Ch L N[1], Beena R[2], Rejeth R[3] (1.Department of Plant Physiology, Kerala Agricultural University, India, 2.Department of Plant Physiology, Kerala Agricultural University, India, 3.Department of Plant Physiology, Kerala Agricultural University, India)

Plant roots play a vital role in acquisition of water and nutrients, their substantial plasticity to prevailing water limited environments has a greater emphasis for sustainable crop production, but these traits were often neglected due to the difficulty in handling large sample for studies. Root anatomical traits governing the radial and axial movement of water are expected to perform better in up taking and conducting water to reduce the yield gap under water stress environments. To understand the importance of root traits in mitigating water stress, an experiment was conducted in two phases. In first phase 35 rice genotypes were evaluated for various morpho-physiological and yield related traits tolerant to drought, from which a representative set of three drought tolerant and three drought susceptible genotypes were identified for phase two. In second phase the selected six (6) genotypes, three drought tolerant - Nagina - 22, Karuthamodan (Ptb 29), Chuvannamodan (Ptb 30) and three drought susceptible – Annapoorna (Ptb 35), Jyothi (Ptb 39) and Swetha (Ptb 57) were further evaluated by maintaining at 100% and 50% FC of available soil moistture. Anatomical and morphological investigations made on the roots of genotypes at their respective booting stage, showed that root length, root diameter, stele diameter, metaxylem number, metaxylem width and ratio of stele diameter to root diameter ratio were significantly varying at genotypic and treatment level ($P < 0.05$). Present study reveals that, genotypes with better plastic nature and conservative for maintenance cost performed satisfactorily under water limited conditions revealing their tolerance.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-13] Crops Response to Water Stress Combination with Temperature Like— Rainfed Condition in Cereal

*Nominated for Presentation Awards

○Phanthasin Khanthavong[1,3], Shin Yabuta[2], Jun-Ichi Sakagami[1,2] (1.The United Graduate School of Agricultural Sciences, Kagoshima University, Japan, 2.Faculty of Agriculture, Kagoshima University,

Japan, 3.Maize and Cash Crops Research Center, National Agriculture and Forestry Research Institute, Laos）

The effect of soil moisture content (MSC) on root and shoot growth was depended on crops. Under combination factors like– water and temperature stresses may change root and shoot phenotyping. This study aimed to evaluate the effect of various SMC combinations with low or high temperatures on morphological and physiological traits in maize, millet, rice, and sorghum. The experiments were conducted in the greenhouse by using a slope field. The same experimental design but the difference of daily temperature was conducted in September (range from 25–34℃)(Exp. A) and October/November (range from 15–24℃) (Exp. B), 2021. The treatments consisted of nine different SMC range from waterlogging to dry MSC. Shoot dry weight (SDW) of maize and sorghum was deceased by higher SMC in all experiments, but not for millet in Exp. B. However, rice was less change on SDW in all experiments. SDW of all crops had a significant correlation with leaf area and plant length for all experiments. Decreasing SDW of maize under low SMC combination with high temperature was observed in Exp. A. Millet and sorghum had lower SDW and for all SMC in Exp. B compared to Exp. A due to lower stomatal conductance. Our results suggested that the effect of SMC depends on crops and temperature. Waterlogging reduced SWD due to reduction of stomatal conductance, leaf area, and plant length in maize and sorghum with independent temperatures, but millet was dependent on temperatures. Under low SMC, maize was sensitive to high temperature. Millet and sorghum were sensitive to low temperature. Rice was less effect on SWC and independent temperature.

Keywords: Stomatal conductance, soil moisture content, morphology, shoot dry weight, slope field.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-14] Root and Leaf Plasticity in Response to Soil Moisture Fluctuation in Rice

*Nominated for Presentation Awards

○Yasutaka Noda[1,2], Mana Kano-Nakata[2], Shiro Mitsuya[1], Akira Yamauchi[1] (1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.International Center for Research and Education in Agriculture (ICREA), Nagoya University, Japan）

Drought and soil moisture fluctuation (SMF) stress negatively affect plant growth and development in rainfed rice ecosystem. In our previous study, CSSL47 (chromosome segment substitution line derived from Nipponbare and Kasalath crosses) and KDML105 showed high root plasticity in response to SMF (Suralta et al. 2010; Owusu-Nketia et al. 2018). Also, leaf morphoanatomical plasticity in response to environmental stresses has been reported. This study aimed to evaluate the leaf morphoanatomical response in relation to root plasticity expression under SMF conditions and those contribution to dry matter production using Nipponbare, CSSL47 and KDML105. We hypothesized that root plasticity exhibited more in mild drought-SMF than severe drought-SMF. Rice plants were grown under waterlogged conditions (Control), 20% of soil moisture content as mild drought to waterlogged (SMF20) and 10% of soil moisture content as severe drought to waterlogged (SMF10) in root box (L × W × H = 25 cm × 2 cm × 40 cm) under glasshouse conditions. CSSL47 and KDML105 showed greater shoot dry matter production than Nipponbare under SMF, which was attributed to the greater root system and stomatal number per plant resulting the maintenance of water uptake. However, there was no difference in stomatal density among the three varieties. Also, more plasticity was exhibited in SMF20 than in SMF10. These results

implied that CSSL47 and KDML105 can increase leaf area and the number of stomata per plant and contributed to the increase in dry matter production under SMF with mild drought to waterlogged.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-15] Combination of GGE and BLUP Models in the Selection of Rice Varieties Adapted to the Rainfed Lowlands

○Via Ann Marcelo[1], Maria Corazon Cabral[2], Jonathan Niones[3], Roel Suralta[4], Mana Kano-Nakata[2], Akira Yamauchi[2] (1.Plant Breeding and Biotechnology Division, Philippine Rice Research Institute, Philippines, 2.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 3.Genetic Resources Division, Philippine Rice Research Institute, Philippines, 4.Crop Biotechnology Center, Philippine Rice Research Institute, Philippines)

Developing lines tolerant to water stress that are highly productive, widely adapted, and stable across environments is crucial to sustain yield increases in the rainfed lowlands (RL). Fourteen varieties were tested in Multi-Environment Trials in 19 experiments across three years. Genotype plus Genotype-vs-Environment interaction (GGE) and Best Linear Unbiased Prediction (BLUP) models were used for genotype mega-environment evaluation while correlation identified traits which are related to grain yield. Genotype confidence index revealed that half of the environments were identified as unfavorable RL, wherein, DRS14 is the best performing genotype across all environments (3.48 t/ha), unfavorable RL (2.78 t/ha), and favorable RL (4.11 t/ha). Moreover, the GGE model identified DRS14 as the best ranking genotype that is location-specific to 18 out of 19 environments. However, based on the mean vs stability biplot and the BLUP model, DRS14 is highly unstable. Bivariate analysis showed that grain yield is positively correlated to shoot dry weight, while low negative relationships were observed for total root length (10-20 cm) and total lateral root length (10-20 cm). Ultimately considering productivity, wide adaptation, and stability across environments in both models, DRS768, DRS63, YTH183, and YTH303 meet parameters in productivity, wide-adaptation, and stability across RL environments.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-16] Absorption and Physiological Treatment Mechanism of Cesium under High NaCl Conditions in Quinoa (*Chenopodium quinoa* Willd.)

*Nominated for Presentation Awards

○Kengo Wada[1], Katsunori Isobe[2], Masao Higo[2], Yoshihiro Kawamura[1], Yuya Tatewaki[1], Koya Nakamura[1] (1.Graduate School of Bioresource Science, Nihon University, Japan, 2.College of Bioresource Science, Nihon University, Japan)

Quinoa (*Chenopodium quinoa*) is known a high salt-tolerant plant, and high cesium (Cs) absorption plant, too. One of reason about high salt-tolerant in quinoa was the existence of bladder cells on the leaf surface, and the excess salts were accumulated in bladder cells. Since cesium is a harmful element for plant growth, the absorbed cesium should be excreted from plant, accumulated in the vacuole or be detoxified. Thus, the change of Cs-absorbing ability of quinoa by NaCl application, and the physiological

treatment mechanism of absorbed Cs in the plant were clarified in this study.
The growth (particularly, shoot fresh weight, and leaf area) of quinoa were promoted by the application of NaCl in the soil. In addition, the Cs absorption was promoted by the application of NaCl, and the almost of absorbed Cs were accumulated in the leaves. However, the number of bladder cells on the leaf surface did not increased by application of NaCl. In addition, the number of bladder cells decreased with decreasing leaf position. The Cs concentration of leaf was similar to that of removed bladder cells leaf, and there was no significant difference on Cs concentration between the bladder cells and the leaves. These results suggested that the most of Cs absorbed by quinoa plants were accumulated in leaves and were not specifically tranced from the leaves to bladder cells. In the future, it is necessary to clarify how Cs accumulated in leaves is rendered harmless in cells.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-17] Differences in the Strategies of Salinity Tolerance between Two Different Genotypic Groups of Quinoa (*Chenopodium quinoa* Willd.)

*Nominated for Presentation Awards

○Mire Hong[1], Yasunari Fujita[2], Yasuo Yasui[3], Keisuke Katsura[1] (1.Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan, 2.Biological Resourse and Post-harvest Division, Japan International Research Center for Agriculture Sciences, Japan, 3.Graduate School of Agriculture, Kyoto University, Japan)

Salinity causes yield loss and it is a common problem in the world. Millions of hectares of land have been damaged by salinity and more will be degraded by salinity. Quinoa (*Chenopodium quinoa* Willd.), a halophyte crop, is receiving increased attention due to its high tolerance to salinity. Quinoa is divided into 3 genotypic groups (Christensen et al., 2007); Southern highland (SH) type, Northern highland type, and Lowland (L) type. SH type is thought to have a high tolerance to salinity since it can survive in Bolivian saline area. However, little is known about the physiological mechanisms and differences in salinity tolerance among the genotypic groups of quinoa. In this study, three lines of SH type quinoa and three lines of L type quinoa were used, and their salinity tolerance was evaluated in pot experiments. We found that regardless of the genotype, quinoa had a high salinity tolerance compared to other crops such as rice and barley. Quinoa could maintain a low Na^+/K^+ ratio in the shoot under high salinity stress condition. The strategy of salinity tolerance differed greatly between the genotypic groups. SH type quinoa avoided the accumulation of Na^+ into the shoot and maintained high biomass. However, L type quinoa maintained high biomass even though they accumulated Na^+ in the shoot. In conclusion, quinoa had a high salinity tolerance regardless of genotypic groups and they showed different strategies between the two genotypic groups to survive under salinity stress conditions.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-18] Mapping of Salinity Tolerance in Rice Through Genome-Wide Association Study (GWAS) at Seedling and Reproductive Stages

*Nominated for Presentation Awards
○Marjorie Punzalan de Ocampo[1,2], Bui Phuoc Tam[1,3], JamesA. Egdane[1], Shiro Mitsuya[2], Akira Yamauchi[2], Amelia Henry[1], Abdelbagi M. Ismail[1] （1.Strategic Innovation-Systems Physiology, International Rice Research Institute, Philippines, 2.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 3.CuuLong Delta Rice Research Institute, Vietnam）

Rice genotypes may have different stress tolerance levels depending on the growth stage of the crop. Studies are needed to investigate whether traits contributing seedling stage tolerance can also contribute to reproductive stage tolerance. In this study, 299 lines from the previously genotyped rice diversity panel 1 (RDP1) were used to assess morphological and physiological traits, and map loci controlling salinity tolerance in rice for both seedling and reproductive stages through genome-wide association studies (GWAS). The salinity stress treatment was 12 dS m^{-1} in the seedling stage and 10 dS m^{-1} in the reproductive stage. The filtered, 4.8 M SNP dataset from 3KRG Release 1.0 and phenotypic data were analyzed using a linear mixed-model by the R package of GAPIT. The threshold was 1.11 x 10^{-8} at level of 1% after Bonferroni multiple test correction. GWAS identified highly significant peaks for salinity tolerance at seedling stage on chromosome 5 (SES score); and chromosome 10 (root length, shoot Na^+:K^+ ratio and vigor) and no significant peaks at the reproductive stage. One variety, Dhala Shaitta, showed salinity tolerance at both seedling and reproductive stages. SES score was strongly correlated with shoot Na^+:K^+ ratio at seedling stage, and grain yield was highly correlated with leaf chlorophyll a+b content at reproductive stage. Further genetic and physiological studies are needed to divulge the underlying mechanisms and genes involved in seedling and reproductive stage salinity tolerance.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-19] NaCl-Stimulated ATP Synthesis in a Halophyte (*Mesembryanthemum crystallinum* L.)

*Nominated for Presentation Awards
○Ryoma Sato[1], Kazuki Yoshida[1], Ayako Konishi[2], Dan Q. Tran[3], Kazuyuki Saito[4], John C. Cushman[5], Sakae Agarie[4] （1.Graduate school of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 2.Faculty of Agriculture, Kagawa University, Japan, 3.The United Graduate School of Agricultural Sciences, Ehime University, Japan, 4.Faculty of Agriculture, Kyushu University, Japan, 5.Department of Biochemistry and Molecular Biology, University of Nevada, United States）

NaCl is one of the factors causing damages in plants that severely impedes their growth and reduces crop productivity. Halophyte, a group of salt-tolerant plants, evolved sophisticated mechanisms to survive under the severe salinity conditions, and they also show halophilism, which is a growth response that increases in the presence of NaCl at a concentration in which almost all crops die. The salt-tolerant and halophilic reactions require a large amount of ATP. In the previous study, we found that the ATP synthesis increased with increasing NaCl concentration in the mitochondria isolated from a halophyte, the common ice plant (*Mesembryanthemum crystallinum* L.). In the present study, RNA-Seq analysis was performed to determine the genes related to NaCl-stimulated ATP synthesis in the NaCl-treated cultured cells of the ice plant. We found that mRNA encoding the subunit B of ATP synthase is expressed at a higher level with NaCl. We also identified a specific amino acid sequence of the ice plant that shows high homology with vacuolar ATPase (V-ATPase, a member of ATP synthase superfamily) using BLASTP and the amino acid sequences of Na^+-driven ATP synthases isolated from archaea. Besides, we found that ATP synthesis of the mitochondria treated with uncoupling agent to dissipate H^+ gradient between the

mitochondrial matrix and intermembrane space was maintained with NaCl. In the presentation, we will discuss the possibility of Na^+-driven ATP synthesis and the mechanism of increased H^+-driven ATP synthesis in the halophyte.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-20] Expression Analysis of Genes Involved in Removal of Na^+ and Cl^- by Leaf Sheath in Rice

○Sarin Neang[1,3], Nicola Stephanie Skoulding[1], Joyce A. Cartagena[1], Mana Kano-Nakata[2], Akira Yamauchi[1], Shiro Mitsuya[1] (1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.International Center for Research and Education in Agriculture, Nagoya University, Japan, 3.Department of Agro-Industry, Ministry of Agriculture, Forestry and Fisheries, Cambodia)

A significant mechanism of salt-tolerance in rice is the ability to remove Na^+ and Cl^- in the leaf sheath, which limits the entry of these toxic ions into the leaf blade. The leaf sheath removes Na^+ and Cl^- in the basal and tip parts, respectively, by unloading them from xylem vessels and sequestering them into the fundamental parenchyma cells (Neang et al. 2019). This study aimed to identify Na^+ and Cl^- transporter genes, their distribution patterns of Na^+ and Cl^- along the longitudinal axis of leaves and in the internal tissues of leaf sheaths, and the genes that increase their expression levels under salinity. Our results indicated that *OsHKT1;1*, *OsHKT1;5*, *OsNHX1*, *2*, *3* and *5* might be involved in the Na^+ accumulation in basal parts of leaf sheaths under salinity. Additionally, *OsHKT1;5* may be involved in Na^+ unloading from xylem vessels. The Na^+ accumulation in fundamental parenchyma cells is probably mediated by *OsNHX3* in the central parts and *OsNHX5* in the peripheral parts under salinity. Furthermore, our results indicated that Cl^- removal in leaf sheaths is possibly regulated by *OsNPF2;4*, *OsCLC1*, *OsCLC2*, *OsSLAH1* and *OsSLAH2*. Cl^- accumulation in fundamental parenchyma cells might be associated with *OsNPF2;4* and *OsCLC2* under salinity.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-22] Evaluation of Salinity Tolerance in Rice Lines Carrying Overlapping Chromosome Segments of *Oryza longistaminata* in a Genetic Background of Kernel Basmati

*Nominated for Presentation Awards

○Rena Tomita[1], Emily Waringa Gichuhi[2], Daniel Makori Menge[2], Mayumi Kikuta[3], Daigo Makihara[4] (1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.Industrial Crops Research Institute, Kenya Agricultural and Livestock Research Organization, Kenya, 3.Graduate School of Integrated Sciences for Life, Hiroshima University, Japan, 4.International Center for Research and Education in Agriculture, Nagoya University, Japan)

In the Hola irrigation scheme, which is developed in semi-arid area of Kenya, Basmati rice varieties with locally preferred aromas are grown. However, rice cultivation in this area is suppressed by salinity stress. *Oryza longistaminata*, a wild rice species native to Kenya, is an important donor for improvement of rice tolerance to environmental stresses, including salinity. To determine the chromosome regions of

O. longistaminata involved in salinity tolerance, we evaluated *Longistaminata* Chromosome Segment Introgression Lines (LCSILs) carrying chromosome segments from *O. longistaminata* in the genetic background of Kernel Basmati. We conducted a pot experiment using nine lines, which were selected in a previous study. Two types of soils were used in the experiment, a weakly acidic sandy clay collected from a rice growing area in the Central Highlands of Kenya (soil A), and weakly alkaline sandy loams collected from the Hola irrigation scheme (soil B). LCSIL 19 and 48 were classified as a group with strong salt tolerance in both soils treated with NaCl (approximately 150 mM). In addition, the Na^+ and Na^+/ K^+ of leaf blades for LCSIL 19, 20, and 48, which maintained higher yield under salted soil B, were lower than those of the parent line, Kernel Basmati. In LCSIL 19, 20, and 48, chromosome segments of *O. longistaminata* could be located on chromosomes 4, 5, and 11, respectively, and genes contained therein may have been involved in the regulation of leaf Na^+ and Na^+/ K^+.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-23] Identification of Rice Varieties Showing Superior Salt Removal Ability in Leaf Sheath and Its Contrasting Varieties

*Nominated for Presentation Awards

○Itsuki Goto, Akira Yamauchi, Shiro Mitsuya （Graduate School of Bioagricultural Sciences, Nagoya University, Japan）

In rice plants, salt sensitivity is associated with the accumulation of Na^+ and Cl^- in the shoots, especially in the photosynthetic tissues. Therefore, salt removal ability at the leaf sheath is an important mechanism of salt tolerance. For further research of molecular mechanism and molecular breeding, we aimed to screen rice varieties showing high Na^+ and/or Cl^- removal ability and its contrasting varieties. Salt removal ability at the leaf sheath can be evaluated by the sheath : blade ratios of Na^+ or Cl^- concentrations. In our study, 20 rice varieties were grown hydroponically under control and saline conditions, and the sheath : blade ratios of Na^+ or Cl^- concentrations were measured. We screened a superior rice variety IR-44595 that showed higher Na^+ removal ability in leaf sheath, and the contrasting variety 318. Regarding Cl^-, OKSHITMAYIN showed a superior removal ability in leaf sheath compared with WC 4419. Moreover, we determined the Na^+ accumulation pattern in leaf sheath of IR-44595 and 318. The highest Na^+ concentration was found in the basal part of leaf sheath of both varieties. Cl^- accumulation pattern in the leaf sheath of OKSHITMAYIN and WC 4419 is now under investigation. Also, candidate genes encoding Na^+ or Cl^- transporters that contribute to Na^+ or Cl^- removal ability in leaf sheath of above varieties will be discussed in the conference.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-24] Transcriptional Regulation of the Stress-Inducible Photosynthesis in the Common Ice Plant, *Mesembryanthemum crystallinum* L.

○Sakae Agarie[1], Kento Kuroda[2], Kasumi Nishikawa[2], Nanako Isshiki[2], Yoko Ide[3], Kazuyuki Saito[1], John C. Cushman[4] （1.Faculty of Agriculture, Kyushu University, Japan, 2.Faculty of Agriculture, Kagawa University, Japan, 3.Faculty of Agriculture, Saga University, Japan, 4.Department of Biochemistry and

Molecular Biology, University of Nevada, Reno, United States）

Crassulacean acid metabolism (CAM) is a photosynthetic pathway that evolved from C_3 mode under the condition of limited water supply. The expressions of the genes related to the key metabolic process of CAM are regulated under circadian control. CAM species fixed CO_2 at night by phosphoenolpyruvate carboxylase (PEPC) and stored produced malic acid in the vacuole. PEPC is activated by phosphorylation mediated by PEPC kinase (PPCK). A facultative CAM plant, *Mesembryanthemum crystallinum*, shifts photosynthetic mode from C_3 to CAM under salinity and drought stresses. To elucidate the factors of transcriptional regulation in the transition of CO_2 fixation, we isolated the 5'-flanking regions of CAM-related genes for two isoforms of PEPC, PEPCK and NADP-ME, which were encoded by *Mcppc1*, *Mcppc2*, *McPpck*, and *Mod1*, respectively. The transient assay of the promoter regions of *McPpck* indicated that the region within 540 bp upstream from the start codon included cis-element controlling the expression of the gene. We analyzed the expression of 20 genes encoding transcriptional factors, which were homologs of drought-induced genes of *Talinum triangulare*. The expression of MYB96 increased at night, and MYB-core and AC-element that are binding sites of MYB 96 were found in the region, indicating that the transcriptional factor is associated with the induction of CAM in *Mesembryanthemum crystallinum*.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-25] Morphological Characterization of Calcium Oxalate Crystals and Effect of Growth-Medium Calcium Levels on Morphology of the Crystals in Tubers and Roots of Chinese Yam

○Michio Kawasaki[1,2], Ryotaro Shibata[2], Shinichiro Ito[2] （1.Faculty of Agriculture, Setsunan University, Japan, 2.Faculty of Agriculture and Life Science, Hirosaki University〔previous affiliation〕, Japan）

Calcium oxalate crystals are widely found in various plant species. The crystals have been proposed to have various functions including regulation of calcium levels in plant bodies. In Chinese yam, the tuber grows from the base of normal stem and many roots grow from the tuber. In this study, morphological characterization of calcium oxalate crystals and involvement of the crystals in calcium homeostasis in the roots and tubers of Chinese yam grown under different calcium levels of growth-medium were investigated. Under scanning electron microscopy and optical microscopy, crystals scattered in the cortex and stele of tubers. In this study, crystals were found in the cortex of root tips. Almost all of crystals were observed as bundle of needle-shaped crystals (raphide type). These crystals were identified as calcium oxalate crystals by energy dispersive X-ray spectroscopy (EDS). The number of crystal bundles, lengths of major and minor axes of crystal bundle, and area of crystal bundle in the tuber sections were higher in 20 mM and 40 mM calcium nitrate treatments than in 0 mM calcium nitrate treatments. In the sections of root tips, area of crystal bundle was higher in 20 mM calcium nitrate treatments than in 0 mM calcium nitrate treatments. Calcium mapping images by EDS showed a positive correlation between the area localized calcium per crystal cell and calcium level of treatments. Thus, it is suggested that the crystals possibly participate in the regulation of calcium levels in not only tubers but also in the tips of roots grown from the tubers.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-26] Root Type-Specific Transcriptome Diversity in Salinity Tolerant and Sensitive Rice Varieties

○Joyce Cartagena[1], Yao Yao[1], Shiro Mitsuya[1], Takashi Tsuge[2] (1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.Department of Biological Chemistry, Chubu University, Japan)

Salinity tolerance in rice is a very important trait especially in areas affected by soil salinity such as coastal regions in rice-producing countries. The roots are the key organs that detect and respond to salinity stress; thus, it is important to have an understanding of how root growth is regulated. Previous studies showed that the different types of rice roots respond differently to abiotic stress and the difference can be related to the difference in function. However, the molecular mechanism of this differential response is still uncovered. In this study, the gene expression profiles of nodal roots, S-type lateral roots, and L-type lateral roots from two contrasting rice genotypes were compared. Significant differences in transcriptome profiles among root types might indicate difference in function, especially during response to salinity stress. The details of the gene expression profiles and gene categories identified will be presented and discussed.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-27] Breeding for Submergence-Tolerant Rice by Marker Assisted Backcross

○Yu-Chien Tseng[1], Yu-Chia Hsu[1], Yu-Chin Chang[2], Yong-Pei Wu[2] (1.Agronomy Department, National Chiayi University, Taiwan, 2.Agronomy Department, Chiayi Agricultural Experiment Station, Taiwan Agricultural Research Institute, Taiwan)

Rice (*Oryza sativa* L.) is an important food crop in the world. Due the climate change, to develop a rice variety which can tolerate the abiotic stress becomes a critical research topic. On this study, submergence-tolerant *indica* variety, IR96321-315-240 was used as donor parent. DT3 is the recurrent parent, which is drought tolerant and show good yield, eating quality and agronomic traits as elite Taiwanese variety, Taiken 9 (TK9). Marker-assisted selection (MAS) was applied in backcross breeding method. For foreground selection, there were two submergence-tolerant markers, Sub1A and SubAB1, utilized on BC_2F_1, BC_3F_1 and BC_3F_2 generations to select submergence-tolerant gene, *Sub1A*. Also, the flooding experiment in the field was applied in BC_3F_2 generation and the surviving plants then used for foreground and background selection.The results showed the similarity between surviving plants and recurrent parent was 92.87%. There are 100 plants evaluated for agronomic traits, yield and eating quality from BC_3F_3 generations. Eleven plants were selected and three of them had higher yield than DT3; three of them had better eating quality than DT3. By MAS, the submergence-tolerant trait has been successfully delivered to a drought tolerant, high yield and quality rice variety.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-28] Seed-Flooding Tolerance in Soybean is Related to Germination Ability under Water

*Nominated for Presentation Awards
○Shinjiro Ootsuka, Ryutaro Morita, Junko Yamagishi, Naohiro Aoki （Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

In Japan, soybean (*Glycine max* [L.] Merr.) is mostly cultivated in the paddy conversion fields. However, such converted fields tend to be flooded, which is one of the major causes to reduce the soybean yield. In particular, flooding stress after sowing dramatically decreases the seed emergence rate. Thus, seed-flooding tolerance of soybean is an important agricultural trait. In this study, to clarify the physiological factors of seed-flooding tolerance, we investigated the relationship between seed emergence rate in the field, water absorption rate, and germination ability under water, using some soybean varieties with different seed-flooding tolerance. As a result, the seed emergence rates were not correlated with the water absorption rate of seed, while highly correlated with the germination ability under water. To examine the relationship between seed emergence rate and germination ability of soybean under water in more detail, the accumulation pattern of seed storage substances such as total soluble protein and lipid, soluble sugars and starch during germination were analyzed using the hypocotyl and cotyledon of seed-flooding tolerant and susceptible varieties grown under water. Although the accumulation patterns in cotyledon were not changed, while glucose and fructose contents of hypocotyl of seed-flooding tolerant variety were higher than that of susceptible variety. These results suggest that seed germination ability under water is an important factor for seed-flooding tolerance of soybean, and it could be associated with sugar metabolism in hypocotyl.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-30] Utilization of *SEMIDWARF1* for Vigorous Growth, Weed Competitiveness and Deep-Water Resistance in Rice Varieties for Organic Farming

*Nominated for Presentation Awards
○Marina Iwasa, Keisuke Katsura, Takashi Motobayashi, Taiichiro Ookawa （Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan）

The interest in environmental conservation agriculture with reduced chemical fertilizers and pesticides applications has increased under the SDGs. The Green Revolution rice varieties with *sd1* adapted to the application of heavy chemical fertilizers and pesticides were developed and widespread. They obtained the resistance to lodging by using mutation in *SD1* that induces the inhibition of GA synthesis. Weed management and the amount of initial growth pose huge challenges in organic farming, because of no synthetized fertilizers and pesticides application. Some cultivation methods have been considered to resolve such problems; eg. organic fertilizer application and conducting the deep-water management. The development of new varieties adapted to organic farming are required for the post-Green Revolution. However, it is still unknown what characteristics should be introduced or what's the useful gene for organic farming, and such research approach has not been undertaken. In this study, we analyzed three key characteristics for organic farming of rice: vigorous growth in initial stage, deep-water resistance and weed competitiveness. Although the effectiveness of *SD1* for weeds competition was not enough, varieties carrying *SD1* grew better than those carrying *sd1* with the deep-water management and green manure application as an organic fertilizer due to their rapid shoot elongation. Therefore, it could be one of the key genes under the organic fertilizer application and the deep-water

management to control weeds during the initial growth stage.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-31] Naked Waxy Barley Yield and Grain β-glucan Affected by Soil Heterogeneity in Different Arable Lands

○Atsushi Matsumura[1], Takuya Morishita[2], Syuusuke Nakai[2], Hiroyuki Masumoto[1], Masanori Yanase[1]
（1.Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Japan, 2.College of Life, Environment and Advanced Sciences, Osaka Prefecture University, Japan）

Due to the high dietary fiber content (β-glucan) of barely, its use in human nutrition is becoming more important in the world. Naked waxy barley contains relatively more β-glucan. Because adequate consumption of a high-fiber food is globally recommended for keeping healthy, waxy barley is one of the promising crops. In general, soils are heterogeneously distributed in cropping field. Barley, which is considered susceptible to waterlogging, often rotated with rice and exposed to waterlogging under heavy rain. Soil physico-chemical properties such as soil penetration resistance, soil water content, pH, available nutrients, which are the factors that affect the growth of waxy barley, supposed to be changed by soil heterogeneity. At present, the relationship between soil physico-chemical heterogeneity and yield of naked waxy barley are poorly understood. Here, we examined these relationships using multiple regression analysis. Two different managed fields, one with upland field converted from paddy and the other with conventional upland field, were used in this experiment. In each filed, spatial variability was observed in soil properties, and upland field from paddy showed higher variation in soil properties. For grain yield in upland field from paddy, pH, EC and water content had significant influence. The β-glucan content was negatively correlated with water content. In case of conventional upland field, grain yield and spike number were influenced by EC and soil water content. For β-glucan content, EC and mineral N had significant positive influence.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-32] Transitional Oxygen Point (TOP), a Physiological Indicator to Evaluate Waterlogging Tolerance in Crops

*Nominated for Presentation Awards

○Yutaro Oba[1], Akihiro Nose[1], Makoto Tokuda[2], Shao Hui Zheng[1] （1.Tropical Crop Science, Agriculture, Saga University, Japan, 2.Systems Ecology, Agriculture, Saga University, Japan）

Soil waterlogging causes poor growth and yield loss of various crops. Under waterlogging soil, plant root respiration is inhibited with hypoxia. The hypoxia is led with excess water inhibiting ventilation and with organic aerobic respirations. Although evaluation of waterlogging tolerance is important to improve crop yields, few efficient physiological indicators have been proposed for interspecific and varietal comparisons of the waterlogging tolerance. In this study, we attempted to establish a useful physiological indicator of the intensity of waterlogging tolerance in some poaceaeous crops. We measured the respiration rate and retainability in seminal and crown roots of rice, maize, wheat and teosinte. Based on a predicted O2 dependence relationship model and our data, we newly established a method calculating Transitional Oxygen Point (TOP). The TOP is defined as the inflection point between

the semi-linear and curvilinear phases in the model. The TOPs in seminal and crown roots were relatively low in rice, which possesses high waterlogging tolerance. In contrast, the TOPs were relatively high in crops with low waterlogging tolerance such as maize and wheat. We propose that the TOP is a useful indicator of waterlogging tolerance of crops, and the respiration rate/retainability at the TOP becomes a novel index for the evaluation of waterlogging tolerant intensity in crops.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-33] Comparative Transcriptome Analysis in Sorghum (*Sorghum bicolor* L.) Leaves during Vegetative Stage under Waterlogging Stress

○Ku Hyun Kwon[1], Sang-Heon Choi[1], Ju-Young Choi[1], Soo-Jeong Kwon[1], Hyen-Chung Chun[2], Dong-Gyu Lee[1], Seong-Hyun Yu[1], Tae-Woong Yun[1], Sun Hee Woo[1] (1.Department of Crop Science, Chungbuk National University, Korea, 2.National Institute of Crop Science, Rural Development Administration, Korea)

Waterlogging stress induces dramatical alterations to sorghum growth and development. However, little information on the waterlogging tolerance and associated mechanisms of sorghum is known. Presently, several morpho-physiological indexes and transcriptome profiling under waterlogging stress were investigated during the 3- and 5-leaf stages in sorghum. Growth characteristics of sorghum showed significant differences in the plant height, stem length, and SPAD values under waterlogging stress compared to untreated seedlings. The functional annotation revealed that the top GO enriched DEGs, based on biological process, were involved in transcription and secondary metabolite biosynthetic processes at 3-leaf stages while the flavonoid biosynthetic process, flavonoid glucuronidation, secondary metabolite was counted as the top GO enriched DEGs in 5-leaf. In KEGG pathway enrichment based on RNA-Seq data, the top GO enriched DEGs are involved in phenylpropanoid biosynthesis, plant hormone signal transduction, and glutathione metabolism in 3-leaf stage. However, in 5-leaf stage, the top GO enriched DEGs are involved in plant hormone signal transduction, photosynthesis, glutathione metabolism. Under waterlogging stress, the plant hormone signal transduction pathways tended to be down-regulated towards all hormone signaling pathways except SA at 3-leaf stage. The over-expression of GST enzyme-related pathways in both the 3-leaf and 5-leaf stage may provide a deeper understanding of the mechanism underlying the response to waterlogging and guidance for the breeding of sorghum.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-34] Death of Roots Retards the Growth Recovery of Common Buckwheat under Waterlogged Conditions

*Nominated for Presentation Awards

○Shun Murakami[1], Masaaki Hashimoto[2], Hiromitsu Aoki[2], Yasuhiro Hirata[2], Yoshiharu Wada[1,2], Takuya Koyama[1,2] (1.Graduate School of Regional Development and Creativity, Utsunomiya University, Japan, 2.School of Agriculture, Utsunomiya University, Japan)

In converted paddy fields, waterlogging severely decreases the growth and yield of common buckwheat (*Fagopyrum esculentum* L.). In this study, we examined the hypothesis that under waterlogged conditions

low soil redox potential (Eh) causes the death of root tips, which retards the shoot growth recovery of common buckwheat. We grew common buckwheat cv. kitawasesoba in root boxes. When seedlings had the 3rd leaf, the root boxes went through either 3 or 6-day waterlogging treatments (W3 or W6), whereas the other root boxes remained as drained controls (C). Death of roots was evaluated by changes of root surface area and a number of root tips turned red by triphenyltetrazolium chloride (TTC) staining. Only Eh of W6 decreased to 300 mV, in which almost all dissolved oxygen would disappear. After waterlogging treatments, both Eh of W3 and W6 recovered to the same value as C. The shoot dry weight(SDW) of W3 recovered remarkably after waterlogging treatment, but that of W6 did not recovered after waterlogging treatment. The root surface area of W3 and W6 showed similar changing trends to SDW. The number of red root tips of W3 was significantly smaller than that of C only at 3 days after the waterlogging treatment initiation (DATI), while that of W6 was significantly fewer than that of C from 3 to 13 DATI. From these results, we concluded that when Eh decreased to about 300 mV, the death of root tips severely inhibited the shoot growth recovery of common buckwheat.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-35] Effects of Root Aerenchyma Formation and Photosynthetic Activity of Leaves under Submergence on Post-Submergence Recovery in *Oryza sativa* and *O. glaberrima*

○Chiharu Sone, Yuta Echizenya, Daichi Tozawa, Kyoko Toyofuku, Atushi Ogawa (Faculty of Bioresource Sciences, Akita Prefectural University, Japan)

Rice plants cope with flash floods using either an "escape strategy" involving rapid shoot elongation or a "quiescence strategy" involving survival underwater with minimal activity. In previous studies, leaf elongation and growth in shoot biomass during complete submergence were greater in *O. glaberrima* than in *O. sativa*. To clarify the mechanism of rapid shoot elongation under submergence of *O. glaberrima*, we studied the effects of root aerenchyma formation and photosynthetic activity of leaves under submergence on post-submergence recovery. *O. glaberrima* cv. TOG6876, *O. sativa* cv. REXMONT and *O. sativa* cv. MILYANG23 were used. TOG6876 and REXMONT exhibit shoot elongation in response to submergence. MILYANG23 elongated slowly when submerged. Twenty-day old seedlings were submerged for 7 days. During submergence, the shoot elongation rates were higher in TOG6876 than in REXMONT and the lowest in MILYANG23. In submerged TOG6876 and MILYANG23, the increase of shoot biomass during post-submergence was significantly larger than in REXMONT. During submergence, the maximal quantum yield of photosystem II (*Fv/Fm*) of the upper developed leaf decreased earlier in REXMONT than in TOG6876 and MILYANG23. At 3 days after submergence, root aerenchyma formation was observed in TOG6876 and REXMONT but not in MILYANG23. The physiological mechanism responsible through the chlorophyll breakdown and photodamage in submerged leaves of *O. glaberrima* might be different from the shoot-elongation cultivar in *O. sativa*.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-36] Hypoxic Tolerance of Four Millets is Attributable to Constitutive Aerenchyma Formation and Root Hair

Development of Adventitious Root

○Asana Matsuura[1], Yasuyuki Kato[1], An Ping[2] (1.School of Agriculture, Tokai University, Japan, 2.Arid Land Research Center, Tottori University, Japan)

The purpose of this study is to elucidate the hypoxic tolerance mechanism of four millet species by focusing on the oxygen acquisition mechanism of adventitious roots. Four species of millets were hydroponically cultivated for 27 days in the control where aeration was continued and a hypoxic treatment where nitrogen gas was aerated to reduce the oxygen concentration. From the stress susceptibility index based on the individual plant growth rate, it was clarified that *E. tef* and *E. utilis* had stronger hypoxic tolerance than *B. ramosa* and *S. italica*. Since the net assimilation rate and mean leaf area of millets with susceptible to hypoxic stress were reduced by hypoxic treatment, both were the determinants of the interspecific difference in plant growth rate. Root growth, nitrogen content of leaf and stem, and sodium content per plant of higher hypoxic-tolerant millet species did not change with hypoxic treatment. Whereas in hypoxic-susceptible millet species, root growth, nitrogen content of leaf and stem decreased, and the sodium content of whole plant increased. The proportion of the stele area of the adventitious root of the hypoxic-tolerant millet species was smaller than that of the hypoxic-susceptible millet species, and the constitute aerenchyma was developed. Furthermore, root hair development was observed up to the vicinity of the root tip in hypoxic -tolerant millet species. From the above, the hypoxic tolerance of the millet species is that the constitutive aerenchyma of adventitious roots develops, the proportion of the stele is small, so oxygen consumption is low, and oxygen is efficiently supplied to the root tips. Development of root hair also contributed to nutrient absorption.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-37] Contrasting Rice Cultivars Responses to Increasing CO_2 Levels and Temperature

*Nominated for Presentation Awards

○Nene Furukawa[1], Murat Aycan[2], Nahar Lutfun[1], Toshihiro Nagamori[1], Eckart Priesack[3], Bertrand Gakière[4], José Luis Araus[5], Iker Aranjuelo[6], Marouane Baslam[2], Toshiaki Mitsui[1,2] (1.Dept. of Life and Food Sciences, Graduate School of Science and Technology, Niigata University, Japan, 2.Laboratory of Biochemistry, Faculty of Agriculture, Niigata University, Japan, 3.Institute of Biochemical Plant Pathology, Helmholtz Center-Munich, Germany, 4.Institute of Plant Sciences Paris-Saclay (IPS2), CNRS University Paris-Saclay, France, 5.Integrative Crop Ecophysiology Group, University of Barcelona, Spain, 6.Agrobiotechnology Institute, Spanish National Research Council, Spain)

The changing global climate is a major threat to rice production. We aim to identify rice crop cultivars management practices conferring high nutrient use efficiency to ensure sustainable agricultural and biomass production adapted to the predicted climate change scenarios. To characterize the crops with higher/lower yield and grain quality characteristics, we investigated the agronomical, physiological, and biochemical response patterns in 10 rice cultivars (selected based on their tolerance/susceptibility under a previous drought field experiment) grown under three conditions of control (CT), high-temperature (HT), and combination of high-temperature + elevated CO_2 (HT+ECO_2). The metric measurements and correlation analyses among the studied traits allowed to systematically break down the divergent behavioral phenotypes of rice genotypes under stressful environment. As a result, the seed-set and yield were reduced while chalkiness increased by high tissue temperature. ECO_2 increases some physiological

traits, spikelet, and seed number, while it decreased the grain traits, and can compensate to some extent the temperature, but the HT+ECO_2 undermines the grain characteristics and quality traits.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-38] Introgression of Dormant Gene *Sdr4-k* Improves Grain Quality of Sake Rice

*Nominated for Presentation Awards

○Shinya Kanazawa[1], Maiko Iwano[1], Marouane Baslam[2], Shigeru Hanamata[2], Murat Aycan[2], Isao Hanashiro[3], Kazuhiko Sugimoto[4], Toshiaki Mitsui[1,2] (1.Graduate School of Science and Technology, Niigata University, Japan, 2.Faculty of Agriculture, Niigata University, Japan, 3.Faculty of Agriculture, Kagoshima University, Japan, 4.Institute of Crop Science, National Agriculture and Food Research Organization, Japan)

Rice is one of the most important factors in determining the quality of sake. The grain kernel of sake rice cultivars is characterized by the possession of a white cloudy tissue at the center, termed 'white core'. The white core is a critical trait that affects, among others, water absorbability for sake production, yet the mechanism of controlling the tissue formation of the white-core remains not fully understood.
In this study, we focused on *Seed dormancy 4* (*Sdr4-k*) — derived from *indica* rice "kasalth"— as a potential regulator of seed dormancy as well as high temperature (HT)-induced grain chalkiness reduction at the ripening stage. Using a biotron speed-breeding system — with controlled light, temperature, tiller removal, and embryo rescue—, we precisely introgressed the *Sdr4-k* gene into the sake rice varieties "Koshitanrei" and "Gohyakumangoku", and we developed a BC_3 population, named "Koshitanrei *Sdr4-k*" and "Gohyakumangoku *Sdr4-k*" in six generations and 17 months.
Field assessment, gene expression, and brewing characteristics data indicated that plants carrying the *Sdr4-k* gene had similar brewing traits to the WT. Koshitanrei *Sdr4-k* subjected to HT had significantly higher grain quality and seed dormancy than the WT. Our data revealed that HT induced alteration of starch-related gene expression in Koshitanrei *Sdr4-k* and Gohyakumangoku *Sdr4-k* ripe seeds than WT.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-39] Effects of Jasmonic Acids on Rice Flower Opening Time and Fertility under High Temperature Conditions

○Kazuhiro Kobayasi[1], Ramin Taheri[2], Masato Tsurumi[3], Yuki Mizokane[3], Fumihiko Adachi[1], Kazuhiro Ujiie[1], Akio Tanaka[4], Taku Tanogashira[4], Hitoshi Ogiwara[5] (1.Institute of Agricultural and Life Sciences, Shimane University, Japan, 2.Graduate School of Natural Science and Technology, Shimane University, Japan, 3.Faculty of Life and Environmental Sciences, Shimane University, Japan, 4. Kagoshima Prefectural Institute for Agricultural Development, Japan, 5.National Agriculture and Food Research Organization, Japan)

Global warming is a serious problem that may increase heat-induced floret sterility (HIFS) in rice, thereby reducing its yield. Flower opening in the early morning helps avoid HIFS. In this study, the effects of two kinds of jasmonic acids (methyl jasmonate [MeJA] and prohydrojasmon [PDJ]) on flower

opening time (FOT) and fertility were examined. The rice panicles (cultivar 'Hinohikari') grown in a greenhouse for heat treatment in Kagoshima Prefecture were subjected to 4 or 0.4 mM MeJA and PDJ at 0900 during the heading stage. By taking photographs of the panicles at 10-min intervals, FOT was determined. The percentage of anther dehiscence at the basal part, number of pollinated pollen grains, and fertility percentage on the treatment day were also examined. The maximum air temperature in the greenhouse was over 36℃, high enough to induce HIFS. The application of 4 mM MeJA advanced FOT by more than 3 hours, whereas the application of 0.4 mM MeJA and 4 and 0.4 mM PDJ did not. Both kinds of jasmonic acids did not affect fertility percentage, number of pollinated pollen grains, and percentage of anther dehiscence, however. In conclusion, MeJA advanced FOT under high temperature, whereas PDJ did not. Moreover, MeJA did not reduce sterility through advancing FOT. Although jasmonic acids are thought to be related to fertility and pollen maturation, the effects of MeJA in avoiding HIFS through an artificial advancement of FOT were offset by some harmful effects of premature flowering on pollen physiological processes that induced mature pollen grain reduction.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-40] The Effect of N-application on cpHSP70-2 Accumulation to Improve Rice (*Oryza sativa* L.) Grain Chalkiness

○Olusegun Idowu, Tomoyuki Katsube-Tanaka （Graduate School of Agriculture, Kyoto University, Japan）

High temperature (HT) increases chalky rice grains which lower grain quality, market value, and substantial yield. Although nitrogen (N) application is a promising technique to enhance transpiration, carbohydrate supply, and then reduce chalkiness but it lowers eating and cooking quality as well. Thus, the underlying molecular mechanism of chalkiness along with N nutrition should be clarified. Recently we isolated conditional chalky grain mutant *flo11-2*, its causative gene encodes amyloplast molecular chaperone (cpHSP70-2) and found a negative correlation between its expression and chalkiness. In this study, we examined the effect of N-application on chalkiness and cpHSP70-2 accumulation using near-isogenic lines with an erect panicle (EP) trait showing low available carbohydrate per spikelet, and a non-EP (NEP) trait. Experiments were conducted in Kyoto, 2020 using 7 cultivars; Aki(EP, NEP), LG5(EP, NEP), *flo11-2*, Nipponbare, and Kinmaze under pot and field conditions with low and high (ambient) temperatures (LT, HT) and/or different N levels, namely low and high N (LN, HN) for pots and 0, 6, 20 gN m^{-2} (0N, 6N, 20N) for fields. The results showed *flo11-2* had the highest chalky ratio under HT, while early heading cultivars [Aki(EP), Aki(NEP)] had the lowest due to escaping from a HT season. LN-HT and 0N treatments produced the highest chalky ratio. Chalky ratio was positively correlated with averaged daily maximum temperature during 20 days after flowering. N-application reduced chalky ratio and tended to increase cpHSP70-2 accumulation irrespective of genotypic differences.

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[P3-41] Genetic Analysis of Drought Response Index in a *Temperate Japonica* Rice Mapping Population

*Nominated for Presentation Awards

○Poornima Ramalingam[1,2], Ha-An Thi Nguyen[1], Kamoshita Akihiko[1] （1.Department of Plant Biotechnology, Tamil Nadu Agricultural University, India, 2.Asian Research Center for Bio-Resources and

Environmental Sciences, Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 3.Asian Research Center for Bio-Resources and Environmental Sciences, Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

Drought response index (DRI), a unique indicator of drought tolerance, was evaluated in a *temperate japonica* mapping population (97 recombinant inbred lines (RILs) from Otomemochi (OTM) and Yumenohatamochi (YHM)) in 2011 and 2012 under temperate monsoon climate conditions with the different extent of drought intensity during reproductive stage to flowering (i.e., July to August). Relationships between grain dry weight under drought with either 50% flowering date or grain dry weight under control (i.e., as regarded as potential yield) were not strong. DRI in the prolonged intense drought in 2011 (ranging from -6.4 to 15.9) was positively correlated with grain dry weight deriving from panicles that emerged after rewatering. Three genomic regions were identified as QTLs for DRI with phenotypic variation explained ranging from 10.3 % to 26.3% (1) RM3703-RM6911 on chromosome 2 detected in the severer drought year 2011, also in the combined analysis of the 2 years, with its positive allelic contribution from YHM, was co-located with QTLs for drought recovery ability after rewatering and for harvest index. (2) RM3703-RM6379 on chromosome 2 detected in the combined analysis was located relatively close to the first region but with its allelic contribution coming from OTM. (3) RM8102-RM7023 on chromosome 6 detected only in 2012 was co-located with grain dry weight under drought as well as root dry weight under control, with their allelic contribution all from OTM. Relative contribution of QTL x E was larger than main effect QTLs indicating the importance of defining the target environment for drought tolerance.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-42] Contribution of the Chromosome 11 of a Salinity-Tolerant Rice Variety Nona Bokra to High Dry Matter Production under Salinity and Its QTL Mapping

○Yumika Yamamoto[1], Masaki Uchida[1], Mana Kano-Nakata[2], Akira Yamauchi[1], Shiro Mitsuya[1] (1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.International Center for Research and Education in Agriculture, Nagoya University, Japan）

Rice is a popular crop in the world especially Asia . In Asia, salinity is a serious problem especially in the coastal areas. Rice is one of salinity-sensitive crops, and salinity causes rice yield reduction. Therefore, it is important to produce a high-yielding rice variety under salinity. Mitsuya et al. (2019) have succeeded in screening a salt-tolerant Koshihikari/Nonabokura Chromosome Segment Substitution Lines (CSSLs) that shows high yield and growth in a salinized paddy field. The genetic background of the CSSLs is mostly Koshihikari (salinity-sensitive) whereas some parts are substituted by the salinity-tolerant Nona Bokra chromosome. Within 44 lines, CSSL538 showed a higher yield than Koshihikari in the consecutive 2-year experiments. CSSL538 has a segment of Nona Bokra chromosome 11. We determined the physiological mechanism of salt tolerance of CSSL538. We found that CSSL538 maintained dry matter production and leaf areas under salinity at not only the early ripening stage but vegetative stage in comparison to Koshihikari. However, the salt concentration in shoots not always explained the growth difference between two genotypes. Also, we hypothesized that there are QTLs for high dry matter production under salinity in the segment of Nona Bokra chromosome 11. We will show the identified QTLs for high dry matter production under salinity in the CSSL538, in the conference.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-43] Genotypic Variation in Root Morpho-Anatomical Traits of Rice Cultivars with High and Low Adaptability under Multi-Stress Environment

○Maria Corazon Julaton Cabral[1,2], Via Ann Candelaria Marcelo[3], Roel Rodriguez Suralta[3], Jonathan Manito Niones[3], Antoinette Soriano Cruz[3], Hiroshi Ehara[1,2], Yoshiaki Inukai[1,2], Akira Yamauchi[1], Mana Kano-Nakata[1,2] (1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.International Center for Research and Education in Agriculture, Nagoya University, Japan, 3.Philippine Rice Research Institute, Philippines)

Drought and salinity are the most common coexistent abiotic stress factors impacting rice yield and productivity. Roots has an important role for the plant's adaptation to abiotic stresses. Plant breeding programs must include developing new cultivars with multiple stress tolerance and improved root traits. Hydroponic experiments were conducted in 20 OryzaSNP cultivars in control (non-stress), drought, saline, combined saline + drought stress and vice versa to determine the changes in root morpho-anatomical characteristics of cultivars with high and low adaptability and stability to abiotic stresses. Shoot biomass was significantly decreased in all cultivars followed by saline, saline + drought, drought and drought + saline. The root morpho-anatomical features were significantly influenced by genotype, treatments and their interactions. The root size in terms of anatomical traits were increased in all treatments compared to the non-stress condition. The variation in root diameter was due to the change in size and width of cortex and stele diameter. The correlation between agronomic and root morphological traits indicate strong and positive correlation however, mostly no correlation with root anatomical traits. AMMI (Additive Main Effects and Multiplicative Interaction) and BLUP (Best Linear Unbiased Prediction) model identified Dom-sufid and FR13A as cultivars with high stability, adaptability and productivity under multi-stress environments. An in-depth analysis encompassing histochemical analysis is on-going.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-44] Heavy Flooding Effects on Productivity of Paddy Rice Cultivar 'Nanatsuboshi'

○Hideki Okamoto[1], Junji Fujikura[2], Katsuhiro Furukawa[2] (1.Tenpoku Sub-centre, Dairy Research Centre, Hokkaido Research Organization, Japan, 2.Kamikawa Agricultural Experiment Station, Hokkaido Research Organization, Japan)

Pot experiments were conducted for three years to elucidate effects of heavy flooding on paddy rice productivity and quality. Every year, three mature seedlings were transplanted onto paddy soil under water of 0.05 m depth in Wagner's pots in late May. Mature rice was harvested in mid-September. Treatments were set as 3 depth levels, 5 growth stages, and 3 flooding durations. We defined 'reducing' as a relative value of gross brown rice weight to control of less than 0.7.
As the averages assessed over three years, 5 days of treatment in booting stage with upper leaf

submergence show a reducing plot. Moreover, under complete submergence, 5 days of treatment in panicle formation stage and more than 3 days of treatment in the booting and heading stage showed as reducing plots. Results show that gross brown rice yield reductions by heavy flooding occurred from panicle formation to the heading stage, and especially during the booting and heading stage.
Yield components of brown rice were affected by submergence treatment from the panicle formation stage to heading. Correlation coefficients between the gross brown rice weight and each yield component show that the number of ears had high positive correlation in the tillering and panicle formation stage, and that grain numbers per ear had high positive correlations in the booting and heading stage. Therefore, rice productivity reduction because of heavy flooding can explain that of ear-numbers until panicle formation stage, and the reduction of grain numbers per ear from booting stage.

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[P3-45] Root Anatomical Traits Related to Root Oxygen Consumption and Transportation between Upland Rice and Lowland Rice Varieties

*Nominated for Presentation Awards

○Shotaro Tamaru[1], Keita Goto[1], Phanthasin Khanthavong[1], Shin Yabuta[2], Jun-Ichi Sakagami[1,2] (1.The United Graduate School of Agricultural Sciences, Kagoshima University, Japan, 2.Faculty of Agriculture, Kagoshima University, Japan)

Root oxygen transportation is important traits to maintain the oxygen consumption to roots under hypoxia. Many studies focused on the aerenchyma formation, in these days anatomical study of root tissue such as narrower stele and larger cortex is revealed to benefit for waterlogging adaptation (Sundgern et al. 2018, Yamauchi et al. 2019). We aimed to investigate the difference of adaptive strategy for waterlogging in upland and lowland rice on physiological and anatomical aspects. We evaluated the anatomical traits in seminal root to seedlings of 6 rice varieties , then we evaluated the physiological and anatomical traits among 4 varieties include Sensho showing lowest CSR (Cortex to stele ratio) in seminal root. Our analysis observed narrower stele and higher CSR in IR42 and Koshihikari. It was considered to benefit adaptation to continuous hypoxia condition such as paddy field because of lower root oxygen consumption per plant. On the other hand, Sensho showed the lowest CSR and porosity, larger stele compered to lowland varieties, but this variety had highest oxygen transportation ability. It may relate the shoot activity because Sensho had highest estimated stomatal contribution to roots. As a result of comparing lowland and upland rice variety, oxygen consumption per plant and stele area were significant higher in upland rice variety than in lowland rice variety. It was considered that this higher oxygen demand was compensated by high CSR and porosity in Black Gora, and by high oxygen transportation in Sensho.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 3 (Poster))

[P3-46] Roles of Root Plasticity to Growth and Yield of Quinoa under Different Soil Water Regimes

*Nominated for Presentation Awards

○Dinh Thi Ngoc Nguyen[1], Cuong Van Pham[1], Thiem Thi Tran[1], Akira Yamauchi[2] （1.Faculty of Agronomy, Vietnam National University of Agriculture, Vietnam, 2.Faculty of Agronomy, Vietnam National University of Agriculture, Vietnam, 3.Faculty of Agronomy, Vietnam National University of Agriculture, Vietnam, 4.Graduate School of Bioagricultural Sciences, Nagoya University, Japan）

Recent studies indicated new perspectives on the morphology and architecture of the quinoa root system, its intraspecific diversity and plasticity in response to drought. This study therefore aimed to evaluate wherether promoted development of root system due to the plasticity triggered by drought stress would contribute to increased growth, and yield of quinoa. The experiment was designed with Split-plot method with 3 replications. The main plots were Green (G1) and Red (G2) genotypes and sub-plots were three soil moisture treatments: 30% soil moisture content (SMC (w/w)) (Well-watered, W1) as control, 20% SMC (mild drought, W2), and 15% SMC (severe drought, W3). The results showed that the growth of genotypes was significantly affected by the different soil water regimes. The root traits such as total root length, total nodal root length, total lateral root length, and nodal root numbers under drought treatments (W2 and W3) were significantly higher as compared with those under control. Furthermore, the root plasticity was expressed in both G1, G2 genotypes, which resulted in significantly increased water use, shoot dry matter, and consequently increased yield and yield components. In addition, the positive and significant relationships were observed among measured traits (total root length and water uptake, water uptake and shoot dry weight, and shoot dry weight and yield) of two genotypes under different water regimes. These results prove that in both genotypes, root plasticity was triggered by drought, which enhanced root systems development contributing to increased water uptake, shoot dry weight and yield.

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[P3-47] Integrated Transcriptome and Proteome Analysis Reveals Complex Regulatory Mechanism of Maize (*Zea mays* L.) in Response to Zinc Deficiency Stress

Jinyao Zhang[1,3], Shuhui Song[1], Yinghong Pan[2], Fangsen Xu[3], ○Hong Wang[1] （1.Institute of Agriculture Resources and Regional Planning, Chinese Academy of Agricultural Sciences, China, 2.The National Key Facility for Crop Gene Resources and Genetic Improvement, Institute of Crop Science, Chinese Academy of Agricultural Sciences, China, 3.College of Resources and Environment, Huazhong Agriculture University, China）

Zinc (Zn) is one of the essential micronutrients for plant growth and development. To investigate the molecular mechanism of maize response to Zn-deficiency stress, maize variety ZD958 was used to perform transcriptome and proteome integrated analysis. Through transcriptome analysis in maize roots under Zn-deficiency stress for 10 days (10DAT) and 15 days (15DAT), we identified 271 and 519 differentially expressed genes (DEGs) at 10 and 15 DAT, while 2048 and 2380 DEGs were identified in leaves at 10 and 15 DAT, respectively. A total of 1258 and 1099 differentially abundant proteins (DAPs) were found from roots and leaves at 10 DAT in proteome data, while 627 and 1553 DAPs at 15 DAT, respectively. DEGs or DEPs involved in ROS, carbohydrate metabolic process, signal transduction, phenylpropanoid biosynthesis and nitrogen metabolism were enriched in roots, while photosynthesis including chlorophyll synthesis, metabolic process of carbohydrate, reactive oxygen species (ROS),

cellular amino acid and gene expression were changed among the identified DEGs or DEPs in maize leaves. Detail analysis of the DEGs or DEPs revealed that complex metabolism, such as photosynthesis, mitogen-activated protein kinase (MAPK) signaling cascade, activation of antioxidant and nitrogen metabolism, were participated in regulating Zn deficiency response in maize. Information provided in this omics research advanced our understanding of the molecular response mechanisms to Zn-deficiency, and further research is needed to cognize the new response genes.

[P4] Crop Genetics and Physiology

Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster) (Crop Genetics and Physiology)

[P4-01] Genetic Variation of Rice Germplasm Including *Oryza sativa* and *O. glaberrima* in Guinea

○Yoshimichi Fukuta[1], Seiji Ynagaihara[2], Nhai Nguyen[3], Oanh Nguyen[3], Narry Mamadou[4], Diawara Souleymane[4], Bah Oumar[4] (1.TARF, Japan International Research Center for Agricultural Sciences, Japan, 2.GRPH, Japan International Research Center for Agricultural Sciences, Japan, 3.AGI, Vietnam, 4.IRAG, Guinea)

12:15 PM - 1:00 PM

[P4-02] Genetic Diversities of Traits Associated with Culm Strength Using a *Temperate Japonica* Rice Varieties

○Koki Chigira[1], Natsuko Kojima[1], Masanori Yamasaki[2], Shunsuke Adachi[3], Taiichiro Ookawa[1] (1.Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan, 2.Food Resources Education and Research Center, Graduate School of Agricultural Science, Kobe University, Japan, 3.College of Agriculture, Ibaraki University, Japan)

1:15 PM - 2:00 PM

[P4-03] Histone Acetyltransferase GCN5 Regulates the Expression of *OsRBCS3* and *OsRBCS5*, Rubisco Small Subunit Genes, in Response to Nitrogen Supply in Rice (*Oryza sativa* L.)

○Shicheng Feng[1], Fumiya Miyamoto[2], Sakae Agarie[3], Kazuyuki Saitou[4] (1.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, China, 2.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 3.Faculty of Agriculture (Graduate School), Kyushu University, Japan, 4.Faculty of Agriculture (Graduate School), Kyushu University, Japan)

12:15 PM - 1:00 PM

[P4-04] Visualizing Aleurone Layers in Mature Rice Grains by a Modified Half-Cut Method

○Thi Mai Phuong Nguyen[1], Tomomi Abiko[2], Ohn Mar Khin[3], Toshihiro Mochizuki[2] (1.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 2.Faculty of Agriculture, Kyushu University, Japan, 3.Department of Agricultural Research, Ministry of Agriculture, Livestock and Irrigation, Myanmar)

1:15 PM - 2:00 PM

[P4-05] Regulation of the Expression of *OsRBCS3*, a Rubisco Small Subunit Gene, by Histone Deacetylase *HDA713* under Nitrogen Deficiency in Rice

○Fumiya Miyamoto[1], Shicheng Feng[2], Sakae Agarie[3], Kazuyuki Saitou[4] (1.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 2.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 3.Faculty of Agriculture(Graduate School), Kyushu University, Japan, 4.Faculty of Agriculture(Graduate school), Kyushu University, Japan)

12:15 PM - 1:00 PM

[P4-06] Estimation of Canopy Transpiration Rate in Rice after Heading Stage by Extracting Leaf Temperature in Thermal Images

○Rintaro Kondo, Yu Tanaka, Tatsuhiko Shiraiwa (Graduare School of Agriculture, Kyoto

University, Japan）
1:15 PM - 2:00 PM

[P4-07] Engineering CAM Traits into C3 crops

○Aoi Saito[1], Mie Wakabayashi[2], Shiori Terai[2], Shiori Yamabe[2], Satoko Kobayashi[2], Kazuyuki Saito[3], John C. Cushman[4], Sakae Agarie[3] （1.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 2.Faculty of Agriculture, Kagawa University, Japan, 3.Faculty of Agriculture, Kyushu University, Japan, 4.Department of Biochemistry and Molecular Biology, University of Nevada, United States）
12:15 PM - 1:00 PM

[P4-08] Assessment of Geographical Distribution and Genetic Diversity of Five Sorghum Taxa Collected in Taiwan

○Wei-hsun Hsieh[1], Yi-tzu Kuo[1], Han-hsuan Chin[1], Hsien-chun Liao[2], Chih-hui Chen[2], Yann-rong Lin[1] （1.Agronomy, National Taiwan University, Taiwan, 2.Experimental Stations Research, Endemic Species Research Institute, Taiwan）
1:15 PM - 2:00 PM

[P4-09] Resistant Loci to Physiological Disorder Cupping in Chinese Cabbage (*Brassica rapa* var.*Pekinensis*)

○Haruto Takamori[1], Osamu Kawaide[3], Tokuko Sakaguchi[1], Minami Nakazawa[1], Natsuki Ito[1], Ayuka Furukubo[2], Minami Amaike[2], Takashi Ito[5], Fumio Azuhata[3], Mashiro Okada[2], Seiji Chino[5], Hideo Matsumura[4], Satoshi Niikura[3], Nobuaki Hayashida[2] （1., Shinshu University, Japan, 2.Division of Applied Biology, Faculty of Textile, Shinshu University, Japan, 3.TOHOKU SEED CO., LTD., Japan, 4.Gene Research Center, Shinshu University, Japan, 5.Engineering Department, Faculty of Textile, Shinshu University, Japan）
12:15 PM - 1:00 PM

[P4-10] Genetic Diversity of Foxtail Millet (*Setaria italica*) Landraces of Taiwan

Yen-chiun Chen[1], Yong-pei Wu[2], Yee-ching Chong[1], ○Yann-rong Lin[1] （1.Department of Agronomy, National Taiwan University, Taiwan, 2.Department of Agronomy, Chiayi Agricultural Experiment Station, Taiwan Agricultural Research Institute, Taiwan）
1:15 PM - 2:00 PM

[P4-11] Branched-Chain Amino Acid Aminotransferases (BCATs) Play Important Roles for the Induction of Autophagy in Leaf Senescence of Soybean

○Tung Tuan Do[1,3], Takaaki Ishibashi[2], Takashi Yuasa[2] （1.Interdisciplinary Graduate School of Agriculture and Engineering, University of Miyazaki, Japan, 2.Faculty of Agriculture, University of Miyazaki, Japan, 3.Faculty of Agronomy, Thai Nguyen University of Agriculture and Forestry, Vietnam）
12:15 PM - 1:00 PM

[P4-12] DGAT1s from Different Plant Species Show Different Triacylglycerol Biosynthesis Activities

○Tomoko Hatanaka[1], Wakana Miyashita[1], Kouki Shibutani[2], Daisuke Matsuoka[1], Daisuke Sasayama[1], Hiroshi Fukayama[1], Tetsushi Azuma[1], David F. Hildebrand[3] （1.Graduate School of Agricultural Science, Kobe University, Japan, 2.Faculty of Agriculture, Kobe University, Japan, 3.Department of Plant and Soil Sciences, University of Kentucky, United States）
1:15 PM - 2:00 PM

[P4-13] Genome Wide Association Study for Leaf Photosynthetic Properties in 166 *Temperate Japonica* Rice Cultivars

○Yoshiaki Seki[1], Kentaro Hayami[1], Tomohiro Nomura[1], Yu Tanaka[2], Taiichiro Ookawa[1], Makoto Matsuoka[3], Shunsuke Adachi[1] （1.Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan, 2.Graduate School of Agriculture, Kyoto University, Japan, 3.Bioscience and Biotechnology Center, Nagoya University, Japan）

12:15 PM - 1:00 PM

[P4-14] Assessment of Genetic Diversity and Relatedness in Citrus Fruits Using RAPD Markers

○Nihar Ranjan Saha, Jarina Binte Jalil, Muhammad Shahidul Haque （Department of Biotechnology, Bangladesh Agricultural University, Bangladesh）

1:15 PM - 2:00 PM

[P4-15] Pyramiding of Disease Resistance Genes into Popular Rice Varieties of Bangladesh

○Tapas Kumer Hore, Corinne Mira Marfori-Nazarea, Mary Ann Inabangan-Asilo, Ratna Wulandari, BP Mallikarjuna Swamy （RGDV Platfrom, International Rice Research Institute, Philippines）

12:15 PM - 1:00 PM

[P4-16] Genetic Analysis of Agronomic and Biofortification Traits in Multiple Rice Populations

○Tapas Kumer Hore, Mary Ann Inabangan Asilo, Gaurav Joshi, Amery Amparodo, BP Mallikarjuna Swamy （RGDV Platfrom, International Rice Research Institute, Philippines）

1:15 PM - 2:00 PM

[P4-17] Meta-QTLs and Candidate Genes Associated with Grain Zinc Content in Rice

○Gaurav Joshi[1,2], B. P. Mallikarjuna Swamy[1], Indra Deo Pandey[2], Yan Paing Soe[3], Jose E. Hernandez[4], Chau Thanh Nha[5], Alvin Palanog[6], Mark Ian Calayugan[4], Mary Ann Inabangan Asilo[1], Amery Amparado[1], Tapas Kumer Hore[1] （1.Rice Breeding Innovations, International Rice Research Institute, Philippines, 2.Genetics and Plant Breeding, Govind Ballabh Pant University of Technology and Agriculture, India, 3.Seed Division, Department of Agriculture, Myanmar, 4.Institute of Crop Science, University of the Philippines Los Baños, Philippines, 5.Genetics and Plant Breeding Department, Cửu Long Delta Rice Research Institute, Vietnam, 6.Research and Development, Philippine Rice Research Institute, Philippines）

12:15 PM - 1:00 PM

[P4-18] Global Analysis of a Rice Panel to Identify QTLs and Genotypes Useful for Rice Breeding

○Gaurav Joshi[1,2], B. P. Mallikarjuna Swamy[1], Mona Liza Jubay[1], Indra Deo Pandey[2], Maria Camila Rebolledo[10, 11], Dmytro Chebotarov[1], Kenneth McNally[1], Rakesh Kumar Singh[9], Hei Leung[1], Sunil Kumar Verma[4], Satish B. Verulkar[4], Shuhha Banerjee[4], Hsu Myat Noe Hnin[3], Rollin de Ocampo[1], Federico Molina[5], Bertrand Muller[11], Justine Bonifacio[1], Eliel Petro Paez[10], Adin Blokounon[7], Kazuki Saito[7], Khady Nani Dramé[8], Stephen Klassen[1], Narne Chamundeswari[6], P. V. Satyanarayana[6] （1.Rice Breeding Innovations, International Rice Research Institute, Philippines, 2.Department of Genetics and Plant Breeding, Govind Ballabh Pant University of Technology and Agriculture, Pantnagar, India, 3.Institute of Crop Science, University of the Philippines Los Baños, Philippines, 4.Department of Plant Molecular Biology and Biotechnology, Indira Gandhi Agricultural University, Raipur (Chhattisgarh), India, 5.Rice Breeding, National Institute of Agricultural Research of Uruguay, Uruguay, 6.Plant Breeding, Regional

Agricultural Research Station, Maruteru, India, 7.Sustainable Productivity Enhancement Program, Africa Rice Center, Côte d'Ivoire, 8.Capacity Development, Africa Rice Center, Côte d'Ivoire, 9.Crop Diversification and Genetics, International Center for Biosaline Agriculture, United Arab Emirates, 10.Rice Program, International Center for Tropical Agriculture (CIAT), Colombia, 11.Centre de Coopération Internationale en Recherche Agronomique Pour le Dé veloppement (CIRAD), France）

1:15 PM - 2:00 PM

[P4-19] A Metabolite Profiling to Explore the Physiological Function of *Short Panicle 1* during Panicle Formation of Rice

Yifan Lin[1], Ryutaro Morita[1], Masaki Okamura[2], Junko Yamagishi[1], ○Naohiro Aoki[1] （1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Central Region Agricultural Research Center, National Agriculture and Food Research Organization, Japan）

12:15 PM - 1:00 PM

[P4-20] Assessment of *Indica* Rice Cultivars for the Use of Whole Crop Silage

Yoshikage Goto, Junko Yamagishi, ○Naohiro Aoki （Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

1:15 PM - 2:00 PM

[P4-21] Morphological Characteristics Related to the Accumulation of Non-Structural Carbohydrates in Stems of Rice at Heading Stage

○Yu Wakabayashi, Ryutaro Morita, Junko Yamagishi, Naohiro Aoki （Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

12:15 PM - 1:00 PM

[P4-22] Comparative Analysis of Sugar Metabolism in Rice Leaves under Field and Controlled Environments

○Yoichi Hashida[1], Ayumi Tezuka[2], Mari Kamitani[3], Makoto Kashima[4], Yuko Kurita[3], Atsushi J. Nagano[3,5] （1.Faculty of Agriculture, Takasaki University of Health and Welfare, Japan, 2.Research Institute for Food and Agriculture, Ryukoku University, Japan, 3.Faculty of Agriculture, Ryukoku University, Japan, 4.College of Science and Engineering, Aoyama Gakuin University, Japan, 5.Institute for Advanced Biosciences, Keio University, Japan）

1:15 PM - 2:00 PM

[P4-23] A Metabolite Profiling to Seek the Molecular Determinant of Spikelet Number in Rice

○Ryutaro Morita[1], Masaki Okamura[2], Shiori Yabe[3], Hiroe Yoshida[4], Satoru Sukegawa[4], Hiroshi Nakagawa[4], Naohiro Aoki[1] （1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Central Region Agricultural Research Center, National Agriculture and Food Research Organization, Japan, 3.Institute of Crop Science, National Agriculture and Food Research Organization, Japan, 4.Institute for Agro-Environmental Sciences, National Agriculture and Food Research Organization, Japan）

12:15 PM - 1:00 PM

[P4-24] Contribution of Several Source Organs to Dry Matter Accumulation into Panicles after Heading of Hulless Barley Sown at Different Terms

○Takuya Araki[1], Yasuhiro Kondo[2], Takato Yano[2], Ryo Kodani[2], Yukina Sakamoto[2] （1.Graduate School of Agriculture, Ehime University, Japan, 2.Faculty of Agriculture, Ehime University, Japan）

1:15 PM - 2:00 PM

[P4-25] Analysis on the Roles of Vacuolar Invertase Isoform, *OsINV3* in Root Development of Rice

○Natsumi Ueda[1], Ryutaro Morita[1], Tatsuro Hirose[2], Junko Yamagishi[1], Naohiro Aoki[1]
（1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Faculty of Agriculture, Takasaki University of Health and Welfare, Japan）

12:15 PM - 1:00 PM

[P4-26] The Purification of Recombinant TGW6, which Limits Grain Size in Rice

○Tatsuki Akabane[1], Nobuhiro Suzuki[2], Wataru Tsuchiya[2], Etsuko Katoh[2], Naoki Hirotsu[1]
（1.Graduate School of Life Sciences, Toyo University, Japan, 2.Structural Biology Team, Advanced Analysis Center, National Agriculture and Food Research Organization, Japan）

1:15 PM - 2:00 PM

[P4-27] Analysis of Genotype and Environment Interaction, and the Response of Grain Yield of Lowland Rice (*Oryza sativa* L.) to Nitrogen Application Under Different Environment in the Philippines

○Kim Nyka Caraan Perdiguerra[1,2], Pompe Campoy Sta. Cruz[1], Shiro Mitsuya[2], Akira Yamauchi[2]
（1.Institute of Crop Science, College of Agriculture and Food Science, University of the Philippines Los Baños, Philippines, 2.Graduate School of Bioagricultural Sciences, Nagoya University, Japan）

12:15 PM - 1:00 PM

[P4-28] Morphological Characteristics of Mealy and Translucent Endosperm Cells of Hulless Barley (*Hordeum vulgare* var. *nudum*) During the Ripening Stage

○Yuto Hatakeyama[1, 2], Ryo Kotani[3], Yukina Sakamoto[3], Kosuke Haraguchi[3], Nana Matsui[3], Takuya Araki[1] （1.Faculty of Agriculture, Ehime University, Japan, 2.Japan Society for the Promotion of Science Research Fellow, Japan, 3.Graduate School of Agriculture, Ehime University, Japan）

1:15 PM - 2:00 PM

[P4-29] Effect of Silicon Application on Grains of *Sorghum bicolor* under Drought Conditions

○Ryoichi Araki[1], Yuka Takano[1], Hidetoshi Miyazaki[2], Hiroyuki Ii[3], Ping An[4], Teru Tanaka[5]
（1.Faculty of Education, Wakayama University, Japan, 2.Research unit, The Global Environmental Forum, Japan, 3.Faculty of Systems Engineering, Wakayama University, Japan, 4.Arid Land Research Center, Tottori University, Japan, 5.Faculty of Agriculture, Setsunan University, Japan）

12:15 PM - 1:00 PM

[P4-30] Relationship between Non-Destructive Measurement Parameters and Yield in Sweet Potatoes

○Masayuki Kadowaki[1], Tomohiro Araki[2], Risa Umehara[2], Sokichi Shiro[1], Shingo Matsumoto[1]
（1.Institute of Agricultural and Life Sciences Academic Assembly, Shimane University, Japan, 2.Faculty of Life and Environmental Science, Shimane University, Japan）

1:15 PM - 2:00 PM

[P4-31] Heat Stress Impact on Heading and Ripening in Major Korean Rice Variety

○Woonha Hwang, Chungkeun Lee, Jaehyeok Jung, Hyeonseock Lee, Seoyeong Yang, Yeonhwa Lim, Myeonggu Choi （Crop Production and Physiology Division, National Institute of Crop

Science, Korea）
12:15 PM - 1:00 PM

[P4-32] Genetic Variations of Rhizome Yield, Essential Oil Content and Constituents in *Curcuma* Species and Strains

○Akira Miyazaki[1], Yukari Shiino[1], Hiroshi Hayakawa[2], Yoshito Ohtani[1], Yoshinori Yamamoto[1]
（1.Faculty of Agriculture and Marine Science, Kochi University, Japan, 2.Museum of Natural and Environmental History, Shizuoka, Japan）
1:15 PM - 2:00 PM

[P4-33] Relationship between Pre-Harvest Sprouting Variation and Physicochemical Properties in Varieties of Rice Flour

○Chae Min Han, Jong Hee Shin, Jung Bae Kwon, Jong Gun Won （Division of Crops Research, Gyeongsangbuk-do Provincial Agricultural Research & Extension Services, Korea）
12:15 PM - 1:00 PM

[P4-34] Physicochemical Properties of Rice Varieties Adapted to a Mountainous Region in Mid-South Korea

○Chae Min Han, Jong Hee Shin, Jung Bae Kwon, Jong Gun Won （Division of Crop Research, Yeongsangbuk-do Provincial Agricultural Research & Extension Services, Korea）
1:15 PM - 2:00 PM

[P4-35] Marker-Assisted Selection to Develop the High Nutrition Rice, Giant-Golden-Purple Rice, PFR32, and Giant-Golden-Red Rice, RFR13

○Yu-Chia Hsu[1], Yu-Chien Tseng[1], Yu-Chi Cheng[2], Bing-Nan Lin[1], Yong-Pei Wu[2] （1.Department of Agronomy, National Chiayi University, Taiwan, 2.Department of Agronomy, Chiayi Agricultural Experiment Station, Taiwan Agricultural Research Institute, Taiwan）
12:15 PM - 1:00 PM

[P4-36] Genetic and Morphological Mechanisms for Soil-Surface Roots Originated from a New Plant Type Cultivar in Rice (*Oryza sativa* L.)

○Asami Tomita[1,2], Hiroki Saito[2], Yoshimichi Fukuta[2] （1.Graduate School of Environmental and Life Science, Okayama University, Japan, 2.Tropical Agriculture Research Front, Japan International Research Center for Agricultural Sciences, Japan）
1:15 PM - 2:00 PM

[P4-37] Development and Genetic Analysis of Compensatory Growth of Lateral Roots in Rice

○Tsubasa Kawai[1, 3], Misuzu Nosaka-Takahashi[2], Yutaka Sato[2], Yinglong Chen[3], Kadambot H. M. Siddique[3], Hirokazu Takahashi[1], Mikio Nakazono[1], Akira Yamauchi[1], Yoshiaki Inukai[4]
（1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.National Institute of Genetics, Japan, 3.The UWA Institute of Agriculture, The University of Western Australia, Australia, 4.International Center for Research and Education in Agriculture, Nagoya University, Japan）
12:15 PM - 1:00 PM

[P4-38] Daytime or Nighttime: When Plant Roots Uptake Nitrogen?

○Md Mehedi Hasan[1], Maya Matsunami[2], Hiroyuki Shimono[2] （1.United Graduate School of Agricultural Sciences, Iwate University, Japan, 2.Faculty of Agriculture, Iwate University, Japan）
1:15 PM - 2:00 PM

[P4-39] Maintaining Higher Leaf Photosynthesis After Heading Stage Contributes to Higher Biomass Accumulation in Rice

○Sotaro Honda[1], Satoshi Ohkubo[2], Nan Su San[2], Anothai Nakkasame[2], Kazuki Tomisawa[2], Keisuke Katsura[2], Taiichiro Ookawa[2], Atsushi J. Nagano[3], Shunsuke Adachi[2,4] （1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan, 3.Faculty of Agriculture, Ryukoku University, Japan, 4.College of Agriculture, Ibaraki University, Japan）

12:15 PM - 1:00 PM

[P4-40] Genetic Analysis of Root Vascular Traits in a Population from Two *Temperate Japonica* Rice Ecotypes

○Ha-An Thi Nguyen[1], Akihiko Kamoshita[1], Poornima Ramalingam[1,2], Phoura Y[1] （1.Asian Research Center for Bioresources and Environmental Sciences, Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Department of Plant Biotechnology, Tamil Nadu Agricultural University, India）

1:15 PM - 2:00 PM

[P4-41] CO_2-Responsive CCT Protein Interacts with 14-3-3 Proteins and Regulates the Expression of Starch Synthesis-Related Genes

○Fumihiro Miyagawa, Naoki Shibatani, Aiko Koudou, Daisuke Sasayama, Tomoko Hatanaka, Tetsushi Azuma, Hiroshi Fukayama （Graduate School of Agricultural Science, Kobe University, Japan）

12:15 PM - 1:00 PM

[P4-42] CRISPR/Cas9 — Based Genome Editing of *GCN5*, a Histone Acetyltransferase Gene, in Rice (*Oryza sativa* L.)

○Shu Takakura[1], Fumiya Miyamoto[1], Shicheng Feng[1], Sakae Agarie[2], Kazuyuki Saitou[2] （1.Graduate School of Bioresource and Bioenviroment Sciences, Kyushu University, Japan, 2.Faculty of Agriculture (Graduate School), Kyushu University, Japan）

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[P4-01] Genetic Variation of Rice Germplasm Including *Oryza sativa* and *O. glaberrima* in Guinea

○Yoshimichi Fukuta[1], Seiji Ynagaihara[2], Nhai Nguyen[3], Oanh Nguyen[3], Narry Mamadou[4], Diawara Souleymane[4], Bah Oumar[4] (1.TARF, Japan International Research Center for Agricultural Sciences, Japan, 2.GRPH, Japan International Research Center for Agricultural Sciences, Japan, 3.AGI, Vietnam, 4.IRAG, Guinea)

Genetic variations of rice including *Oryza sativa* and *O. glaberrima* in Guinea were clarified based on the polymorphism data of SSR markers and heading date.
Cluster analyses were performed with the basis of the polymorphism data of 12 SSR markers, and accessions were classified into three cluster groups; Ia, Ib and II. *O. glaberrima* were mainly classified into cluster Ia, and *O. sativa* were clusters Ib and II. *japonica* Group cultivar, Nipponbare, and *indica* Group cultivar, Kasalath, were categorized into clusters Ib and II, respectively.The days to heading of *O. sativa* were later than*O. glaberrima*. The days to heading in the accessions of cluster II were the latest among three groups.
These results indicated that *O. sativa* and *O. glaberrima*were cultivated widely, and *O. glaberrima* was still conserved in Guinea. The genetic variation of days to heading in *indica* Group accessions was wider than those of *japonica* Group, and the accessions in the late heading type in *japonica* Group were limited. These of *O. glaberrima* also showed similar variation, but they included more late heading accessions in compared with these of *japonica* Group. The accessions of *O. sativa* were mainly classified into cluster groups Ib and II, and these of *O. glaberrima* were into cluster group Ia. The genetic variations of *O. glaberrima* was limited in compare with those of *O. sativa*, might be corresponded with the results of variation in heading date.

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[P4-02] Genetic Diversities of Traits Associated with Culm Strength Using a *Temperate Japonica* Rice Varieties

*Nominated for Presentation Awards

○Koki Chigira[1], Natsuko Kojima[1], Masanori Yamasaki[2], Shunsuke Adachi[3], Taiichiro Ookawa[1] (1.Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan, 2.Food Resources Education and Research Center, Graduate School of Agricultural Science, Kobe University, Japan, 3.College of Agriculture, Ibaraki University, Japan)

Lodging is a serious problem in rice production, leading to yield loss and low grain quality. Having lodging resistance, modern varieties with semi-dwarfism have contributed to increasing rice productivity. However, their low biomass production and lodging under extreme weather (e.x. super typhoon hitting) have been still challenging for developing high yielding varieties. For next generation rice, the breeding of new type varieties with strong culms is a promising strategy. In this research, we cultivated a *temperate japonica* population composed of 135 varieties and evaluated the traits associated with culm strength over two years. We also detected the region associated with these traits by genome-wide association studies (GWAS). Large variances were observed in the traits for culm strength among the varieties, indicating that there were causal genes responsible for culm strength. The two remarkable landraces named 'Kameji' and 'Omachi' had superior traits for culm strength, and have been rarely used in

modern breeding programs. The GWAS revealed 55 candidate regions associated with the traits, and the most likely association with culm thickness was detected on chromosome 5. From gene-based GWAS, some candidate genes which might be involved in cell division were detected in this region. Several landraces could have beneficial alleles for increasing culm diameter and culm strength. We need to identify causal genes and elucidate their physiological functions. The information obtained from this study will be useful for breeding new varieties with strong culms.

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[P4-03] Histone Acetyltransferase GCN5 Regulates the Expression of *OsRBCS3* and *OsRBCS5*, Rubisco Small Subunit Genes, in Response to Nitrogen Supply in Rice (*Oryza sativa* L.)

*Nominated for Presentation Awards

○Shicheng Feng[1], Fumiya Miyamoto[2], Sakae Agarie[3], Kazuyuki Saitou[4] (1.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, China, 2.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 3.Faculty of Agriculture (Graduate School), Kyushu University, Japan, 4.Faculty of Agriculture (Graduate School), Kyushu University, Japan)

Nitrogen is a primary component of plant substances. Nitrogen deficiency leads to slow and stunted growth and chlorosis. Five Ribulose-1,5-bisphosphate carboxylase/oxygenase small subunit (RBCS) genes identified in the rice genome are designated as *OsRBCS1,2,3,4* and *5*. In this study, we investigated the relationship between the expression of *GCN5*, a GNAT-type histone acetyltransferase gene, and RBCS genes. *OsRBCS1* transcripts were not detectable. The mRNA levels of *OsRBCS2*, *OsRBCS3*, *OsRBCS4*, and *OsRBCS5* in leaf blades were increased by nitrogen supply, but the incremental ratio of *OsRBCS5* was much lower than those of other RBCS multigene family members. The mRNA level of *GCN5* was increased by nitrogen supply. To study whether GCN5 regulates the expression of RBCS genes, we produced overexpression transformants of *GCN5* under the control of the maize ubiquitin promoter and the CaMV 35S promoter, and knockdown transformants of *GCN5* by RNAi. The expression of *GCN5* doesn't correlate with that of *OsRBCS2* or *OsRBCS4*, but it has a significant positive correlation with that of *OsRBCS3* and *OsRBCS5*. Furthermore, under the same expression level of *GCN5*, the expression level of *OsRBCS3* was higher than that of *OsRBCS5*. These results suggest that GCN5 regulates the expression of *OsRBCS3* and *OsRBCS5* specifically in response to nitrogen supply.

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[P4-04] Visualizing Aleurone Layers in Mature Rice Grains by a Modified Half-Cut Method

*Nominated for Presentation Awards

○Thi Mai Phuong Nguyen[1], Tomomi Abiko[2], Ohn Mar Khin[3], Toshihiro Mochizuki[2] (1.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 2.Faculty of Agriculture, Kyushu University, Japan, 3.Department of Agricultural Research, Ministry of Agriculture, Livestock and Irrigation, Myanmar)

Rice bran, a byproduct of rice milling process, is utilized to produce rice bran oil. Larger embryo size or increased aleurone layer thickness are effective on amount of bran oil. So far, mutants of giant embryo mutated by N-methyl-N-nitrosourea have been developed. However, varieties having thickened aleurone have not considerably established due to difficulty in screening methods. In this study, a simple method was established to screen the aleurone layer's thickness from a larger number of rice grains.
Total of 100 of half-cut brown rice (*Oryza sativa* L.) were embedded in one plate by acrylic resin and soaked into water overnight at room temperature, then subsequently stained with two solutions (1) new MG solution diluted 1:2 with methanol (99.8%) and (2) iodine solution. The sample sections were observed under digital microscope (MSX-500Di, Moritex Schott) and analyzed by software (WinROOF 2018, Mitani Corporation).
The method was successfully established by combination with preparation of half-cut samples on plate, staining and clear observation under a digital microscope. After staining, aleurone layer was detected clearly by light blue, whereas, starchy endosperm was distinguished by purple. This modified method can generate a massive number of seeds of 100 halved grains staining at the one-time cut. Besides, when seeds are attached on plates one day beforehand, screening aleurone layer thickness of about 700 seeds is achievable on the next day.

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[P4-05] Regulation of the Expression of *OsRBCS3*, a Rubisco Small Subunit Gene, by Histone Deacetylase *HDA713* under Nitrogen Deficiency in Rice

*Nominated for Presentation Awards

○Fumiya Miyamoto[1], Shicheng Feng[2], Sakae Agarie[3], Kazuyuki Saitou[4] (1.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 2.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 3.Faculty of Agriculture(Graduate School), Kyushu University, Japan, 4.Faculty of Agriculture(Graduate school), Kyushu University, Japan)

Histone modifications represent key epigenetic mechanisms that regulate gene expression. The expression of Rubisco genes is enhanced in response to nitrogen supply. However, histone modification events regulating the expression of Rubisco genes are not well understood. In the study, we investigated the relationship between the expression of *HDA713*, a RPD3/HAD1-type histone deacetylase gene, and the expression of *OsRBCS3*, a Rubisco small subunit gene, in rice. The mRNA level of *HDA713* was decreased and that of *OsRBCS3* was increased by nitrogen supply. To examine whether *HDA713* regulates the expression of *OsRBCS3*, we produced overexpression transformants of *HDA713* under the control of the maize ubiquitin promoter and CaMV 35S promoter, and knockdown transformants of *HDA713* by RNAi. There was no correlation between the expression of *HDA713* and *OsRBCS3* under nitrogen sufficiency. Surprisingly, a significant positive correlation was found between the expression of *GCN5*, a GNAT-type histone acetyltransferase gene, and *OsRBCS3*. Under nitrogen deficiency, there was a significant positive correlation between the expression of *HDA713* and *OsRBCS3*, whereas there was no correlation between the expression of *GCN5* and *OsRBCS3*. These results indicate that the expression of *OsRBCS3* is regulated by GCN5 under nitrogen sufficiency and by HDA713 under nitrogen deficiency.

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[P4-06] Estimation of Canopy Transpiration Rate in Rice after Heading Stage by Extracting Leaf Temperature in Thermal Images

*Nominated for Presentation Awards

○Rintaro Kondo, Yu Tanaka, Tatsuhiko Shiraiwa (Graduare School of Agriculture, Kyoto University, Japan)

To understand biomass production process in rice, long-term monitoring of canopy transpiration rate (E) is useful. E before heading stage can be estimated using thermal imaging techniques and heat balance model (Monteith 1973) modified by aerodynamic resistance under windless condition (r_a*, Kondo et al. 2018). However, this technique is not applicable after heading stage because panicle surface temperature is higher than leaf temperature in the daytime. In this study, we aimed to extract leaf temperature in thermal images after heading stage, and to estimate E based on extracted leaf temperature. In 2019, cultivar 'Koshihikari' and 'Takanari' was cultivated. On August 11th (86 days after transplanting), 201 thermal images and micro meteorological data was recorded. Canopy temperature was extracted for each pixel and separated based on the assumption that it was composed of two normal distributions. Lower mean value of the distributions was assumed to be the representative of leaf temperature. Estimated E based on this leaf temperature was significantly higher in Takanari than Koshihikari. However, in both cultivars, estimated E based on the current protocol seems to be overestimated compared with the previous study. The source of the error might be the shaded region of leaves or panicles, which is not assumed in the heat balance model. Optimization of protocols to take thermal images and/or algorithms to extract leaf temperature is needed for the accurate estimation of E after heading stage.

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[P4-07] Engineering CAM Traits into C3 crops

○Aoi Saito[1], Mie Wakabayashi[2], Shiori Terai[2], Shiori Yamabe[2], Satoko Kobayashi[2], Kazuyuki Saito[3], John C. Cushman[4], Sakae Agarie[3] (1.Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan, 2.Faculty of Agriculture, Kagawa University, Japan, 3.Faculty of Agriculture, Kyushu University, Japan, 4.Department of Biochemistry and Molecular Biology, University of Nevada, United States)

Crassulacean acid metabolism (CAM) is a carbon fixation pathway that evolved as an adaptation to limited water availability. CAM species exhibit extremely high water-use efficiency. CO_2 is fixed during the night by phosphoenolpyruvate carboxylase (PEPC) and produced malic acid is accumulated in the vacuole. PEPC is activated by phosphorylation, which is catalyzed by PEPC kinase (PPCK). During the day, the malic acid is decarboxylated to release CO_2 by NADP-malic enzyme (NADP-ME). The PEPC, PPCK, and NADP-ME were encoded by *McPpc1*, *McPPCK* and *Mod1*, respectively. We isolated intron-containing genes (with and without promoter region), cDNA and antisense cDNA of those genes from *Mesembryanthemum crystallinum*. We constructed vectors including the cDNA of *McPpc1* and *McPPCK*, which were fused to a promoter of circadian clock associated1 (CCA1), which regulates gene expression at night, and *Mod1*, which was fused to the promoter of Chlorophyll a-b binding protein (Cab), which regulated gene expression at day. These promoters were isolated from *Arabidopsis thaliana*. We obtained transgenic

Arabidopsis that expressed *McPpc1* and *McPpck* during the night at a higher level. The expression levels of these genes were about 6 and 3 times higher than those in *M. crystallinum*, respectively. The PEPC activity of *McPpck* transgenic *Arabidopsis* was about 2 times higher than that of non-transformants. We applied the same strategy to rice to confer CAM traits.

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[P4-08] Assessment of Geographical Distribution and Genetic Diversity of Five Sorghum Taxa Collected in Taiwan

*Nominated for Presentation Awards

○Wei-hsun Hsieh[1], Yi-tzu Kuo[1], Han-hsuan Chin[1], Hsien-chun Liao[2], Chih-hui Chen[2], Yann-rong Lin[1]
（1.Agronomy, National Taiwan University, Taiwan, 2.Experimental Stations Research, Endemic Species Research Institute, Taiwan）

The genus *Sorghum* comprises a few C_4 species which are important resources for food, feedstock, and biofuel; instead, some of them are noxious weed. In Taiwan, abundant morphological diversity of five taxa, *S. bicolor*, *S. propinquum*, *S. halepense*, *S. bicolor* subsp. *verticilliflorum* and *S. vulgare* var. *technicum* were observed. These taxa can be found on wastelands, ditches, and farmlands where certain geographical distribution was observed, indicating different features of spreading within different types of sorghum. The cultivated- and wild-type sorghum were quite distinct. The panicle shape of *S. bicolor* subsp. *verticilliflorum* was also distinguishable. Yet, it was difficult to identify them based on plant and panicle architectures easily due to the existence of intermediate types. This study aims to survey the geographical distribution of five sorghum taxa in Western Taiwan and to investigate genetic diversity and clustering analysis among subpopulations estimated from 122 wild collections with 25 highly polymorphic SSR markers. *S. halepense* subpopulation displayed the highest genetic diversity. *S. bicolor* subsp. *verticilliflorum*, possessed the lowest diversity, was separated from the other taxa revealed by principal coordinate analysis, consistent with the result of the neighbor-joining tree. Finally, morphological identification mostly corresponded to the clades shown in the phylogenetic tree. Our study laid a foundation for evolutionary research of *Sorghum*.

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[P4-09] Resistant Loci to Physiological Disorder Cupping in Chinese Cabbage (*Brassica rapa* var.*Pekinensis*)

*Nominated for Presentation Awards

○Haruto Takamori[1], Osamu Kawaide[3], Tokuko Sakaguchi[1], Minami Nakazawa[1], Natsuki Ito[1], Ayuka Furukubo[2], Minami Amaike[2], Takashi Ito[5], Fumio Azuhata[3], Mashiro Okada[2], Seiji Chino[5], Hideo Matsumura[4], Satoshi Niikura[3], Nobuaki Hayashida[2] （1., Shinshu University, Japan, 2.Division of Applied Biology, Faculty of Textile, Shinshu University, Japan, 3.TOHOKU SEED CO., LTD., Japan, 4.Gene Research Center, Shinshu University, Japan, 5.Engineering Department, Faculty of Textile, Shinshu University, Japan）

Chinese cabbage (*Brassica rapa* var. *pekinensis*) is one of the major crops in the Brassicaceae, showing form of leafy heads at the later growth stage. Cupping is one of the problematic physiological disorder in Chinese cabbage, caused by the environmental stresses as calcium deficiency. Also, defect of calcium

causes other multiple disorder or disease like tip burn and soft rot, leading degradation of its quality. Therefore, we evaluated genetic cupping resistance in Chinese cabbage, as a novel indicator of calcium deficiency, in different environments. Progeny derived from a cross between two Chinese cabbage lines, showing different properties of cupping resistance, were prepared. One thousand of F1-S2 seedlings were grown in the cultivation room for phenotypic observation. Cupping phenotypes at the heading stage were evaluated in the field with replication for four years, resulting that thirty-two hundreds of F1-S2 individuals were scored. Based on these scores and genotyping data obtained from the RAD-seq analysis, QTL analysis was performed. Interestingly, independent QTL peaks appeared in different linkage group (LG) between seedling and heading stages. Unique major peak of the QTL was detected in LG2 for the phenotype at seedling stage. For headings stage, QTLs were found in LG1, LG3, and LG7. Candidate genes for cupping resistance are involved in these QTLs, which expected to contribute to genetic improvements in Chinese cabbage. Also, these genes will be helpful for understanding the mechanisms in various calcium-related traits.

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[P4-10] Genetic Diversity of Foxtail Millet (*Setaria italica*) Landraces of Taiwan

Yen-chiun Chen[1], Yong-pei Wu[2], Yee-ching Chong[1], ○Yann-rong Lin[1] (1.Department of Agronomy, National Taiwan University, Taiwan, 2.Department of Agronomy, Chiayi Agricultural Experiment Station, Taiwan Agricultural Research Institute, Taiwan)

Foxtail millet (*Setaria italica*), a symbolic crop for indigenous peoples in Taiwan, has been cultivated for more than 5,000 years. Through a long term of adaptation to various environments of different altitudes and latitudes and of preferences for food and cultural applications, the landraces preserved by in indigenous peoples exhibit great diversity revealed by plant morphology and grain quality. The aim of this study is to understand the genetic diversity of Taiwan landraces revealed by molecular markers. A diversity panel of 211 foxtail millet accessions, including 154 Taiwan landraces, 8 Taiwan cultivars, and 49 India landraces, were sequenced by the genotype-by-sequencing (GBS) method, and 13,720 high-quality SNPs were obtained. After eliminating high genetic similarity because of repeated collection, a core population of 153 accessions was further selected for genetic diversity analysis. Taiwan landraces exhibited high levels of genetic diversity and moderate population structures, while Indian accessions were much differentiated from Taiwan landraces. Three major genetic subpopulations were constructed which were in concordance with geographical regions and the accessible breeding histories. An obvious phylogeographic relationship and gene flow could be observed in our study, for which the samples collected from boundary regions were admixed. This study revealed the genetic diversity of foxtail millet landraces of Taiwan is highly diverse, providing good germplasm for foxtail millet breeding.

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[P4-11] Branched-Chain Amino Acid Aminotransferases (BCATs) Play Important Roles for the Induction of Autophagy in Leaf Senescence of Soybean

*Nominated for Presentation Awards

○Tung Tuan Do[1,3], Takaaki Ishibashi[2], Takashi Yuasa[2] (1.Interdisciplinary Graduate School of Agriculture and Engineering, University of Miyazaki, Japan, 2.Faculty of Agriculture, University of Miyazaki, Japan, 3.Faculty of Agronomy, Thai Nguyen University of Agriculture and Forestry, Vietnam)

We previously reported that autophagy plays an important role in nitrogen translocation from leaf senescence to sink organs in higher plants under starvation conditions (Nang et al 2011). Intracellular levels of free branched chain amino acids (BCAA) pool appeared to be involved in autophagy regulation in yeast and animal cells via the mTOR pathway. In this study, we focused on BCAA specific aminotransferase (BCAT), which catalyzes the last transamination step in the pathway of synthesis and initial step of degradation of BCAA, the induction of senescence and autophagy of shaded leaf. Leaf shading treatments resulted in a significant reduction of leaf chlorophyll content and photosynthesis II activity. We examined the roles of soybean BCAT in leaf senescence and autophagy of soybean. The expression profiles of mitochondrial and chloroplast BCAT genes and ATG-related genes in soybean are examined. GmBCATX and GmBCAT2 that localized in mitochondria, were significantly induced under shading leaves. Resultantly, the levels of BCAA pool under shading treatments decreased significantly. The Bispyribac sodium (BIS) treatment resulted in a reduction of proline contents due to the upregulation of ProDH expression. Amylase activities of vacuolar proteases were upregulated in soybean seedling in response to BIS treatment. It is suggested that the induction of GmProDH and vacuolar proteases are regulated in the same manner with autophagy induction via a reduced pool of BCAA. Immunoblot, immunoprecipitation of soybean tissue extracts by anti-BCAT antibodies will be discussed.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-12] DGAT1s from Different Plant Species Show Different Triacylglycerol Biosynthesis Activities

○Tomoko Hatanaka[1], Wakana Miyashita[1], Kouki Shibutani[2], Daisuke Matsuoka[1], Daisuke Sasayama[1], Hiroshi Fukayama[1], Tetsushi Azuma[1], David F. Hildebrand[3] (1.Graduate School of Agricultural Science, Kobe University, Japan, 2.Faculty of Agriculture, Kobe University, Japan, 3.Department of Plant and Soil Sciences, University of Kentucky, United States)

Triacylglycerols (TAGs) are the major component of plant storage lipids. Acyl-CoA:diacylglycerol acyltransferase (DGAT) catalyzes the final step of Kennedy pathway and it is considered a rate-limiting enzyme responsible for plant oil accumulation. In our former study, the *DGAT1* cDNAs obtained from Arabidopsis (*Arabidopsis thiliana*), soybean (*Glycine max*), castor bean (*Ricinus communis*), and Vernonia (*Vernonia galamensis*) were introduced into Arabidopsis. All Vernonia *DGAT1* expressing lines showed a significantly higher seed oil content compared to the wild type followed by soybean*DGAT1*, castor bean *DGAT1* and Arabidopsis *DGAT1*. These results reflected our previous results from the yeast microsome assay (Hatanaka et al. 2016).
In this study, in addition to the above four *DGAT1*s, cDNAs of *DGAT1* were cloned from sunflower (*Helianthus annuus*), Jatropha (*Jatropha curcas*) and sesame (*Sesamum indicum*). The sunflower DGAT1 has one of the closest amino acid sequence to Vernonia DGAT1. In regards to Jatropha and sesame DGAT1s, it has been reported that they were effective to increase seed oil contents of Arabidopsis (Misra et al. 2013, Wang et al. 2014). These *DGAT1* genes from seven species were introduced into the TAG biosynthesis defective yeast mutant (H1246). In the yeast expression culture, DGAT1s from Arabidopsis, castor bean or soybean did not increase TAG content in the yeast significantly, however, DGAT1s from

Vernonia, sunflower, Jatropha and sesame remarkably increased TAG content more than 10 times higher than the former three DGAT1s.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-13] Genome Wide Association Study for Leaf Photosynthetic Properties in 166 *Temperate Japonica* Rice Cultivars

*Nominated for Presentation Awards

○Yoshiaki Seki[1], Kentaro Hayami[1], Tomohiro Nomura[1], Yu Tanaka[2], Taiichiro Ookawa[1], Makoto Matsuoka[3], Shunsuke Adachi[1] （1.Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan, 2.Graduate School of Agriculture, Kyoto University, Japan, 3.Bioscience and Biotechnology Center, Nagoya University, Japan）

Intraspecific genetic variation of leaf photosynthetic capacity is a promising resource for crop improvements. Although a lot of QTL studies for leaf photosynthesis have been reported elsewhere, few attempts of genome wide association study (GWAS) have been made. This is partly due to the low efficiency of photosynthetic measurements and the influence of environmental fluctuations on photosynthesis in the field. In this study, using 166 cultivars of temperate *japonica* rice grown in the field, we conducted GWAS for leaf photosynthetic properties in our original procedure enabling multiple photosynthetic evaluations under laboratory settings. We found a wide range of difference in CO_2 assimilation rate (*A*) among the varieties by 125.6% and 85.8% in 2019 and 2020, respectively. From the combined analysis across the years to extract genotypic effects, we found GWAS peaks for *A* on chromosomes 3, 4, 7, and 10, which overlapped with most of the peaks of stomatal conductance, mesophyll conductance, and electron transport rate, the values of which positively correlated with *A*. Among these peaks, the peak on chromosome 4 was located on *NAL1*, a well-known gene associating photosynthesis, while the other peaks seemed to be uncharacterized genetic factors. These results show that our procedure enables evaluation of photosynthetic diversity in rice cultivars and estimations of novel genetic factors for photosynthetic properties. Determinations of genes underlying these peaks should lead to understand new molecular mechanisms for the photosynthetic control.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-14] Assessment of Genetic Diversity and Relatedness in Citrus Fruits Using RAPD Markers

*Nominated for Presentation Awards

○Nihar Ranjan Saha, Jarina Binte Jalil, Muhammad Shahidul Haque （Department of Biotechnology, Bangladesh Agricultural University, Bangladesh）

Citrus fruits are the most economically important fruit crops widely cultivated in subtropical and tropical regions of the world including Bangladesh. They comprise one of the largest fruit crops in the world. In order to have comprehensive information about the extent of genetic variability between and within various Citrus species, a combined approach involving morphological, and molecular approaches were adopted. Genetic diversity and inter-relationship among thirty one citrus fruits were analysed by using morphological characters as per the descriptors (Biodiversity International, Rome, Italy) and RAPD

markers. Out of twenty five morphological traits studied, the analysis of variance for the quantitative traits revealed statistically significant differences for the fourteen characters studied among tested genotypes. Total twenty six random markers were used in molecular study, which produced 261 bands, of which 257 were polymorphic. The size of the amplified products ranged from 150-3352 bp with an average of 3-15 bands per primer. A pair-wise similarity value between cultivars ranged from 0.08 to 0.56. A dendrogram generated based on UPGMA discriminated all the cultivars into two Major clusters. It was revealed that the first main cluster consists with orange and malta. The other main cluster in turn divided into two sub-clusters, the first sub-cluster was formed with lemon while the second sub cluster consisted with jambura (pomelo) and satkara (Citrus macroptera). These results suggest that RAPD based markers are useful for genetic characterization of Citrus Fruits and useful in germplasm classification and introgression studies.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-15] Pyramiding of Disease Resistance Genes into Popular Rice Varieties of Bangladesh

*Nominated for Presentation Awards

○Tapas Kumer Hore, Corinne Mira Marfori-Nazarea, Mary Ann Inabangan-Asilo, Ratna Wulandari, BP Mallikarjuna Swamy （RGDV Platfrom, International Rice Research Institute, Philippines）

Rice is the major staple food of Bangladesh, contributing to 65-70% of the daily caloric intake. Its stable production is essential to meet the food and nutritional demands. However, rice production is affected by several biotic constraints such as bacterial blight, blast and tungro. Most of the popular rice varieties released during the last two decades are becoming susceptible to major diseases, so pyramiding disease resistance genes by marker-assisted backcrossing is a fast-track approach to address biotic stresses. We introgressed bacterial blight (*Xa5*, *Xa13* and *Xa21*) and blast genes (*Pi9*, *Pita2* and *Pi35*) into BRRI dhan28, BRRI dhan63 and BRRI dhan81 rice varieties. We also introgressed tungro resistance gene tsv1 into BRRI dhan71 rice variety. Materials have been advanced to BC_3 generation and homozygous lines selection is in progress using gene-specific markers. While twenty-three BC_3F_3 tungro resistance homozygous lines phenotypically similar to recipient parent have been selected and field evaluated. The overall results of the work will be presented during the conference.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-16] Genetic Analysis of Agronomic and Biofortification Traits in Multiple Rice Populations

*Nominated for Presentation Awards

○Tapas Kumer Hore, Mary Ann Inabangan Asilo, Gaurav Joshi, Amery Amparodo, BP Mallikarjuna Swamy （RGDV Platfrom, International Rice Research Institute, Philippines）

Malnutrition is a major global health problem that affects more than two billion people, especially children and women. Iron and Zinc deficiencies cause anemia, stunting, diarrhea, reduced immunity, poor cognitive function, etc. These problems are highly prevalent in rural populations without access to adequate nutrition. Most of the popular high-yielding rice varieties are a poor source of micronutrients;

hence, the biofortification of rice varieties with essential micronutrients is a popular intervention to tackle hidden hunger. Understanding the genetic basis of agronomic and biofortification is vital to develop high-yielding micronutrient-rich rice varieties. We characterized two biparental and two multi-parental populations for agronomic, yield, and micronutrient traits over two seasons at the International Rice Research Institute. Populations were genotyped using 7K SNP chip and genotype by sequencing. Wider variations were observations for all the traits in both the seasons and all the populations. Zn content ranged from 13.14–35.65 mg/kg and 6.58–41.24 mg/kg in biparental and multi-parental populations, respectively. QTL analysis showed prominent and consistent QTLs for grain Zn content on chromosomes 5 and 7, explaining a phenotypic variance of 11.4% and 10.4%, respectively. Further analysis is in progress.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-17] Meta-QTLs and Candidate Genes Associated with Grain Zinc Content in Rice

*Nominated for Presentation Awards

○Gaurav Joshi[1,2], B. P. Mallikarjuna Swamy[1], Indra Deo Pandey[2], Yan Paing Soe[3], Jose E. Hernandez[4], Chau Thanh Nha[5], Alvin Palanog[6], Mark Ian Calayugan[4], Mary Ann Inabangan Asilo[1], Amery Amparado[1], Tapas Kumer Hore[1] (1.Rice Breeding Innovations, International Rice Research Institute, Philippines, 2.Genetics and Plant Breeding, Govind Ballabh Pant University of Technology and Agriculture, India, 3.Seed Division, Department of Agriculture, Myanmar, 4.Institute of Crop Science, University of the Philippines Los Baños, Philippines, 5.Genetics and Plant Breeding Department, Cửu Long Delta Rice Research Institute, Vietnam, 6.Research and Development, Philippine Rice Research Institute, Philippines)

Zinc and Iron deficiencies affect more than half of the global population. Rice is the major source of calories but a poor source of nutrition in its milled form. Biofortification of major staple crops with essential micronutrients has emerged as one of the prominent tools to address malnutrition. However, grain yield and micronutrient traits are genetically complex and significantly influenced by the environmental factors. So, identification of stable QTLs and their use in marker assisted breeding fast track the development of biofortified rice varieties. Recently there has been significant progress in mapping QTLs for grain Zn and to breed Zn biofortified rice. We carried out a comprehensive genome-wide meta-analysis of Zn QTLs reported from 25 different studies in rice. Results revealed 51 meta-QTLs (MQTLs) distributed across the 12 rice chromosomes. A total of 415 transcripts/genes related to Iron and Zinc homeostasis were shortlisted, which were found to be involved in oxidation reduction process, trans-membrane transport, cell redox homeostasis, cation/metal ion binding etc. Haplotype analysis of 20 well characterized genes related to Zinc and Iron metabolism were further studied using the 3K rice genome panel. Results showed that 19 out of 20 genes had haplotypes ranging from 2 to 7. The results will be useful for designing markers for the precise and faster development of Zn biofortified rice varieties.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-18] Global Analysis of a Rice Panel to Identify QTLs and Genotypes Useful for Rice Breeding

*Nominated for Presentation Awards

○Gaurav Joshi[1,2], B. P. Mallikarjuna Swamy[1], Mona Liza Jubay[1], Indra Deo Pandey[2], Maria Camila Rebolledo[10, 11], Dmytro Chebotarov[1], Kenneth McNally[1], Rakesh Kumar Singh[9], Hei Leung[1], Sunil Kumar Verma[4], Satish B. Verulkar[4], Shuhha Banerjee[4], Hsu Myat Noe Hnin[3], Rollin de Ocampo[1], Federico Molina[5], Bertrand Muller[11], Justine Bonifacio[1], Eliel Petro Paez[10], Adin Blokounon[7], Kazuki Saito[7], Khady Nani Dramé[8], Stephen Klassen[1], Narne Chamundeswari[6], P. V. Satyanarayana[6] (1.Rice Breeding Innovations, International Rice Research Institute, Philippines, 2.Department of Genetics and Plant Breeding, Govind Ballabh Pant University of Technology and Agriculture, Pantnagar, India, 3.Institute of Crop Science, University of the Philippines Los Baños, Philippines, 4.Department of Plant Molecular Biology and Biotechnology, Indira Gandhi Agricultural University, Raipur (Chhattisgarh), India, 5.Rice Breeding, National Institute of Agricultural Research of Uruguay, Uruguay, 6.Plant Breeding, Regional Agricultural Research Station, Maruteru, India, 7.Sustainable Productivity Enhancement Program, Africa Rice Center, Côte d'Ivoire, 8.Capacity Development, Africa Rice Center, Côte d'Ivoire, 9.Crop Diversification and Genetics, International Center for Biosaline Agriculture, United Arab Emirates, 10.Rice Program, International Center for Tropical Agriculture (CIAT), Colombia, 11.Centre de Coopération Internationale en Recherche Agronomique Pour le Développement (CIRAD), France)

Rice as a major staple plays an important role in global food and nutritional security. Hence, its sustainable production is essential to meet the food and nutritional demands of rapidly increasing human population. But climate change induced risks pose a major challenge to food production; so there is an urgent need to provide solutions that can improve the resilience of rice food systems. The Global Rice Array Project helps to address climate change through characterization of diverse germplasm, identification of donor lines, genetic dissection of major traits and by better understanding of genotype, environment and crop management interactions. We successfully evaluated a subset of MAGIC *indica* population at 12 locations across Asia, Africa and Latin America during 2018 to 2020. MAGIC *indica* population was created using 8 Founders with desirable traits for biotic and abiotic stress tolerance, yield, and grain quality. A total of 21 data sets have been generated on yield and yield related traits. The population has been genotyped by sequencing. Preliminary analysis showed that IR13V902, IR13V924, IR13V1268 and IR13V1357 genotypes are stable and high yielding. Moreover, GGE Biplots showed that Uruguay is an environment good for selecting specifically adapted genotypes. Genome wide association study using 27041 markers showed consistent marker-trait association for flowering and plant height on chromosomes 6 and 1 respectively. Further analysis using weather, soil and crop management parameters is in progress. The results will help in understanding the complexity of interactions between genotype, environment and crop management and will lead to identification of traits, QTLs/genes and genotypes useful for breeding climate resilient rice varieties.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-19] A Metabolite Profiling to Explore the Physiological Function of *Short Panicle 1* during Panicle Formation of Rice

Yifan Lin[1], Ryutaro Morita[1], Masaki Okamura[2], Junko Yamagishi[1], ○Naohiro Aoki[1] (1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Central Region Agricultural Research Center, National Agriculture and Food Research Organization, Japan)

The rice inflorescence architecture, which is determined by the length and number of branches, has a great agronomic value and therefore also attracted much attention in the past years. The Short Panicle 1

(*SP1*) is categorized in the Nitrate Transporter 1/Peptide Transporter gene family and the knock-out mutant (*sp1*) displays a short-panicle phenotype with fewer rachis-branches. Previous studies reported that *SP1* functions in the vasculature of young panicles after primordia initiation, but the molecular mechanism underlying its effect on panicle formation remains unclear. In the present study, the *sp1* mutant and wild type (cv. "Nipponbare") were grown in paddy fields and compared to investigate the physiological function of *SP1*. From 28 to 14 days before the heading date, we sampled a 3-cm bottom part of stem including young panicle, and conducted a metabolite profiling by using an ion chromatography and a high performance liquid chromatography. Among sugar phosphates and carboxylic acids involved in the primary metabolism, mannose-6-phosphate (M6P) and 2-oxoglutaric acid (2OG) were accumulated in the *sp1* mutant at significantly higher levels, compared with the wild type. M6P can be converted into GDP-mannose, which is related to cell wall formation. 2OG is known to be a key metabolite in amino acid synthesis, providing the carbon skeleton for nitrogen assimilation. Thus, the higher accumulation of M6P and 2OG may imply that the cell wall formation and nitrogen assimilation pathways are inhibited in *sp1* mutant.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-20] Assessment of *Indica* Rice Cultivars for the Use of Whole Crop Silage

Yoshikage Goto, Junko Yamagishi, ○Naohiro Aoki （Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

Whole crop silage (WCS) is a fermented roughage for which the whole plant of grass species, including panicles, leaves, and stems, are harvested at the late ripening stage and used for silage preparation. In Japan, the cultivation of WCS rice (*Oryza sativa* L.) has been promoted from the viewpoints of more efficient use of paddy field, improvement of self-sufficient ratio of livestock feed, and promotion of integrated farming system of rice cultivation and cattle raising. Thus, breeding of new rice cultivars for the use of WCS has grown attention to researchers and breeders. In particular, it would be useful to select genetic resources on the basis of WCS-related traits. Here we report an assessment of two *indica* rice cultivars, 'Calotoc' and 'Anjana Dahn', as for the use of WCS. These two *indica* cultivars and existing WCS cultivars, 'Tachiayaka', 'Tachisuzuka', and 'Leafstar' were grown in paddy fields in the Institute for Sustainable Agro-ecosystem Services, The University of Tokyo, Japan, and compared in light of biomass production, lodging resistance, spikelet number, sugar content, and water content, all of which are traits related to WCS aptitude. From the results, we found that 'Calotoc', rather than 'Anjana Dahn', has some traits suitable for WCS, and could be a genetic material for WCS breeding.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-21] Morphological Characteristics Related to the Accumulation of Non-Structural Carbohydrates in Stems of Rice at Heading Stage

*Nominated for Presentation Awards
○Yu Wakabayashi, Ryutaro Morita, Junko Yamagishi, Naohiro Aoki （Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan）

Non-structural carbohydrates (NSC) stored in stems before heading are the important carbohydrate source for the grain development of rice. In the present study, the dynamics of NSC were analyzed in each part of stems to clarify the morphological factors related to the NSC accumulation in stems at heading stage.
Field experiments were conducted in two consecutive years using "Tequing (*O. sativa* L. spp. *indica*)" and "Momiroman (*O. sativa* L. spp. *japonica*)", which have different accumulation patterns of NSC in stems. From the day of young panicle formation, internodes and leaf sheaths of main stem were divided into five parts based on the node, and internode length, culm diameter, leaf sheath length, and NSC content were measured.
In both varieties, NSC stored in leaf sheath until about 10 days before heading were preferentially used for the elongation of 1st and 2nd internode than that of 4th and 5th internodes. The amounts of stem NSC in heading stage were larger in "Tequing" than in "Momiroman". Compared to "Momiroman", length and culm diameter of 4th and 5th internodes were larger, while length of 1st and 2nd internodes were shorter in "Tequing". In the case of Momiroman with long upper internodes, NSC accumulation in stems tended to be suppressed for about 10 days before heading. From our studies, it was considered that rice varieties with larger lower internodes and shorter upper internodes are suitable for increasing NSC accumulation in stems at heading stage.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-22] Comparative Analysis of Sugar Metabolism in Rice Leaves under Field and Controlled Environments

○Yoichi Hashida[1], Ayumi Tezuka[2], Mari Kamitani[3], Makoto Kashima[4], Yuko Kurita[3], Atsushi J. Nagano[3,5] （1.Faculty of Agriculture, Takasaki University of Health and Welfare, Japan, 2.Research Institute for Food and Agriculture, Ryukoku University, Japan, 3.Faculty of Agriculture, Ryukoku University, Japan, 4.College of Science and Engineering, Aoyama Gakuin University, Japan, 5.Institute for Advanced Biosciences, Keio University, Japan）

Environmental factors such as irradiance and temperature fluctuate under field environments while those in conventional growth chamber (GC) are usually regulated as square-wave condition, which are constant during the day and the night, and abruptly transited at dawn and dusk. To clarify the differences in the sugar metabolism of rice leaves under fluctuating environments and GC condition, we compared sugar and starch content and diurnal transcriptome of rice leaves grown in field and GC condition, and simulated field condition by SmartGC, a high-performance growth chamber that can control light, temperature and relative humidity by 1-minute resolution. In the field, sucrose content in leaves rose gradually after dawn, reached plateau and started to fall before dusk. Starch content in leaves also increased gradually after dawn and reached plateau before dusk. Similar trends were observed in conditions simulating fluctuation of light by SmartGC, although the sucrose and starch content in leaves tended to be higher in the field. On the other hand, sucrose and starch content in GC condition rose earlier after dawn than in the field and did not fall until dawn. The difference in the expressions of genes related to sugar metabolism between conditions was mainly found before dusk, which is consistent with the difference in sugar status of leaves. Overall, these results indicate that the

difference in sugar metabolism of rice leaves in field and GC condition mainly derive from diurnal change of irradiance and is remarkable around dawn and dusk.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-23] A Metabolite Profiling to Seek the Molecular Determinant of Spikelet Number in Rice

○Ryutaro Morita[1], Masaki Okamura[2], Shiori Yabe[3], Hiroe Yoshida[4], Satoru Sukegawa[4], Hiroshi Nakagawa[4], Naohiro Aoki[1] (1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Central Region Agricultural Research Center, National Agriculture and Food Research Organization, Japan, 3.Institute of Crop Science, National Agriculture and Food Research Organization, Japan, 4.Institute for Agro-Environmental Sciences, National Agriculture and Food Research Organization, Japan)

The number of spikelets is a key determinant of the grain yield of rice. Generally, the number of spikelets is determined by the nitrogen accumulation up to 2-weeks before heading and carbon supply during 2-week period preceding heading. However, the metabolic pathway involved in the determination of spikelet number is not fully understood. In this study, to clarify the relationship between the number of spikelets and metabolism of rice, we conducted the field experiment using the two rice cultivars "Nipponbare", "Koshihikari", and the *taw1-D2* mutant lines for each cultivar, which exhibits increased spikelet number per panicle in the two sites in Japan. From 40 days before heading to the heading stage, a basal part of stem including the shoot apical meristem of rice was sampled to analyze the metabolite contents an ion chromatography and a high-performance liquid chromatography. As reported in previous studies, the number of spikelets was highly proportional to the shoot nitrogen content. Among measurable 50 metabolites, the iso-citrate contents were positively while the shikimate contents at 28 days before heading were negatively correlated with the number of spikelets. The number of spikelets is divided into two components, i.e., the panicle number and the spikelet number per panicle. The inorganic phosphate content and fructose-6-phoshate content were highly correlated with the panicle number and the spikelet number per panicle, respectively. Based on the results, the key metabolites determining the number of spikelets will be discussed.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-24] Contribution of Several Source Organs to Dry Matter Accumulation into Panicles after Heading of Hulless Barley Sown at Different Terms

○Takuya Araki[1], Yasuhiro Kondo[2], Takato Yano[2], Ryo Kodani[2], Yukina Sakamoto[2] (1.Graduate School of Agriculture, Ehime University, Japan, 2.Faculty of Agriculture, Ehime University, Japan)

Barley has several sources for dry matter into panicles not only leaves and nonstructural carbohydrate (NSC), accumulating into a column during vegetative stage, but also awns and lemma. In this study, we considered contribution of these sources to dry matter accumulation into panicles of hullless barley (*Hordeum vulgare* L.) cv. Haruhimeboshi and Mannenboshi sown at different sowing terms. These cultivars

were sown on 12th November and 15th December, which are standard sowing (SS) and late sowing (LS) terms, respectively. The contribution of photoassimilates of awns to dry matter increase of panicles was calculated by the difference of dry matter increase of panicles between non-removed and removed awns. To evaluate the contribution of photoassimilates of lemma to dry matter increase of panicles, panicles were covered with black plastic films to restrict carbon dioxide assimilation. NSC content showed maximum at 20 days after heading, when that of Haruhimeboshi in SS was the highest. Dry matter increase in panicles derived from awn and lemma was higher in LS than that in SS of both cultivars. The ratio of source contribution to the dry matter increase in SS was 55%, 31% and 14% in leaves, NSC and awns and lemma, respectively. In LS, the ratio of awns and lemma showed 23%, which was higher than that in SS. The higher contribution of awns and lemma in LS was implied that source activity of awns and lemma was higher due to higher integrated temperature after heading in LS. From these results, awns and lemma has important role in dry matter accumulation in panicles.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-25] Analysis on the Roles of Vacuolar Invertase Isoform, *OsINV3* in Root Development of Rice

*Nominated for Presentation Awards

○Natsumi Ueda[1], Ryutaro Morita[1], Tatsuro Hirose[2], Junko Yamagishi[1], Naohiro Aoki[1] (1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Faculty of Agriculture, Takasaki University of Health and Welfare, Japan)

Root system is the only organ to absorb water and nutrient from soil, therefore it is an important factor for crop growth and yield. Carbon required for root development is supplied exclusively from shoot, however, the relationship between root development and metabolism of photoassimilates has been yet unknown. Here, we analysed the sugar metabolism in the root of rice *inv3* mutant, in which *OsINV3* a vacuolar invertase gene, is knocked out. The mutant was compared with wild-type (cv. Nipponbare) to clarify the role of sucrose degradation in root development.
Fresh weights of shoot, main roots and lateral roots were significantly smaller in *inv3*, while fresh weight of root tips was almost same level as wild-type. Non-structural carbohydrate (starch and soluble sugars) contents of main roots were not different in both lines. Although the sucrose contents in root tips and lateral roots of the mutant were more than twice that of the wild-type the glucose content in lateral roots of *inv3* was significantly lower in the mutant than in the wild-type. Moreover, the fructose content in root tips and lateral roots of the mutant decreased to approximately one-seventh and one-third, respectively, compared to the wild-type. Whole root length in *inv3* was also shorter than in the wild-type. These results imply that *OsINV3* functions especially in lateral roots and root tips for their elongation.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-26] The Purification of Recombinant TGW6, which Limits Grain Size in Rice

○Tatsuki Akabane[1], Nobuhiro Suzuki[2], Wataru Tsuchiya[2], Etsuko Katoh[2], Naoki Hirotsu[1] （1.Graduate School of Life Sciences, Toyo University, Japan, 2.Structural Biology Team, Advanced Analysis Center, National Agriculture and Food Research Organization, Japan）

THOUSAND-GRAIN WEIGHT 6 (*TGW6*) encodes an indole-3-acetic acid (IAA)-glucose hydrolase. By the function of native TGW6, the number of endosperm cells and the weight of grains are limited. Otherwise, the 1-bp deletion allele of *tgw6* cloned from the Indian landrace rice Kasalath loses the function and enhances the grain size as well as yield. We hypothesized that the chemical intervention strategy for the specific inhibition of TGW6 might increase the grain size and yield. However, we do not have the information for the structure of the TGW6 protein to design the antagonist.
In this study, we purified the recombinant TGW6 through the *Escherichia coli* expression system. We cloned full-length *TGW6* from Nipponbare by PCR and inserted it into pET-32b. The constructs were transformed into Rosetta-gami 2 (DE3). The *E.coli* cells contained a pET-32b expression plasmid for TGW6 were grown at 37℃ in LB minimal medium. Isopropyl-1-thio-β-d-galactopyranoside was added to induce the expression of the TGW6 construct. After harvesting the cells, we extracted the recombinant TGW6 by sonication and purified using Ni-affinity chromatography. However, most of the recombinant TGW6 expressed as insoluble forms. Then, we cloned *TGW6* truncated 30 amino acid sequences from N-terminus with the same experimental condition. We could improve the solubility by truncation of N-terminus amino acids and purify the recombinant TGW6. Further, we will report on the enzyme activity of the recombinant TGW6.

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[P4-27] Analysis of Genotype and Environment Interaction, and the Response of Grain Yield of Lowland Rice (*Oryza sativa* L.) to Nitrogen Application Under Different Environment in the Philippines

○Kim Nyka Caraan Perdiguerra[1,2], Pompe Campoy Sta. Cruz[1], Shiro Mitsuya[2], Akira Yamauchi[2] （1.Institute of Crop Science, College of Agriculture and Food Science, University of the Philippines Los Baños, Philippines, 2.Graduate School of Bioagricultural Sciences, Nagoya University, Japan）

Philippines rice growing areas have different climatic and edaphic characteristics resulting to difference in the performances of rice genotypes across different regions. Grain yield of rice (*Oryza sativa* L .) varies across genotypes and environments caused by genotype by environment (GxE) interactions, which is further affected by management (GxExM). Analysis of these interactions helps in the identification of genotypes with high stability, most adaptable environment, and the most suitable management. In this study, three rice genotypes namely: PSB Rc18, NSIC Rc222 and NSIC Rc202H were planted with and without nitrogen fertilizer application in 14 different environments which included all the dry seasons (DS) and wet seasons (WS) of Bukidnon, North Cotabato, Davao Del Sur, Isabela, Laguna, Oriental Mindoro, and Nueva Ecija. Environment accounted for the largest variability in grain yield (72.3%), followed by the genotype (25.3%) and their interaction (2.3%). Among the environments, dry season of Nueva Ecija with N fertilizer application had the highest mean grain yield (5.9 t ha^{-1}), while wet season of North Cotabato with zero N fertilizer application had the lowest mean grain yield (2.13 t ha^{-1}). The response of the genotypes across all environment also varied. Among the genotypes, NSIC Rc202H had the highest increase in yield as response to N application in DS Nueva Ecija compared to the other

environments. This shows that variation of grain yield and yield response is affected by genotype, environment and management (GxExM).

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-28] Morphological Characteristics of Mealy and Translucent Endosperm Cells of Hulless Barley (*Hordeum vulgare* var. *nudum*) During the Ripening Stage

*Nominated for Presentation Awards

○Yuto Hatakeyama[1, 2], Ryo Kotani[3], Yukina Sakamoto[3], Kosuke Haraguchi[3], Nana Matsui[3], Takuya Araki[1]
(1.Faculty of Agriculture, Ehime University, Japan, 2.Japan Society for the Promotion of Science Research Fellow, Japan, 3.Graduate School of Agriculture, Ehime University, Japan)

Glassiness rate is one of the important indices for grain quality of hulless barley (*Hordeum vulgare* var. *nudum*), and the high glassiness rate declines the processing efficiency and market value of the grain. The glassiness represents the ratio of the mealy and translucent areas in the endosperm of the grain. Although it was reported that the glassiness was involved in the protein matrix (protein bodies) and structure of starch granules in the endosperm cell, the differences in the development process of these organelles between putative mealy and translucent cells during the ripening stage remain unclear. In this study, using a right microscope and transmission electron microscope, the endosperm cells of two hulless barley cultivars, Haruhimeboshi and Mannenboshi, at the eight ripening stages were observed. At maturation, the percentage of glassy grain which translucent endosperm area occupied more than 70 % of the whole cross-section area of grain was less than 20 % in Haruhimeboshi, whereas that was more than 80 % in Mannenboshi. The protein bodies and amyloplasts developed especially after 20 days after flowering, and the area of protein bodies at maturation became larger in Mannenboshi than Haruhimeboshi. Moreover, the area of protein bodies in the outer endosperm where the glassy cell was observed with high frequency was larger than that in the middle and inner endosperm. These results suggested that the development of protein bodies at the later ripening stage could be involved in the glassy formation of hulless barley grains.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-29] Effect of Silicon Application on Grains of *Sorghum bicolor* under Drought Conditions

○Ryoichi Araki[1], Yuka Takano[1], Hidetoshi Miyazaki[2], Hiroyuki Ii[3], Ping An[4], Teru Tanaka[5] (1.Faculty of Education, Wakayama University, Japan, 2.Research unit, The Global Environmental Forum, Japan, 3.Faculty of Systems Engineering, Wakayama University, Japan, 4.Arid Land Research Center, Tottori University, Japan, 5.Faculty of Agriculture, Setsunan University, Japan)

The positive effects of silicon on plant growth are well known. To date, it has been reported that stress conditions such as drought enhanced the effect of silicon treatment in various plant species. In this study, we investigated the mineral contents in sorghum under drought stress conditions with or without silicon to reveal the effects of silicon application on sorghum (Sorghum bicolor cv. K8) grains. Silicon

treatment changed the mineral contents of the grains under drought stress conditions. Especially, the application of silicon to sorghum grown under drought stress significantly increased iron content in the grain, although plant biomass was decreased. On the other hand, the silicon application did not considerably affect the plant biomass under our experimental conditions. These results suggested that silicon application enhanced iron accumulation in grains under drought stress conditions, although the plant biomass was not affected. To further elucidate the accumulation of iron in grains, RNA-seq analysis was performed on sorghum leaves grown in pots. RNA-seq analysis showed that about 2,500 genes were significantly up-regulated by drought stress, and about 1,000 genes were significantly up-regulated by silicon treatment under drought conditions. In contrast, less than 100 genes were up-regulated in the non-drought treatment. These expression patterns indicated that the silicon treatment had a significant effect on gene expression under drought stress conditions.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-30] Relationship between Non-Destructive Measurement Parameters and Yield in Sweet Potatoes

○Masayuki Kadowaki[1], Tomohiro Araki[2], Risa Umehara[2], Sokichi Shiro[1], Shingo Matsumoto[1] (1.Institute of Agricultural and Life Sciences Academic Assembly, Shimane University, Japan, 2.Faculty of Life and Environmental Science, Shimane University, Japan)

The purpose of this study was to elucidate in detail the relationship between non-destructive measurement parameters such as plant coverage rate and yield in sweet potatoes.
The experiment was conducted at the Jinsai Sandy Dune Farm, Shimane University. Fertilizer application was set at 5 kg N, 14 kg P_2O_5, and 14 kg K_2O per 10 a in 2019, and three levels of nitrogen fertilization were set at 0 kg, 5 kg, and 15 kg per 10 a in 2020. Twenty varieties of sweet potato were used as experimental materials. Transplanting was done in late June. Yield was measured at about 100 days after planting. Plant coverage rate and NDVI values were also measured until 30 days after transplanting. Above-ground traits were measured in July 2019.
There was a significant positive correlation between plant coverage rate in early growth period and yield in both years. Multiple regression analysis of the relationship between above-ground traits and plant coverage rate in early growth showed a relationship between the number of branches and branch nodes and planting rate. There was a significant positive correlation between NDVI value and yield at 1% level. Furthermore, NDVI value and plant coverage rate were also found to be significantly positively correlated. The average plant coverage rate of all varieties increased with increasing nitrogen fertilization. However, the relationship between plant coverage rate and yield was almost constant regardless of the increase or decrease in nitrogen fertilization.
A part of this work was supported by Grant-in-Aid for Scientific Research(C)(18K05596).

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-31] Heat Stress Impact on Heading and Ripening in Major Korean Rice Variety

○Woonha Hwang, Chungkeun Lee, Jaehyeok Jung, Hyeonseock Lee, Seoyeong Yang, Yeonhwa Lim, Myeonggu Choi （Crop Production and Physiology Division, National Institute of Crop Science, Korea）

Heat stress is one of big stress in rice cultivation. Even mean temperature is gradually increasing and extremly high tempertaure even is also increasing in Korea. In these condition, the understanding of heat stress impact on rice is important to harvest stable yield and quality. Therefore, we checked heat stress impact on rice flowering, heading and ripening stage using major Korean varieties. To check flowering characters of rice, we used 11 Korean varieties. After cultivation under natural condition until heading, the pots were transported in green house which temperature was controlled. Until 30 degree of mean temperature, the flowering time did not changed. However, in 33 degree of mean temperature, flowering time changed earlier then other temperature condition. Fertility also changed under 33 degree, significant reduced. Under 33 degree, anthor viobility and germination rate were significantly reduced. In high temperature condition, heading time also changed. The growth days from transplanting to heading reuced about 3.5 days under 1 degree of mean temperature changed. In ripening stage, heat stress impact on 1000 brown rice wieght, rice quality and protein content. 1000 brown rice weight was reduced about 0.02 g according to 1 degree of mean temperature. The bigger rice showed more reduction in heat stress. And head rice rate was reduced about 5% and immature rice rate was increased about 1.9% by 1 degree of mean temperature.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-32] Genetic Variations of Rhizome Yield, Essential Oil Content and Constituents in *Curcuma* Species and Strains

○Akira Miyazaki[1], Yukari Shiino[1], Hiroshi Hayakawa[2], Yoshito Ohtani[1], Yoshinori Yamamoto[1] （1.Faculty of Agriculture and Marine Science, Kochi University, Japan, 2.Museum of Natural and Environmental History, Shizuoka, Japan）

Rhizomes in *Curcuma* species, used as spices, dyes and medicines, contain essential oil (terpenoid) as medicinal properties. It is reported that essential oil ratio and constituent are different with species and strains. Therefore, the characteristics of essential oil ratio and constituent were compared between Japanese and foreign *Curcuma* species and strains. Foreign turmeric had a lower rhizome yield but a higher essential oil ratio than Japanese turmeric and yellow zedoary. This resulted in no significant difference among these three groups in essential oil content amount, expressed as a product of ratio and rhizome yield. However, some foreign turmeric had a high rhizome yield with a low essential oil ratio, showing a similar character to Japanese turmeric. Major constituents of essential oil shown as relative area percentages were ar-turmerone (25.4-45.7%) and zingiberene (6.8-39.5%) in Japanese turmeric, ar-turmerone (15.5-74.2%) in foreign turmeric, and 1,8-cineole (19.0-63.4%) in yellow zedoary. Detected constituent patterns were different between the Japanese and foreign turmeric, however some foreign turmeric indicated a similar pattern to Japanese turmeric. Differences of rhizome yield, essential oil ratio and constituent pattern among these *Curcuma* species and strains were consistent with a classification indicated by a network analysis from DNA sequence in 4 regions of a chloroplast.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-33] Relationship between Pre-Harvest Sprouting Variation and Physicochemical Properties in Varieties of Rice Flour

○Chae Min Han, Jong Hee Shin, Jung Bae Kwon, Jong Gun Won （Division of Crops Research, Gyeongsangbuk-do Provincial Agricultural Research & Extension Services, Korea）

This study was conducted to examine the influence of pre-harvest sprouting variation on rice quality and starch properties (morphology and pasting properties) of rice varieties that may be used for the production of rice flour. Pre-harvest sprouting refers to seed germination during ripening, due to loss of dormancy before harvest, which is an important trait of varieties of rice flour. In this study, we investigated four varieties of rice flour with different genetic backgrounds to determine whether their starch is suitable for producing high-quality, dry-milled rice flour. Until now, 'Seolgaeng', 'Hangaru', 'Shingil', and 'Garumi-2' have been varieties developed for the production of dry-milled rice flour developed in Korea. The changes in the rice yield, yield components, and viviparous germination rates in the four varieties of rice flour are investigated. 'Shingil' variety produced the highest comparative grain yield and lowest pre-harvest sprouting rate. On the other hand, 'Garumi-2' produced the highest pre-harvest sprouting rate. The rice grains were ground in a mixture grinder and stored properly at room temperature prior to their use in the actual experiment and investigated for its starch and quality characteristics. Amylose and protein content, amylopectin short-branch chain and pasting properties of rice flours were measured. The pasting and thermal properties of rice flours determined by rapid-visco analyser (RVA) and differential scanning calorimeter (DSC). The morphology of the starch granule of the varieties was determined by SEM.

1:15 PM - 2:00 PM （Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster)）

[P4-34] Physicochemical Properties of Rice Varieties Adapted to a Mountainous Region in Mid-South Korea

○Chae Min Han, Jong Hee Shin, Jung Bae Kwon, Jong Gun Won （Division of Crop Research, Yeongsangbuk-do Provincial Agricultural Research & Extension Services, Korea）

With global warming, the cultivation period by climate zone for major food crops is expected to change, so the crops' growth and production variations need to be evaluated. In this research, we studied the changes in rice starch properties of the varieties adapted to the changing climate in the mountainous mid-South region in Korea and provided palatability data of major crops. The post-harvest rice starch of varieties such as Ilpum, Saechucheong, Samkwang, Chilbo, and Dasomssal was evaluated for its physicochemical properties. All varieties used in this study were harvested by Gyeongsangbuk-do Agricultural Research and Extension Services in 2020. The sowing date was April 20th and transplanting was done on May 20th. The sample rice flour was harvested, milled after drying to reach 14% moisture content, and passed through a 100-mesh sieve, from which the starch was separated using alkaline immersion. The protein amylose content of the white rice was measured non-destructively and the distribution of particle sizes was analyzed. The pasting properties, gelatinization properties, and crystallinity were measured by RVA, DSC, and XRD to examine starch properties, respectively. In the analysis of particle size distribution, the particle size (D50) of Saechucheong was the largest, while that of Chilbo was the smallest. The damaged starch content was the highest in Chilbo and the lowest in Ilpum. In examining the pasting properties, the peak viscosity was the highest in Samkwang and the lowest in Chilbo. The BD value was the highest in Samkwang but the lowest in Ilpum.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-35] Marker-Assisted Selection to Develop the High Nutrition Rice, Giant-Golden-Purple Rice, PFR32, and Giant-Golden-Red Rice, RFR13

○Yu-Chia Hsu[1], Yu-Chien Tseng[1], Yu-Chi Cheng[2], Bing-Nan Lin[1], Yong-Pei Wu[2] (1.Department of Agronomy, National Chiayi University, Taiwan, 2.Department of Agronomy, Chiayi Agricultural Experiment Station, Taiwan Agricultural Research Institute, Taiwan)

Rice (*Oryza sativa* L.) is one of the most important crops in the world. Functional rice can help people quickly gain nutrition and improve the health condition. CNY103108 and CNY103107, are two rice lines with purple waxy, golden endosperm and giant embryo. They were utilized as the donor parents in this study. In Taiwan, CNY922401, an elite purple waxy rice line and TNGSW26, a *indica* red waxy rice variety with high yield, which were used as the recurrent parents. The progenies were foreground selected by OsALDH7 (rice aldehyde dehydrogenase 7) and ge2 (giant embryo gene 2) functional markers and consequently background selected by molecular markers to recover their recurrent parent's background genome. The MAS results showed on purple rice population (CNY922401 / CNY103108), the recovery of recurrent parental genome was 91.3% and on red rice population (TNGSW26 / CNY103107), the recovery of recurrent parental genome was 89.8%. Through observing the grain appearance of brown rice from two populations, the progenies showed that they have the same color of pericarp with the recurrent parents, and have the larger embryo than the recurrent parents. After three-year yield trials in the field, PFR32 and RFR13 were selected from purple rice and red rice population, respectively. They have similar yield as the recurrent parents with golden endosperm and giant embryo. These results indicated that these lines can be grown in the fields for cultivation, and have been successful introgressed two genes, OsALDH7 and ge2 to the recurrent parents using marker-assisted selection. The new functional rice varieties will be developped and suitable for rice production in Taiwan and the world.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-36] Genetic and Morphological Mechanisms for Soil-Surface Roots Originated from a New Plant Type Cultivar in Rice (*Oryza sativa* L.)

○Asami Tomita[1,2], Hiroki Saito[2], Yoshimichi Fukuta[2] (1.Graduate School of Environmental and Life Science, Okayama University, Japan, 2.Tropical Agriculture Research Front, Japan International Research Center for Agricultural Sciences, Japan)

Soil-surface roots of rice might be useful for the stresses under reduced soil in Tropical region, such as iron, manganese toxicity and salinity field. The QTLs for soil-surface root have been already detected on the three regions of chromosomes (chr.) 2, 5, and 7 originated from a New Plant Type (NPT) cultivar, IR 65600-87-2-2-3, with the genetic background of an *indica* Group cultivar IR 64. NPT alleles of these QTLs increased soil-surface roots. Seven chromosome segment lines (CSL) harboring and combined from single to three QTLs' regions with the IR 64 genetic backgrounds were developed. Using these CSLs,

these effects of each and pyramided QTL(s) were evaluated, and that of chr. 5 particularly played a role for supporting the effect with the others. And these lost the gravitropic response of seminal root partially under dark condition. Therefore, these QTLs for soil-surface roots were occurred by partial losing of root gravitropic response and these accumulations in the NPT cultivar. These CSLs for QTLs will be useful materials for genetic and physiological studies for understanding the root architecture of rice, and for resources of rice breeding.

12:15 PM - 1:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-37] Development and Genetic Analysis of Compensatory Growth of Lateral Roots in Rice

*Nominated for Presentation Awards

○Tsubasa Kawai[1, 3], Misuzu Nosaka-Takahashi[2], Yutaka Sato[2], Yinglong Chen[3], Kadambot H. M. Siddique[3], Hirokazu Takahashi[1], Mikio Nakazono[1], Akira Yamauchi[1], Yoshiaki Inukai[4] (1.Graduate School of Bioagricultural Sciences, Nagoya University, Japan, 2.National Institute of Genetics, Japan, 3.The UWA Institute of Agriculture, The University of Western Australia, Australia, 4.International Center for Research and Education in Agriculture, Nagoya University, Japan)

Soil compaction is a major problem limiting crop production. Compacted soils limit root system development, causing significant reduction in water and nutrient uptake from the soil, and resulting in yield loss. Mechanical impedance on primary roots caused by soil compaction triggers compensatory lateral root (LR) growth in various plant species. Maintenance of sufficient total root length contributes to continued shoot growth under compacted soils. Therefore, improving compensatory LR growth is a strategy for developing crop plants that tolerate soil compaction. To reveal the mechanisms of compensatory LR growth in rice, a method for root tip excision was established to induce the compensatory LR growth. To identify the genes regulating the compensatory LR growth, a novel rice mutant (T3-7-1) was isolated for its altered root phenotype and response pattern to root tip excision. The mutant produced fewer LRs under water culture and produced thicker LRs in response to root tip excision. Through characterization of the mutant and RNA-seq analysis in LR primordia captured with laser microdissection, molecular mechanisms underlying compensatory LR growth is being investigated. Furthermore, phenotypic traits related to the degree of compensatory LR growth is being examined in rice genotypes using a semi-hydroponic system.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-38] Daytime or Nighttime: When Plant Roots Uptake Nitrogen?

*Nominated for Presentation Awards

○Md Mehedi Hasan[1], Maya Matsunami[2], Hiroyuki Shimono[2] (1.United Graduate School of Agricultural Sciences, Iwate University, Japan, 2.Faculty of Agriculture, Iwate University, Japan)

When plant roots uptake nitrogen (N)? for this question, limited information is available. To answer this question, we monitored N uptake rate and transpiration during daytime and nighttime. Rice cultivar Hitomebore (*Oryza sativa*. L) was grown hydroponically in growth chamber (12h light; daytime and 12h dark; nighttime) under 26° C &60~70% humidity. NH_4Cl was used as N source and two treatments were

conducted as "Full N" (1mM N for 24h fed), "Half N" (0.5mM N for 24h fed) for 31~32 days in two cycles. N uptake rate (per plant) increased with days either during daytime or nighttime as plant growth progress. The N uptake rate in nighttime was slightly lower than daytime by 17~39% for "Full N" and 24~31% for Half N. There are close and positive correlation between N uptake rate and transpiration rate for each daytime and nighttime, but the slope of the relation differed between daytime and nighttime, because transpiration rate in nighttime was significantly lower than daytime by 78~79% for "Full N" and 80~81% for "Half N". In conclusion, rice plants absorbed N more in daytime than nighttime, and there is great difference in contribution of transpiration to N uptake between daytime and nighttime.

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[P4-39] Maintaining Higher Leaf Photosynthesis After Heading Stage Contributes to Higher Biomass Accumulation in Rice

*Nominated for Presentation Awards

○Sotaro Honda[1], Satoshi Ohkubo[2], Nan Su San[2], Anothai Nakkasame[2], Kazuki Tomisawa[2], Keisuke Katsura[2], Taiichiro Ookawa[2], Atsushi J. Nagano[3], Shunsuke Adachi[2,4] (1.Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan, 2.Graduate School of Agriculture, Tokyo University of Agriculture and Technology, Japan, 3.Faculty of Agriculture, Ryukoku University, Japan, 4.College of Agriculture, Ibaraki University, Japan)

Leaf photosynthetic rate changes across the growing season as crop plants age. Most studies of leaf photosynthesis focus on a specific growth stage, leaving the question of which pattern of photosynthetic dynamics maximizes crop productivity unanswered. In this study, we obtained high-frequency data of photosynthesis from two elite rice cultivars and 76 inbred lines across the growing season and analyzed associations between leaf CO_2 assimilation rate (A) dynamics and crop growth rate (CGR). A brand-new device "MIC-100", which enables high-throughput gas exchange examination, was used for A measurements (Tanaka, Adachi et al. 2021). The A values decreased as plants aged but small increase was found at around heading stage with a genetic variation. The integrated A value from heading to harvest was positively associated with CGR, but that before heading was not. A curve-smoothing analysis of A after heading showed that accumulated A at >80% of its maximum (A_{80}) was positively correlated with CGR in analyses of all lines mixed and of lines grouped by genetic background, while the maximum A was less strongly correlated with CGR. These results suggest that maintaining high A after heading, rather than having high maximum A, is a potential target for enhancing rice biomass accumulation. We propose that multiple examinations of A with the high-throughput gas exchange device will achieve the screening of high-yielding crops with high photosynthetic capacity.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-40] Genetic Analysis of Root Vascular Traits in a Population from Two *Temperate Japonica* Rice Ecotypes

*Nominated for Presentation Awards

○Ha-An Thi Nguyen[1], Akihiko Kamoshita[1], Poornima Ramalingam[1,2], Phoura Y[1] (1.Asian Research Center for Bioresources and Environmental Sciences, Graduate School of Agricultural and Life Sciences, The

University of Tokyo, Japan, 2.Department of Plant Biotechnology, Tamil Nadu Agricultural University, India）

The genetic basis for root vascular traits in rice, despite its direct impacts on root axial and radial hydraulic conductivity, has not been widely studied compared with deep rooting traits. We used five phenotyping datasets (i.e., from maturity stage grown in upland field in 2013, and from vegetative and maturity stages grown in upland and lowland fields in 2019) to quantify the genotypic variations and genomic regions of root vascular traits in a *temperate japonica* mapping population (from lowland Otomemochi and upland Yumenohatamochi). Yumenohatamochi had larger stele transversal area (STA) and total late metaxylem area (LMXA), as well as higher deep root ratio and total root length at deeper layers (>30 cm) than Otomemochi. Root vascular traits were significantly different among progenies in each dataset, and the sum square of each component of genotype-by-environment interactions was less than genotypic variation but their total sum was comparable. From the combined analysis of all five datasets, five out of 13 genomic regions related to root vascular traits were found collocated with deep rooting traits, although no root vascular traits were positively correlated with any of deep rooting traits. Two key genomic regions were (1) RM3703-RM6379 in Chromosome 2 for STA, collocated with a previously reported *qSTA-2* in an *indica* x *japonica* population, and (2) RM1388-RM5503 in Chromosome 4 for STA, LMXA and root transversal area collocated with deep rooting traits. This study is the first report of genomic regions of root vascular traits in a *temperate japonica* mapping population.

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[P4-41] CO_2-Responsive CCT Protein Interacts with 14-3-3 Proteins and Regulates the Expression of Starch Synthesis-Related Genes

*Nominated for Presentation Awards

○Fumihiro Miyagawa, Naoki Shibatani, Aiko Koudou, Daisuke Sasayama, Tomoko Hatanaka, Tetsushi Azuma, Hiroshi Fukayama （Graduate School of Agricultural Science, Kobe University, Japan）

CO_2-responsive CCT protein (CRCT) is a positive regulator of starch synthesis-related genes such as *ADP-glucose pyrophosphorylase large subunit 1* and *starch branching enzyme I* particularly in the leaf sheath of rice (*Oryza sativa* L.). RNA-seq analysis and subsequent RT-qPCR analysis showed that sucrose treatment induced the expression of *CRCT*, which in turn induced starch synthesis-related genes in WT. However, this induction did not occur in *CRCT* knock out mutants. A chromatin immunoprecipitation (ChIP) using a FLAG-CRCT overexpression line and subsequent qPCR analyses showed that the 5'-flanking regions of some starch synthesis-related genes were enriched by ChIP, indicating that CRCT can bind to the promoter regions of these genes. A bimolecular fluorescence complement (BiFC) assay revealed that CRCT interacts with a 14-3-3 protein in the nucleus. These results suggests that CRCT responds to sugar and regulates starch synthesis by directly binding to the promoter region of starch synthesis-related genes and interacting with 14-3-3 protein.

1:15 PM - 2:00 PM (Thu. Sep 9, 2021 12:15 PM - 2:00 PM Room 4 (Poster))

[P4-42] CRISPR/Cas9 — Based Genome Editing of *GCN5*, a Histone Acetyltransferase Gene, in Rice (*Oryza sativa* L.)

*Nominated for Presentation Awards

○Shu Takakura[1], Fumiya Miyamoto[1], Shicheng Feng[1], Sakae Agarie[2], Kazuyuki Saitou[2] (1.Graduate School of Bioresource and Bioenviroment Sciences, Kyushu University, Japan, 2.Faculty of Agriculture (Graduate School), Kyushu University, Japan)

Nitrogen is a primary component of plant substances. The expression of Rubisco genes is enhanced in response to nitrogen supply. Histone acetylation regulates gene expression in diverse biological processes, but histone acetylation events regulating the expression of Rubisco genes are not well understood. In this study, to examine whether the rice histone acetyltransferase GENERAL CONTROL NON-REPRESSED PROTEINS (GCN5) regulates the expression of Rubisco genes, we produced *GCN5* knockout rices using the CRISPR/Cas9 system. We choosed two guide RNA spacer sequences corresponding to nucleotides 65-83 and 203-221 of the *GCN5* coding region. The two sequences were inserted into CRISPR/Cas9 expression vector pRGEB32 and designed as *KO1-GCN5* plasmid and *KO2-GCN5* plasmid, respectively. The plasmids were introduced into rice calluses through *Agrobacterium tumefaciens* (strain EHA105). Fourteen (6.4%) of 218 calluses infected with the Agrobacterium harbored the *KO1-GCN5* plasmid redifferentiated. Eight (57%) of the 14 redifferentiated individuals had mutations in the *GCN5* gene. The mutations included deletions of one to 159 bases and insertions of one or two bases. Five individuals (62.5%) of the eight mutants had frameshift mutations in one *GCN5* allele, and one individual (12.5%) had frameshift mutations in both *GCN5* alleles. The same results were obtained in calluses introduced the *KO2-GCN5* plasmid. There was no obvious phenotypic difference between the heterozygous knockout rice and the wild-type rice. Tiller number of the homozygous knockout rice was fewer than that of the wild-type rice. The homozygous knockout rice was smaller than the wild-type rice, suggesting that GCN5 regulates the growth of rice.