S5-1

Identification of plant-derived compounds regulating juvenile hormone receptor complex

Jae Young Choi[1] and Yeon Ho Je[1,2*]

[1]*Research Institute for Agriculture and Life Sciences, Seoul National University, Seoul 08826, Korea,*
[2]*Department of Agricultural Biotechnology, College of Agriculture & Life Science, Seoul National University, Seoul 08826, Korea*

Insects not only cause severe economic damage to agricultural products but also act as vectors of human diseases by carrying various pathogens. Insect growth regulators (IGRs) are attractive pest control agents due to their high target specificity and relative safety to the environment. Plants have been shown to synthesize IGRs that affect the insect juvenile hormone (JH) as a part of their defense mechanisms. Using a yeast two-hybrid system transformed with the *Aedes aegypti* JH receptor as a reporter system, we identified plant compounds that serve as JH agonists (JHAs) and antagonists (JHANs). These compounds affect the JH receptor, methoprene-tolerant (Met), by regulating formation of receptor complex with its partner protein, CYCLE or FISC. They showed high mosquitocidal activities with relatively low LC_{50} values and caused retardation in the ovarian development of female mosquitos. While the JHAs increased the expression of a JH-induced gene, the JHANs caused a reduction in the expression of the same gene. The compounds identified in this study could provide insights into plant-insect interactions and may be useful for the development of novel IGR insecticides.

S5-2

TmCactin plays an important role in Gram-negative and -positive bacterial infection by regulating expression of 7 AMP genes in *Tenebrio molitor*

Yong Hun Jo[1], Yu Jung Kim[2], Ki Beom Park[1], Jeong Hwan Seong[1], Soo Gon Kim[1], Soyi Park[1], Mi Young Noh[1], Yong Seok Lee[3] and Yeon Soo Han[1*]

[1]*Division of Plant Biotechnology, Institute of Environmentally-Friendly Agriculture (IEFA), College of Agriculture and Life Sciences, Chonnam National University, Gwangju 500-757, Korea,* [2]*Department of Chemistry and Biochemistry, College of Natural Sciences, California State University, San Bernardino, CA, 92407, USA,* [3]*Department Department of Life Science and Biotechnology, College of Natural Sciences, Soonchunhyang University, Asan 336-745, Korea*

Cactin was originally identified as an interactor of the Drosophila IκB factor Cactus and shown to play a role in controlling embryonic polarity and regulating the NF-κB signaling pathway. While subsequent studies have identified the roles for Cactin in the mammalian immune response, the immune function of Cactin in insects has not been described yet. Here, we identified a Cactin gene from the mealworm beetle, *Tenebrio molitor* (*TmCactin*) and characterized its functional role in innate immunity. TmCactin was highly expressed in prepupa to last instar stages, and its expression was high in the integument and Malpighian tubules of last instar larvae and adults. TmCactin was induced in larvae after infection with different pathogens and detectable within 3 hours of infection. The highest levels of TmCactin expression were detected at 9 hours post infection. TmCactin RNAi significantly decreased the survival rates of larvae after challenge with *Escherichia coli* and *Staphylococcus aureus*, but had no significant effect after challenge with *Candida albicans*. Furthermore, TmCactin RNAi significantly reduced the expression of seven antimicrobial peptide genes (AMPs) after bacterial challenge. Our results suggest that TmCactin may serve as an important regulator of innate immunity, mediating AMP responses against both Gram-positive and Gram
-negative bacteria in *T. molitor*.

S5-3

Development of new microbial biopesticides for resistant insect pest control

Taek Su Shin[1*], Tae Hyun Park[1], Tae Hoon Kim[1], Panjung Ha[1], Hae Woong Park[2], Jae Su Kim[3], Jin-Cheol Kim[4], Han-young Lee[1], Eul-Jae Myung[1]

[1]Crop Protection R&D Center, FarmHannong Co., Ltd, Korea, [2]R&D division, World Institute of Kimchi
[3]Department of Agricultural Biology, College of Agricultural & Life Sciences, Chonbuk National University,
[4]Division of Applied Bioscience & Biotechnology, Chonnam National University

The problem of resistance pests in domestic and overseas crop cultivation is not a problem in some areas. Many studies have been conducted to solve the problem of resistance to crop protection agents, which is a common problem in many regions. Among these studies, efforts to solve resistance pest problems using biocontrol agents using biocontrol agents have been made worldwide. Many researchers and companies are striving to develop core technologies and develop high-quality products by securing excellent biomaterials. Thrips worms and root-knot nematodes occur in a variety of crops, and have shown a great deal of damage to farm income every year, and the damage is increasing every year. In order to solve these problems, a variety of biological materials are used in Korea to develop a control agent. However, there are very few products available that can satisfy the consumer's satisfactory control effect, efficacy, formulation stability and pesticide compatibility. In order to propose a biological control solution to these problems, this study was conducted to develop the optimal bioprocess technology and formulations suitable for the material by transferring the *Aspergillus niger* F22 strain, which is effective for root - knot nematodes, at Chonnam National University. This study was conducted to investigate the efficacy of *Aspergillus niger* F22 20% suspension concentrate (Product name: NEMAFREE), which has excellent efficacy on root nematodes. The packing test result showed about 70-90% control effect. Soil fumigation and disinfection treatments after 4 days of planting were effective. In addition, we have developed a product to control the under powder pupa using *Beauveria bassiana* ERL 836, an insect pathogenic microorganism, which has excellent control effect against resistant insect pupa. The main purpose of this study was to investigate the effect of insect pests on the under poor control of the pupa in the soil. In the pavement test, more than 70% (GR) formulation, which can be treated with chemical pesticides, and it is confirmed that synergy effect is in the control of Thrips worm.

S5-4

Insect Ecology and Fungal Epizootics for Successful Pest Management

Jae Su Kim*, Se Jin Lee, Jong Cheol Kim, Sihyeon Kim, Mi Rong Lee, So Eun Park, Seok Ju Lee

Department of Agricultural Biology, College of Agricultural & Life Sciences, Chonbuk National University, Jeonju 561-756, Korea

Now we are trying to deal with problems in pest management, such as ecological toxicity of synthetic pesticides, increasing pest resistance and stronger pesticide regulation in many countries. As one of the solutions, many global companies have been merging and acquiring some biopesticide companies, Pasteuria, Agraquest, Prohphya, Itaforte, and Becker Underwood. Some collaborative works have been producing biopesticides with enhanced quality. In the R&D of microbial insecticides, bacterial and viral insecticides received many interests and outstanding commercial products have been developed. However little consideration has been given to the fungal insecticides, although this group has much higher potential in controlling hemipteran and thysanopteran insects by the hyphal penetration through the integument. High production cost of fungal insecticides might be a technical barrier. Application of the fungal insecticides to unfavorable conditions might result in lower performance in pest management. Herein this work, I suggest ecological biocontrol considering long-term colonization in nature rather than quick pest control. Additionally other important technical aspects need to be strongly considered, such as economic downstream process, effective control and environmentally safe, so finally proposing 4e-biopesticide. In terms of ecological biocontrol, entomopathogenic fungal pesticides can be applied to the soil and water in agricultural fields, water in urban cities and hydric areas in forest, where the use of synthetic pesticides is not easily accepted and getting disapproved before long. We have some achievements in the management of thrips and other pests. With this field-oriented works, our group is also working on fungal molecular biology to elucidate the mode of actions and interaction between insects and entomopathogenic fungi. This ecological biocontrol can be a strong background for successful development of fungal biopesticides.

S5-5

Nematicidal Activity of Grammicin Produced by *Xylaria grammica* KCTC 13121BP Against *Meloidogyne incognita*

Tae Yoon Kim[1], Ja Yeong Jang[1], Nan Hee Yu[1], Won Jae Chi[2], Chang-Hwan Bae[2], Joo Hong Yeo[2], Ae-Ran Park[1], Jae-Seon Hur[3], Hae Woong Park[4], Ji-Yeon Park[5], Jong-Hwan Park[5], Sung Ki Lee[6], and Jin-Cheol Kim[1*]

[1]Division of Applied Bioscience and Biotechnology, Institute of Environmentally Friendly Agriculture, College of Agriculture and Life Sciences, Chonnam National University, 77 Yongbong-ro, Buk-gu, Gwangju 61186, Republic of Korea, [2]Biological and Genetic Resources Assessment Division, National Institute of Biological Resources, 42 Hwangyeong-ro, Seo-gu, Incheon 404-170, Republic of Korea, [3]Korean Lichen Research Institute, Suncheon National University, 255 Jungang-ro, Suncheon 57922, Republic of Korea, [4]R&D Division, World Institute of Kimchi, 86 Kimchi-ro, Nam-gu, Gwangju 61755, Republic of Korea, [5]Laboratory Animal Medicine, College of Veterinary Medicine and BK21 PLUS Project Team, Chonnam National University, 77 Yongbong-ro, Buk-gu, Gwangju 61186, Republic of Korea, [6]Department of Obstetrics and Gynecology, College of Medicine, Konyang University, 158 Gwangeodong-ro, Seo-gu, Daejeon 35365, Republic of Korea

Xylaria grammica KCTC 13121BP, an endolichenic fungus, showed strong nematicidal activity against *Meloidogyne incognita*. Bioassay-guided fractionation and instrumental analyses led to grammicin being identified as the nematicidal metabolite. Several biological activities of grammicin and its mycotoxic isomer, patulin, were compared. Grammicin showed strong second-stage juvenile killing and egg-hatching inhibitory effects, with an $EC_{50/72\ h}$ value of 15.9 µg/mL and $EC_{50/14\ days}$ value of 5.87 µg/mL, respectively, whereas patulin was virtually inactive in both respects. However, patulin was strongly active toward various phytopathogenic bacteria *in vitro*, whereas grammicin was weakly so. Patulin at the concentration range of 0.1–10 µg/mL also showed dose-dependent cytotoxicity toward the human first-trimester trophoblast cell line SW.71, whereas grammicin was not toxic toward this cell line. In pot and field experiments, the wettable powder-type formulation and fermentation broth filtrate of *X. grammica* KCTC 13121BP effectively suppressed the development of root-knot nematode disease on tomato and melon plants. The results suggest that *X. grammica* and grammicin may be applicable to control root-knot nematode disease occurring on various crops.

S5-6

Agricultural Application of Chitinase- and Chitosanase-producing Bacteria

Dong-Jun Seo, Yong-Su Song, and Woo-Jin Jung*

Department of Agricultural Chemistry, Institute of Environmentally-Friendly Agriculture (IEFA), College of Agricultural and Life Science, Chonnam National University, Gwangju 61186, Korea

Chitin and chitosan have been obtained from crustacean shells such as crab shell and shrimp by chemical and biological process. Also chitin and chitosan oligosaccharides (COS) have been traditionally obtained by chemical digestion with strong hydrochrolic and sulfuric acids. Enzyme preparations with chitinase, chitosanase, and lysozyme are primarily used to hydrolyze chitin and chitosan. We are primarily concerned with the enzymatic hydrolysis of polysaccharides obtained from crustacean shells for the bioproduction of COS. We introduce the preparation and bioproduction of COS with enzymes from chitinase- and chitosanase-producing bacteria and fungi. Chitosan beads (CTB) and *Terminalia nigrovenulosa* bark (TNB) were prepared using chitosan powder combined with *T. nigrovenulosa* powder (TNP) and *T. nigrovenulosa* extract (TNE). The chitosan beads combined with TNB were tested for their antifungal activity against *Fusarium solani*. Chitosan was mixed with cinnamon powder (CP) and cinnamon extract (CE) to obtain chitosan-cinnamon powder (CCP) beads and chitosan-cinnamon extracted (CCE) beads, respectively. The potential antifungal and nematicidal activities of CCP and CCE were investigated against *Rhizoctonia solani* and *Meloidogyne incognita in vitro. Paenibacillus chitinolyticus* MP-306 bacterium was incubated in nine culture media [crab shell powder chitin (CRS), chitin-protein complex powder (CPC), carboxymethyl-chitin powder (CMC), yeast extract only (YE), LB (Trypton, NaCl, and yeast extract), GT (Trypton, NaCl, and glucose), crab shell colloidal chitin (CSC), squid pen powder chitin (SPC), and cicada slough powder chitin (CSP)] at 30°C for 3 days. *Bacillus cereus* MP-310 was incubated on various culture media substrates as LB, colloidal chitin, chitosan powder and chitosan beads to investigate the concurrent expression patterns of chitinase and chitosanase isozymes by SDS-PAGE.

S6-1

A Research of Pesticide Inspection for Safety management of Imported Food in Korea

Moo-Hyeog Im*

Department of Food Engineering, Daegu University, Korea

It is essential to establish database construction including Maximum Residue Limits for Pesticides (MRLs) and monitoring of pesticide residues from other countries for safety management of imported food since pesticides remained in agricultural products are various based on countries' weather or application methods and purposes. Because each countries do registration or cancelation of pesticides year round, their pesticide MRLs and monitoring data should be updated and applied to inspection of imported food at all the times. This study is designed to make a checklist of pesticide residues in imported agricultural products in Korea. At first, main exporters and their market share by imported agricultural products will be examined, and changes of imports will also be analyzed by years. Database will be constructed after analysis of monitoring data and reports from USA and Japan, Europe, and etc. In addition, database of pesticide residue detection condition in domestic and imported agricultural products will be built after studying and analyzing pesticide residue monitoring data from distribution and imported agricultural products of a recent 5-year period. Moreover, in order to investigate pesticide usage condition in world wide, establishment condition of MRLs from USA, Europe, Japan, China, Codex, and so on will be investigated by quarterly-base. The results will be utilized for pesticide residue inspection of imported agricultural products. Physical and chemical characteristics of about 700 pesticides will be examined. Their detection properties will also be compared and analyzed. Pesticide detection prediction program will be developed by newly established data base from Codex MRL. After completing data base construction, it will be used as basic data for selection of pesticide residue checklist by imported agricultural products in Korea.

S6-2

Pesticide residue monitoring system in England and Europe

Moo-Hyeog Im*

Department of Food Engineering, Daegu University, Korea

England pesticide residue monitoring data will be presented from 2015 annual report of Expert Committee on Pesticide Residues in Food (PRiF). This monitoring system is consisted with three categories. First, monitoring after food distribution is conducted quarterly-base (Brand Name Annex), second is for fruits and vegetables consumed in school. The last is industry monitoring reports based on self inspection. Since industry monitoring is performed before food distribution for food quality control, it is clear that food in excess of pesticide MRLS is not sold to consumers. EU requires safety management for pesticide residue in food to all EU members. After reports of analytical results are submitted to European Food Safety Authority (EFSA), EFSA makes final reports. When the results are reported, they have to follow the guidelines including prodCode, prodTreatCode, actTakenCode, and resType. Final reports are announced 2-3 years later. When EU member nations give notification of incongruent results, EFSA updates the results by RASFF Potal in real time. EU members are Austria, Belgium, Bulgaria, Croatia, Cyprus, Czecho, Denmark, Estonia, Finland, France, Germany, Greece, Hungari, Iceland, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Norway, Protugal, Rumania, Slovakia, Slovenia, Spain, Sweden, and England.

S6-3

Pesticide residue monitoring system in USA and Japan

Kun-Sang Park[1], Yu-Jeong Ji[2], Yu-Jeong Lee[2], Myoung-Seok Kim[2], Seo-Hong Kim[3], Moo-Hyeog Im[2*]

[1]Korea Food Safety Association, [2]Department of Food Engineering, Daegu University, Korea,
[3]Department of Environmental and Biological Chemistry, Chungbuk National University, Korea

Department of Agriculture (USDA) and Department of Health and Human Services (DHHS) take charge of pesticide residue monitoring in USA. Specially Food and Drug Administration (FDA) in DHHS performs regulation monitoring in order to control pesticides MRL from imported products and domestic food except meat, poultry, and processed egg products (these will be monitored by Food Safety Inspection Service in USDA). It also conducts pesticide residual incidence/level monitoring and total diet study as well. Since 1991 Agricultural Marketing Service and U.S. State Government conduct Pesticide Data Program(PDP) on agricultural products. In Japan, Imported Foods Inspection Services in Ministry of Health, Labor, and Welfare conducts pesticide residue test for imported products and follows the inspection guidelines. It is consisted with inspection, order inspection, monitoring inspection, and independent inspection. Violated food after inspection will be seized, searched, or discarded constrainingly.