





The Apicultural Society of Korea  
<https://bee.or.kr>

2024년 2월 19일(월) ~ 21일(수)  
서울대학교 호암교수회관

2024년 제40차

# 한국양봉학회 정기총회 및 COLOSS Asia 국제학술대회

꿀벌의 건강과 지속가능한 양봉산업을 위한 공적기능 강화

40th Annual Meeting of Apicultural Society of Korea,  
with the International Conference of COLOSS Asia 2024

Bee Health and Sustainable Beekeeping for Public Benefit



한국양봉학회  
THE APICULTURAL SOCIETY OF KOREA

주관



한국양봉학회



국립농업과학원



국립안동대학교

농업과학기술연구소



서울대학교



COLOSS Asia



Asian Apicultural Association

후원



한국양봉협회



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인바이러스테크

래티스





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윤희주(동아대학교)



# 행사일정표

## Program

날 짜	시 간	무궁화홀(2F)	목련홀(1F)	수련홀(1F)	
2월 19일 (월)	12:00-	등 록			
	13:00-13:30	총 회			
	13:30-14:00	개회식 : 개회사, 축사, 공로상 및 학술상 시상			
	14:00-14:10	Special Talk I(무궁화홀) : 김정옥 국장(농림축산식품부 축산정책관)			
	14:10-14:50	기조강연 I : 무궁화홀 좌장 : 이명렬 교수(인천대)			
		Beekeeping in a changing world, new pests and more! Dr. Jeff Pettis (APIMONDIA President)			
	14:50-15:00	휴 식			
	15:00-15:30	초청강연 1 좌장 : 김혜경 교수(한농대) Prof. Huoqing Zheng	15:00-16:10 Bee Product 양봉산물 좌장 : 우순옥 박사(농과원) [구두발표 5]	Symposium I 디지털양봉의 현재와 미래  좌장 : 김동원 박사(농과원)  [구두발표 10]	
		15:30-17:00	Bee Health I 꿀벌 병해충 I  좌장 : 김혜경 교수(한농대) [구두발표 6]		16:10-16:40 초청강연 2 좌장 : 우순옥 박사(농과원) Dr. Bajaree Chuttong
	휴 식				
	Special Talk II(무궁화홀) : 이용권 과장(산림청 산림자원과)				
	17:20-18:00	기조강연 II : 무궁화홀 좌장 : 최용수 박사(농과원)			
		Development of RNAi method to control Varroa destructor: lethal effects of knockdown of coatomer proteins Prof. Keon Mook Seong (Chungnam National University)			
18:30-	간 친 회				
2월 20일 (화)	09:00-09:30	초청강연 3. Bee Health II 좌장 : 김기영 교수(경희대)  Dr. Norman L Carreck	초청강연 4. 좌장 : 이경용 박사(농과원)  Prof. Lekhnath Kafle	Symposium IV 좌장 : 길익준 교수(안동대)  Honeybee Viruses and Pathogens with COLOSS VTF	
		Bee Health II 꿀벌 병해충 II 좌장 : 김기영 교수(경희대) [구두발표 3]	Pollination Honey Plant 화분매개 및 밀원식물 좌장 : 이경용 박사(농과원) [구두발표 3]	초청강연 5  Delphine Panziera	
	10:10-10:20	휴 식			
	10:20-11:40	Bee Health II 꿀벌 병해충 II 좌장 : 유미선 박사(검역본부) [구두발표 6]	Bee Biology 꿀벌 생리 좌장 : 이광식 교수(동아대) [구두발표 5]	[구두발표 7]	
	11:40-12:00	Poster Presentation			
	12:00-13:30	점심식사			
	13:30-14:10	기조강연 III : 무궁화홀 좌장 : 정철의 교수(안동대) The chemosensory machinery of the Varroa mite Dr. Victoria Soroker (Chair of COLOSS Varroa TF)			
		휴 식			
	14:20-16:50	Symposium II 산림밀원의 확대 및 공적 기능 강화 좌장 : 이승환 교수(서울대)  초청강연 6 Angus McPherson 좌장 : 나성준 박사(산림과학원) 최영임 박사(산림과학원) [구두발표 8]	Symposium III 꿀벌질병 좌장 : 유미선 박사(검역본부)  [구두발표 6]	Beekeeping 사양관리 좌장: 정제원 교수(경성대)  [구두발표 9]	
		폐 회 식			
		2월 21일 (수)	09:00-17:00 Technical Tour : 화분매개시설농가 - 양봉농가 - 양봉농협		

# 세부일정표

## 무궁화홀

시 간	무궁화홀 2월 19일 (월)	
12:00-13:00	등 록	
13:00-13:30	제40차 한국양봉학회 정기총회	
13:30-14:00	[개회식] 사 회 : 김혜경 총무이사(한농대) 개회사 : 한국양봉학회 정철의 회장 축 사 : 국립농업과학원 이상재 부장, (사)한국양봉협회 윤화현 회장, (사)한국한봉협회 윤관로 회장, 한국양봉농협 김용래 조합장 시 상 : 40주년 공로상 및 학술상 시상	
14:00-14:10	Special Talk I. 김정옥(농림축산식품부 축산정책관)	
14:10-14:50	기조강연 I. Dr. Jeff Pettis (APIMONDIA President) Beekeeping in a changing world, new pests and more! 좌장 : 이명렬 교수(인천대)	
14:50-15:00	휴 식	
15:00-15:30	초청강연 I. Prof. Huoqing Zheng (Zhejiang University, China) Filling gaps in the understanding of the relationship between <i>Varroa spp.</i> and <i>Apis cerana</i> 좌장 : 김혜경교수(한농대)	
15:30-17:00	꿀벌 병해충 I. 좌장 : 김혜경 교수(한농대)	
	O-1	The influence of <i>Varroa destructor</i> on virus infection of honeybees from the perspective of virome analysis Ruike Wei, Zhejiang University
	O-2	Acaricidal susceptibility of <i>Varroa destructor</i> and <i>Tropilaelapsmercedesae</i> in <i>Apis mellifera</i> colonies Hyunha Oh, Andong National University
	O-3	Acaricidal Activity of major component from <i>Cymbopogon citratus</i> in Combination with Other Monoterpenes, on <i>Varroa destructor</i> and Honey bees TekalignBegna, Andong National University
	O-4	Development of a Multiplex RT-PCR Diagnostic Method for the Predominant Three Species of Honey Bee Viruses in Uzbekistan So-yoon Jang, Andong National University
	O-5	Development and Application of RT-RPA Based Detection Methods for the Diagnosis of Bee Viruses Man-Cheol Son, Andong National University
17:00-17:10	휴 식	
17:10-17:20	Special Talk II : 이용권 과장(산림청 산림자원과)	
17:20-18:00	기조강연 II. 성건목 교수(충남대학교) Development of RNAi method to control <i>Varroa destructor</i> : lethal effects of knockdown of coatomer proteins 좌장 : 최용수 박사(농과원)	
18:30-	간 친 회	
시 간	무궁화홀 2월 20일 (화)	
09:00-09:30	초청강연 III. Dr. Norman L Carreck (Carreck Consultancy Ltd.) The COLOSS association and the BEEBOOK project 좌장 : 김기영 교수(경희대)	
	꿀벌병해충 II. 좌장 : 김기영 교수(경희대)	
09:30-10:10	O-12	The task forces of the COLOSS association and its missions Victoria Soroker, Agricultural Research Organization, Israel
	O-13	Taxonomic notes on parasitic mites on honeybee in Korea Jaeseok Oh, Seoul National University
	O-14	The larvae of greater wax moth, <i>Galleria mellonella</i> affects the health of adult honeybees Yanling Xie, Zhejiang University, China

10:10-10:20	휴 식	
10:20-11:40	꿀벌병해충 II. 좌장 : 유미선 박사(검역본부)	
	O-15	Potential control of <i>Vespa velutinanigrithorax</i> using sex pheromone Dongueui Hong, Andong National University
	O-16	Phenological and compositional changes of <i>Vespa</i> species from the long term monitoring data in Korea SeongbinBak, Andong National University
	O-17	Effects of imidacloprid on Hypopharyngeal glands and GST isoenzyme profile Fani Hatjina, EllinikosGeorgikosOrganismos 'DIMITRA', Greece
	O-18	Enhancing Honeybee Resilience: Curcumin as an Antidote to Mitigate Carbaryl-Induced Harm and Promote Sustainable Pollination Saeed MohamadzadeNamin, Andong National University
	O-19	Exploring the Impact of Different Carbohydrate Types on Honeybee Longevity and Hypopharyngeal Gland Dimensions ArezoNajarpour, Andong National University
	O-20	Identifying Effects and Markers Related to <i>Apis mellifera</i> ligustica Honey Bee Health Olga Frunze, Incheon National University
11:40-12:00	Poster Presentation (무궁화홀 로비)	
12:00-13:30	점심식사	
13:30-14:10	기조강연 III. Victoria Soroker (Agricultural Research Organization, Israel) The chemosensory machinery of the Varroa mite 좌장 : 정철의교수(안동대)	
14:10-14:20	휴 식	
14:20-16:50	심포지엄 II. 산림밀원의 확대 및 공적 기능 강화 좌장 : 나성준 박사(산림과학원), 최영임 박사(산림과학원)	
	초청강연 VI. Angus McPherson (NZ Trees for Bees Research Trust) Designing and Establishing Multi-function Bee Forage Planting to Support Beekeepers and Farmers 좌장 : 이승환교수(서울대),	
	S-11	Major honey plants in the central region of Korea, evaluated by foraging preferences of honeybees Seunghun Jung, Seoul National University
	S-12	Threats to Honeybee: Investigation of Potential Predators in Apiary Jong-Hwa Oh, Seoul National University
	S-13	Habitat Suitability Assessment of Major Honey Tree Species in Mt. Gariwang and Mt. Yumeong Yong-Ju Lee, Kookmin University
	S-14	Economic valuation of pollination resources in national forests of Mt. Gariwang and Mt. Yumyeong relative to beekeeping Kwanhui Lee, Andong National University
	S-15	Development of evaluation indicators and case application research for the creation of honey plant complex Sora Kim, Korea Forest Conservation Association
	S-16	Proposals for the Expansion of Honey Plant Complexes in Korea Sung-Joon Na, National Institute of Forest Science
	S-17	Effects of Rising Winter Temperatures and Day Length on Spring Flowering Time in Future Warm Climates Sukyung Kim, Seoul National University
	S-18	A report on changes in spring flowering duration of seven Korean tree species over the last 52 years and the potential resultant effect at the community-level Min-Jung Kim, National Institute of Forest Science
17:00-	[폐회식] 사 회 : 김혜경 총무이사(한농대) 폐회사 : 한국양봉학회 정철의 회장 시 상 : 우수논문상 시상	

## 세부일정표

목련홀

시 간	목련홀 2월 19일 (월)	
15:00-16:10	양봉산물 좌장 : 우순옥 박사(농과원)	
	O-7	Evaluating Royal Jelly Quality from Korean Commercial Apiaries and Analyzing the Nutrient Content impact of Honey bee Feed Sampat Ghosh, Andong National University
	O-8	Unveiling Floral Diversity and Nutritional Profiling of Bee Pollens from Uzbekistan Sukjun Sun, Andong National University
	O-9	Characterization of volatile compound detected in drone pupa ( <i>Apis mellifera</i> L.) fat extract Seonmi Kim, National Institute of Agricultural Science
	O-10	The R&D of immunity strengthening functional propolis products by the water-soluble cocktail method Hadong Kim, Seoul Propolis Co., Ltd. R&D Center
	O-11	Pancreatic cancer cell death and blood sugar regulation by propolis and honey mixture Kim Sung-Kuk, National Institute of Agricultural Science
16:10-16:40	초청강연 II. Dr. Bajaree Chuttong (Chiang Mai University, Thailand) Guidelines for establishing a quality standard for honey produced by the stingless bee genus <i>Tetragonula</i> in Thailand 좌장 : 우순옥박사(농과원)	
시 간	목련홀 2월 20일 (화)	
09:00-09:30	초청강연 IV. Prof. Lekhnath Kafle (National Pingtung University, Taiwan) Efficacy of probiotic and prebiotic supplements on honeybee productivity and strength	
09:30-10:10	화분매개 및 밀원식물 좌장 : 이경용 박사(농과원)	
	O-21	Assessing niche overlap of bees, butterflies, and hoverflies in plant-pollinator networks Ehsan Rahimi, Andong National University
	O-22	Environmental Big Data based Implementation of the Honey Production Environment Grade Map Jea-Chul Kim, AirTech Inc
	O-23	주요 밀원식물 찰피나무의 특성과 우량개체 선발 김세현, 순천대학교
10:10-10:20		휴 식
10:20-11:30	꿀벌생리 좌장 : 이광식 교수(동아대)	
	O-24	Stingless Bees Tongue Morphology is Different Compared to Honeybees Sarah Najiah Ramli, Universiti Malaysia Terengganu, Malaysia
	O-25	Morphological Exploration of <i>Apis cerana</i> with different colors in South Korea Hyeonjeong Jang, Andong National University
	O-26	Honeybee genetic resource and national diffusion system in Korea Chang-hoon Lee, National Institute of Agricultural Science, RDA
	O-27	Predictive Modeling of Honeybee Winter Mortality in Response to weather Anomalies : Utilizing 'Honeybee Meteorological Index' Sunghyun Min, National Institute of Agricultural Science
	O-28	Comparison of the expression levels of cytochrome P540 monooxygenases between <i>Apis cerana</i> and <i>Apis mellifera</i> (Hymenoptera: Apidae) in response to various insecticides Youngcheon Lim, Seoul National University

11:30-12:00	Poster Presentation (무궁화홀 로비)	
12:00-13:30	점심식사	
13:30-14:20	휴 식	
14:20-16:50	심포지엄 III. 꿀벌질병   좌장 : 유미선박사(검역본부)	
	S-19	Evaluation of efficacy of lactic acid bacteria from Honeybee for American foulbrood and Nosemosis Mi-Sun Yoo, Animal and Plant Quarantine Agency
	S-20	Prevalence and Trends of Honeybee Diseases in the Republic of Korea Thi-Thu Nguyen, Animal and Plant Quarantine Agency
	S-21	Point-of-care-testing 기법에 의한 꿀벌질병 진단 최옥란, (주)진시스템
	S-22	Efficacy of complex plant extracts (Winning bee plus) for varroa mite Sung-Min Lee, CTC VAC
	S-23	꿀벌의 주요 법정 감염병에 대한 현장용 분자진단법 개발 및 임상평가 천두성, 포스트바이오(주)
	S-24	Association between Honeybee ( <i>Apis mellifera</i> L.) diseases and CCD in Korea Juhaeng Heo, Korea Apicultural Agriculture Cooperative

# 세부일정표

수련홀

시 간	수련홀 2월 19일 (월)	
15:00-17:00		심포지엄 I. 디지털양봉의 현재와 미래 좌장 : 김동원 박사(농과원)
	S-1	Controlling vespa velutina nest using drone Su-Bae Kim, National Institute of Agricultural Sciences, RDA
	S-2	비주얼 카메라를 이용한 등검은말벌집 탐색 최인찬, 국립농업과학원 농업공학부
	S-3	Development of Unmanned Aerial Vehicles-based Wasp Tracking and Habitat Search Technology Bosung Kim, Chonnam National University
	S-4	딥러닝 기반 말벌탐지 및 모니터링 이철희, 안동대 컴퓨터공학과
	S-5	지속가능한 양봉산업을 위한 디지털 양봉 기술 현황과 전망 정원기, 농업회사법인 ㈜온팜
	S-6	꿀벌 해충 관리를 위한 공학기술의 접목 Changyeun Mo, Kangwon National University
	S-7	Current Status and Perspectives of Intelligent Beekeeping Management Device Developments Xiongzhe Han, Kangwon National University
	S-8	Conditions and functions of smart honey bee house for overwintering study Yongrak Kang, Andong National University
	S-9	Utilizing Sensing Technology for Honeybee Colony Monitoring Byoung-Jo Choi, Incheon National University
	S-10	Utilization of ChatGPT in Beekeeping Industry and Apiculture Research 오대근, National Institute of Agricultural Science
시 간	수련홀 2월 20일 (화)	
09:00-11:30		심포지엄 IV. Honeybee Viruses and Pathogens (with COLOSS Virus TF) 좌장 : 길의준 교수(안동대)
		초청강연 V. Delphine Panziera (Wageningen University & Research) Chronic bee paralysis and winter mortality in the Netherlands
	S-25	Is commercial trade of queens a way for virus spread? Anne Bonjour-Dalmon, INRAE, Bees and the Environment research department, France
	S-26	Habitat structure and virome examination in newly field-exposed bumble bees Orlando Yañez, University of Bern, Switzerland
	S-27	RNAi as a honeybee virus repressor: case studies and potentials June-Sun Yoon, Jeonbuk National University
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	S-30	Unveiling Novel and Unreported Honeybee Viruses in South Korea, 2023: A Fresh Perspective on Beekeeping Epidemiology Minhyeok Kwon, Andong National University



	S-31	Harnessing the Bee Virome: A Novel Tool for Unearthing Unreported and Emerging Plant Viruses Jiho Jeon, Andong National University
11:30-12:00	Poster Presentation (무궁화홀 로비)	
12:00-13:30	점심식사	
13:30-14:20	휴 식	
14:20-16:50	사양관리 좌장 : 정제원 교수(경성대)	
	O-29	Conservation of honey bees in Britain and Ireland Norman L Carreck, Carreck Consultancy Ltd., United kongdom
	O-30	Stingless bee-friendly garden for the sustainability of beehives Norasmah Basari, Universiti Malaysia Terengganu, Malaysia
	O-31	Robotic System Design In Royal Jelly Production Sedat Sevin, Ankara University, Turkiye
	O-32	Responses of the Climate Change impact on <i>Apis cerana</i> beekeeping in Korea Yeonjeong Lee, Andong National University
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# Program

Mugunghwa Hall

Time	Mugunghwa Hall 2024-02-19 (Mon)	
12:00-13:00	Registration	
13:00-13:30	40th Annual Meeting of Apicultural Society of Korea	
13:30-14:00	Opening Ceremony	
14:00-14:10	Special Talk I: Jung-sook Kim (Ministry of Agriculture, Food and Rural Affairs, Livestock Policy Division, Director General)	
14:10-14:50	Plenary Lecture I. Dr. Jeff Pettis (APIMONDIA President) Beekeeping in a changing world, new pests and more!	
14:50-15:00	Coffee Break	
15:00-15:30	Invited Lecture I. Prof. Huoqing Zheng (Zhejiang University, China) Filling gaps in the understanding of the relationship between <i>Varroa spp.</i> and <i>Apis cerana</i>	
15:30-17:00	Bee Health I.	
	O-1	The influence of <i>Varroa destructor</i> on virus infection of honeybees from the perspective of virome analysis Ruikue Wei, Zhejiang University
	O-2	Acaricidal susceptibility of <i>Varroa destructor</i> and <i>Tropilaelaps mercedesae</i> in <i>Apis mellifera</i> colonies Hyunha Oh, Andong National University
	O-3	Acaricidal Activity of major component from <i>Cymbopogon citratus</i> Combination with Other Monoterpenes, on <i>Varroa destructor</i> and Honey bees Tekalign Begna, Andong National University
	O-4	Development of a Multiplex RT-PCR Diagnostic Method for the Predominant Three Species of Honey Bee Viruses in Uzbekistan So-yoon Jang, Andong National University
	O-5	Development and Application of RT-RPA Based Detection Methods for the Diagnosis of Bee Viruses Man-Cheol Son, Andong National University
	O-6	The role of vaccination in sustainable hive health: a One Health discussion Nigel Swift, Dalan Animal Health, USA
17:00-17:10	Coffee Break	
17:10-17:20	Special Talk II: Yong-Kwon Lee (Forest Resources Division, Deputy Director General / Ph.D)	
17:20-18:00	Plenary Lecture II. Prof. Keon Mook Seong (Chungnam National University) Development of RNAi method to control <i>Varroa destructor</i> : lethal effects of knockdown of coatomer proteins	
18:30-	Conference Dinner	
Time	Mugunghwa Hall 2024-02-20 (Tue)	
09:00-09:30	Invited Lecture III. Norman L. Carreck (Carreck Consultancy Ltd.) The COLOSS association and the BEEBOOK project	
09:30-10:10	Bee Health II.	
	O-12	The task forces of the COLOSS association and its missions Victoria Soroker, Agricultural Research Organization, Israel
	O-13	Taxonomic notes on parasitic mites on honeybee in Korea Jaeseok Oh, Seoul National University
	O-14	The larvae of greater wax moth, <i>Galleria mellonella</i> affects the health of adult honeybees Yanling Xie, Zhejiang University, China

10:10–10:20	Coffee Break	
10:20–11:40	Bee Heath II	
	O–15	Potential control of <i>Vespa velutinanigrithorax</i> using sex pheromone Dongueui Hong, Andong National University
	O–16	Phenological and compositional changes of <i>Vespa</i> species from the long term monitoring data in Korea SeongbinBak, Andong National University
	O–17	Effects of imidacloprid on Hypopharyngeal glands and GST isoenzyme profile Fani Hatjina, EllinikosGeorgikosOrganismos 'DIMITRA', Greece
	O–18	Enhancing Honeybee Resilience: Curcumin as an Antidote to Mitigate Carbaryl-Induced Harm and Promote Sustainable Pollination Saeed MohamadzadeNamin, Andong National University
	O–19	Exploring the Impact of Different Carbohydrate Types on Honeybee Longevity and Hypopharyngeal Gland Dimensions ArezoNajarpour, Andong National University
	O–20	Identifying Effects and Markers Related to <i>Apis mellifera ligustica</i> Honey Bee Health Olga Frunze, Incheon National University
11:40–12:00	Poster Presentation (Mugunghwa Hall Lobby)	
12:00–13:30	Lunch	
13:30–14:10	Plenary Lecture III. Victoria Soroker (COLOSS Varroa TF, Israel) The chemosensory machinery of the Varroa mite	
14:10–14:20	Coffee Break	
14:20–16:50	Symposium II. Expanding honey forest and enhancing public service	
	Invited Lecture VI. Angus McPherson (NZ Trees for Bees Research Trust) Designing and Establishing Multi-function Bee Forage Planting to Support Beekeepers and Farmers	
	S–11	Major honey plants in the central region of Korea, evaluated by foraging preferences of honeybees Seunghun Jung, Seoul National University
	S–12	Threats to Honeybee: Investigation of Potential Predators in Apiary Jong-Hwa Oh, Seoul National University
	S–13	Habitat Suitability Assessment of Major Honey Tree Species in Mt. Gariwang and Mt. Yumeong Yong-Ju Lee, Kookmin University
	S–14	Economic valuation of pollination resources in national forests of Mt. Gariwang and Mt. Yumyeong relative to beekeeping Kwanhui Lee, Andong National University
	S–15	Development of evaluation indicators and case application research for the creation of honey plant complex Sora Kim, Korea Forest Conservation Association
	S–16	Proposals for the Expansion of Honey Plant Complexes in Korea Sung-Joon Na, National Institute of Forest Science
	S–17	Effects of Rising Winter Temperatures and Day Length on Spring Flowering Time in Future Warm Climates Sukyung Kim, Seoul National University
	S–18	A report on changes in spring flowering duration of seven Korean tree species over the last 52 years and the potential resultant effect at the community-level Min-Jung Kim, National Institute of Forest Science
17:00–	Closing Ceremony	

# Program

Mokryon Hall

Time	Mokryon Hall 2024-02-19 (Mon)	
15:00-16:10	Bee Product	
	O-7	Evaluating Royal Jelly Quality from Korean Commercial Apiaries and Analyzing the Nutrient Content impact of Honey bee Feed Sampat Ghosh, Andong National University
	O-8	Unveiling Floral Diversity and Nutritional Profiling of Bee Pollens from Uzbekistan Sukjun Sun, Andong National University
	O-9	Characterization of volatile compound detected in drone pupa ( <i>Apis mellifera</i> L.) fat extract Seonmi Kim, National Institute of Agricultural Science
	O-10	The R&D of immunity strengthening functional propolis products by the water-soluble cocktail method Hadong Kim, Seoul Propolis Co., Ltd. R&D Center
	O-11	Pancreatic cancer cell death and blood sugar regulation by propolis and honey mixture Kim Sung-Kuk, National Institute of Agricultural Science
16:10-16:40	Invited Lecture II. Dr. Bajaree Chutong (Chiang Mai University, Thailand) Guidelines for establishing a quality standard for honey produced by the stingless bee genus <i>Tetragonula</i> in Thailand	
Time	Mokryon Hall 2024-02-20 (Tue)	
09:00-09:30	Invited Lecture IV. Prof. Lekhnath Kafle (National Pingtung University, Taiwan) Efficacy of probiotic and prebiotic supplements on honeybee productivity and strength	
09:30-10:10	Pollination & Honey Plants	
	O-21	Assessing niche overlap of bees, butterflies, and hoverflies in plant-pollinator networks Ehsan Rahimi, Andong National University
	O-22	Environmental Big Data based Implementation of the Honey Production Environment Grade Map Jea-Chul Kim, AirTech Inc
	O-23	The characteristics of <i>Tilia mandshurica</i> Rupr.&Maxim. as major honey plants and the selection of superior tree Sea Hyun Kim, Sunchon National University / Korea Forest Research Institute
10:10-10:20	Coffee Break	
10:20-11:30	Bee Biology	
	O-24	Stingless Bees Tongue Morphology is Different Compared to Honeybees Sarah Najiah Ramli, Universiti Malaysia Terengganu, Malaysia
	O-25	Morphological Exploration of <i>Apis cerana</i> with different colors in South Korea Hyeonjeong Jang, Andong National University
	O-26	Honeybee genetic resource and national diffusion system in Korea Chang-hoon Lee, National Institute of Agricultural Science, RDA
	O-27	Predictive Modeling of Honeybee Winter Mortality in Response to weather Anomalies : Utilizing 'Honeybee Meteorological Index' Sunghyun Min, National Institute of Agricultural Science
	O-28	Comparison of the expression levels of cytochrome P540 monooxygenases between <i>Apis cerana</i> and <i>Apis mellifera</i> (Hymenoptera: Apidae) in response to various insecticides Youngcheon Lim, Seoul National University

11:30-12:00	Poster Presentation (Mugunghwa Hall Lobby)	
12:00-13:30	Lunch	
13:30-14:20	Coffee Break	
14:20-16:50	Symposium III. Control of infectious diseases in honeybee	
	S-19	Evaluation of efficacy of lactic acid bacteria from Honeybee for American foulbrood and Nosemosis Mi-Sun Yoo, Animal and Plant Quarantine Agency,
	S-20	Prevalence and Trends of Honeybee Diseases in the Republic of Korea Thi-Thu Nguyen, Animal and Plant Quarantine Agency,
	S-21	Diganosis of Honeybee Disease using Point-of-care-testing technique Choi, Ok Ran, Genesystem Co., Ltd.
	S-22	Efficacy of complex plant extracts (Winning bee plus) for varroa mite Sung-Min Lee, CTC VAC
	S-23	Development and Clinical Evaluation of Point of Care qPCR for Notifiable Infectious Diseases of Bee Doo-Sung Cheon, DVM, PhD., POSTBIO Inc
	S-24	Association between Honeybee ( <i>Apis mellifera</i> L.) diseases and CCD in Korea Juhaeng Heo, Korea Apicultural Agriculture Cooperative

Time	Suryon Hall 2024-02-19 (Mon)	
15:00–17:00	Symposium I. The current Status and Future Prospects of Digital (smart) Beekeeping	
	S-1	Controlling <i>vespa velutina</i> nest using drone Su-Bae Kim, National Institute of Agricultural Sciences, RDA
	S-2	<i>Vespa Velutina</i> Nest Detection using Visual Camera Inchan Choi, National Institute of Agricultural Sciences
	S-3	Development of Unmanned Aerial Vehicles-based Wasp Tracking and Habitat Search Technology Bosung Kim, Chonnam National University
	S-4	Vespa detection and monitoring based on deep learning model Cheolhee Lee, Department of Computer Engineering, Andong National University
	S-5	Status and the Prospect of Smart Beekeeping for Sustainable Apiculture Won-ki Chung, Onfarm Corp.
	S-6	Application of engineering technology for honey bee pest management Changyeun Mo, Kangwon National University
	S-7	Current Status and Perspectives of Intelligent Beekeeping Management Device Developments Xiongzhe Han, Kangwon National University
	S-8	Conditions and functions of smart honey bee house for overwintering study Yongrak Kang, Andong National University
	S-9	Utilizing Sensing Technology for Honeybee Colony Monitoring Byoung-Jo Choi, Incheon National University
	S-10	Utilization of ChatGPT in Beekeeping Industry and Apiculture Research Daegeun Oh, National Institute of Agricultural Science
Time	Suryon Hall 2024-02-20 (Tue)	
09:00–11:30	Symposium IV. (Honeybee Viruses and Pathogens (with COLOSS Virus TF))	
	Invited Lecture V. Delphine Panziera (Wageningen University & Research) Chronic bee paralysis and winter mortality in the Netherlands	
	S-25	Is commercial trade of queens a way for virus spread? Anne Bonjour-Dalmon, INRAE, Bees and the Environment research department, France
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한국양봉학회 회원 여러분,  
안녕하십니까?  
한국양봉학회 회장 정철의입니다.



입춘과 설을 보내면서 꿀벌이 활동하는 시기가 다가옵니다.

올해도 월동 꿀벌의 폐사 문제가 보고되고 있으나, 그래도 지난 해 보다는 나은 것 같습니다.

오늘은 우리 한국양봉학회가 40주년이 되는 자리입니다. 1985년 서울대 농대에서 고 최승윤 교수님을 비롯한 많은 양봉선배님들이 시작한 이래, 우리 학회의 발전을 위해서 애써주시고 격려해주신 많은 회원 여러분들과 양봉 산업체 관계자 여러분들께 깊이 감사드립니다.

우리 학회는 그간 양적으로 질적으로 큰 성장을 보여왔습니다. 2010년 아시아 양봉 대회, 2015년 세계 양봉 대회 등을 거치며 우리나라의 양봉 산업과 양봉 과학이 세계와 견줄만한 수준으로 다가가고 있습니다. 학회 회원의 숫자도 사백여 명 이상으로 늘어나고, 년 2회 이상의 학술대회를 통해 새로운 과학적 탐구와 실용 기술 개발을 주도하고 있습니다. 2019년 양봉산업육성법 제정, 2021년 농촌진흥청 농업과학원 내에 양봉생태과 설립에도 영향을 기여했습니다. 학회에서 발간하는 학술지는 년 4권으로 확대 발간하면서 아시아양봉협회 공식 학술지로 인정을 받고 있으며, 최근 뉴스레터를 통해 회원들간의 의사소통을 더해 가고 있습니다.

그 와중에 우리나라 양봉산업은 세계 10위권의 규모로 발전하였습니다. 회원 여러분, 정책입안과 수행자, 산업체 관계자 여러분께 다시 한번 감사드립니다.

40주년을 기념하며, 감사의 기회를 갖고자 합니다. 최근 산림밀원자원의 활용의 길을 터 주신 산림청 남성현 청장님, 꿀벌의 겨울철 대량폐사 사건 등의 문제를 슬기롭게 해결할 수 있게 조율해 주신 농림부 축산정책관 김정욱 국장님, 학회의 방향과 길을 이끌어 주신 우건석, 마영일, 윤병수 전임 회장님, 산업체에서 오금석 대표님, 현장기술 지도를 담당해 주신 김안식 지도관님 특별히 감사의 인사를 전합니다.



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또한 올해부터 산업체의 후원을 받고 우리 학회에서도 격년제로 대한민국 양봉 학술상을 시상할 수 있게 되었습니다. 감사드립니다.

학술활동을 장려하기 위해 5월 20일 세계벌의날 기념 학술우수상 등을 제정하여 운영하였으며, 올해부터 산업체의 후원을 받아 우리 학회에서도 격년제로 대한민국 양봉 학술상을 시상할 수 있게 되었습니다. 연구 활성화에 더 큰 힘이 되겠습니다. 감사합니다.

그리고 항상 우리 학회를 지원해 주시는 한국양봉협회 윤화현 회장님, 한국한봉협회 윤관로 회장님, 한국양봉조합 김용래 조합장님, 농업과학기술원 이승돈 원장님과 이상재 부장님께도 감사드립니다.

이번 학술대회는 COLOSS라고 하는 국제 꿀벌 연구연합과 함께 국제학회로 진행하게 됩니다. 기조 강연을 맡아 주신 Jeff Pettis 아피몬디아 회장님, Victoria Soroker 콜로스 분과장님, 성건목 충남대학교 교수님 감사드립니다. 그리고 이번 COLOSS Asia를 같이 준비해 주신 중국 저장대학 Zheng Houqing 교수께도 감사드립니다. AAA회장 Wongsiri 교수와 COLOSS 회장인 Peter Neuman 교수는 일정상 참여치 못해 화상으로 응원해 주었습니다.

최근 양봉 환경이 나쁘다고 하지만 이러한 어려움 속에서도 새로운 돌파구를 찾아나갈 수 있는 것이 우리 양봉의 저력이라고 생각합니다. 이번 학회에는 "꿀벌의 건강과 지속가능한 양봉산업을 위한 공적기능 강화"라는 주제로 다양한 방면에 논의를 진행해 보고자 합니다.

2박3일의 일정으로 학술대회와 현장견학을 준비했습니다.

여러분들의 많은 기대와 관심 그리고 참여를 부탁드립니다.

그리고 우리나라의 꿀벌 산업이 더욱 번성할 수 있기를 기대합니다.

감사합니다.

2024년 02월 19일

한국양봉학회 회장 정 철 의

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축사

Congratulatory message



반갑습니다.

국립농업과학원장 이승돈입니다.

한국양봉학회 창립 40주년을 축하드립니다.

오늘 농촌진흥청과 한국양봉학회가 준비한 한국양봉학회 40주년을 기념하고 「건강과 지속 가능한 양봉산업을 위한 공적 기능 강화」라는 주제로 열리는 국제심포지엄에 참석해 자리를 빛내주신 정철의 회장님을 비롯한 내외빈 여러분께 진심 어린 감사와 축하를 드립니다.

최근 이상기상과 꿀벌응애로 꿀벌 감소 현상이 반복해 발생하였습니다. 이를 해결하기 위해 관계기관과 대학, 산업계 등 각 분야의 전문가들이 힘을 합쳐 노력하는 중입니다.

이런 시점에 한국양봉학회 임원과 회원분들, 양봉협회, 양봉 조합 등 산업계의 노력으로 한국양봉학회 40주년을 기념하고 국내외 유명 연구자들을 한자리에 모으는 뜻깊은 자리가 마련되었습니다. 양봉산업 진흥과 연구의 한 축을 맡은 국립농업과학원의 원장으로서 깊이 감사드리고 싶습니다.

현재 우리 양봉산업은 이상기상으로 인한 꿀 작황 부진, 등검은말벌과 꿀벌응애류의 피해 확산 등 많은 어려움을 안고 있습니다. 그렇기에 어느 때보다도 기술 개발이 중요합니다. 이럴 때일수록 연구개발 내용을 공유하고 공조해 발전시켜나가야 합니다.

이번 학회에서는 인위적으로 조절할 수 없는 주변 환경에 적절하게 대응하기 위한 스마트 양봉 기술을 깊이 논의할 예정입니다. 이를 통해 양봉농가의 어려움을 신속히 해결할 방안을 마련하고 우리 양봉산업이 한 단계 성장할 수 있길 바랍니다.

우리 원은 앞으로도 학계, 산업계와 함께 국가 양봉 연구의 기반을 다지고 연구 영역을 확대해 양봉산업이 국가 농업 기반 산업으로 우뚝 설 수 있도록 최선을 다하겠습니다.

오늘 귀중한 시간을 내어 발표를 준비해 주신 발표자 여러분, 이 자리를 준비하느라 애써주신 관계가 여러분께도 감사 말씀 전합니다.

감사합니다.

2024년 02월 19일

국립농업과학원 원장 이 승 돈

축사

Congratulatory message



안녕하십니까.  
한국양봉협회장 윤화현입니다.

먼저, 양봉학회 정기총회 개최를 위해 여러모로 애써주신 학회장님 및 학회 관계자 여러분들께 깊은 감사의 말씀을 드리며, 특히 이번 총회가 “건강과 지속가능한 양봉산업의 공적기능 강화”라는 주제를 다루면서 각계각층의 양봉전문가 여러분께서 심도있는 토론과 정책대안을 제시해 주실 것으로 기대합니다. 저는 모든 양봉인들의 권익을 보호할 책임을 지고있는 양봉협회장으로서, 양봉산업의 공적기능을 강화시키고자 노력하시는 여러분들께 3만여 우리 양봉가족을 대표하여 진심으로 감사하다는 말씀을 드립니다.

두말할 필요도 없이, 양봉산업은 양봉농가의 생계수단을 넘어서 꿀벌의 화분매개 활동을 통해서 과수·원예농가의 결실작용에도 중요한 역할을 하며, 자연생태계 유지·보전에도 중대한 기능을 수행하고 있습니다. 모두 아시다시피 근래의 기후변화, 신종 꿀벌 바이러스 출현, 다양한 꿀벌 질병 발생 등으로 꿀벌이 집단폐사하는 사례가 매년 반복되고 있어서 양봉농가들은 큰 위기감을 느끼고 있습니다. 이러한 현상이 앞으로도 계속 반복된다면 양봉산업이 위기를 맞을 것이고, 양봉산업의 위기는 우리 인류의 위기로 다가올 수도 있을 것입니다.

다행스러운 것은, 우리 정부에서도 꿀벌 살리기를 위하여 다양한 정책적 배려를 하고 있으며, 우리 양봉학회도 매년 두차례씩 학술대회를 개최하여 산림밀원 확대, 화분매개의 중요성, 꿀벌 질병연구, 디지털 양봉 등 우리 양봉산업이 지향해야 할 과제들을 발굴해 주시고 방향을 제시해 주셔서 다시한번 감사하다는 말씀을 드립니다. 지금의 양봉산업은 기후변화, 농약살포, 질병발생 등 각종 위험으로부터 꿀벌을 반드시 살려내야 하는 당면과제가 있고, 이에 더해서 값싼 외국산 벌꿀의 대량수입으로 인해 국산 벌꿀이 판로가 막히는 등 벌꿀 유통에 있어서도 어려운 숙제가 놓여 있습니다.

이러한 대내외적인 어려움을 동시에 돌파해야 하는 상황에서, 우리 영세한 양봉농가의 힘만으로는 한계가 있을 수밖에 없다고 생각합니다.

위기는 곧 기회라고 합니다. 우리 양봉협회는 혼신의 힘을 다하여 현재의 위기를 극복하는데 노력하고자 합니다. 여기에 계신 관계자 여러분께서도 양봉산업의 위기를 극복할 수 있도록 각자 본인의 영역에서 관심을 갖고 적극 도와주시기를 부탁드립니다.

멀지 않은 미래에 우리나라가 양봉선진국이 되어서 우리 모두 한자리에 모여 오늘의 노고를 함께 치하하고 축배를 드는 날이 올때까지 함께 힘을 모아 즐기게 전진합니다. 감사합니다.

2024년 02월 19일

(사)한국양봉협회장 윤 화 현

축사

Congratulatory message



존경하는 한국양봉학회 회원 여러분!  
한국한봉협회장 **윤관로**입니다.

존경하는 한국양봉학회 회원 여러분!

갑진년 청용의 새해 복 많이 받으십시오.

제40차 한국 양봉학회 정기총회 및 COLOSS Asia 국제학술대회를 맞이하여 학회에서 양봉인을 위하여 많은 논문을 발표해 주신데 대하여 깊은 감사를 드립니다.

저는 한봉협회장으로서 그동안 양봉에 대하여는 많은 노력을 해오시고 양봉발전에는 크게 기여하신 것으로 알고 있습니다.

그러나 우리 고유의 전통벌인 토종벌 연구에는 다소 소홀하지 않았나 생각이 되어서, 앞으로는 우리 고유의 토종벌이 세계적인 토종벌로 세계적인 토종꿀, 토종화분을 통하여 인간이 살아가는데 크게 기여 할 수 있는 길을 열어주시고 건강식으로 인체에 큰 기능 역할을 할 수 있는 기능성 연구, 생태계에 기여하는 효과성, 모든 과일의 화분매개에도 토종벌이 필수라는 인식으로 연구에 연구를 거듭해 주셔서 세계속에 대한민국의 토종벌, 토종꿀, 토종화분이 우수하다는 많은 논문발표가 있기를 기대합니다.

40주년을 맞이한 것을 다시 한번 축하드리며, 한국양봉학회가 세계속의 학회로써 명성과 권위가 있는 학회로 거듭나는데 한국한봉협회가 적극적으로 협력하겠습니다.

한국양봉학회의 무궁한 발전과 회원 여러분의 건승을 빕니다.

2024년 02월 19일

사)한국한봉협회장 **윤 관 로**

축사

Congratulatory message



안녕하십니까?  
한국양봉농협 조합장 김용래입니다.

먼저 2024년 제40차 한국양봉학회 정기총회 및 COLOSS Asia 국제학술대회 개최를 진심으로 축하드립니다.

아울러 본 행사를 주최하신 한국양봉학회 정철의 회장님을 비롯하여 국립농업과학원 이승돈 원장님, 참여하시는 양봉 농가, 양봉 관련 기관 및 단체 등 관계자 여러분께도 깊은 감사의 인사를 드립니다. 특히 제 40차 한국양봉학회 정기총회를 기념하고 축하하기 위해 직접 방문하신 Jeff Pettis 세계양봉연맹 회장님께도 한국양봉산업에 대한 관심에 감사드립니다.

현재 국내 양봉산업은 이상 기후에 따른 꿀벌 병해충의 지속적인 발생과 월동 봉군 소멸 피해가 지속적으로 나타나고 있으며, 경기 침체로 벌꿀 소비가 감소하는 등 생산과 소비 모두 위기에 처해 있으며, 이를 위한 다각도의 해결방안 및 정책 마련이 무엇보다 시급한 상황이라 생각합니다.

이에 금차 개최되는 한국양봉학회 총회 및 동계국제학술대회에서 국내 양봉산업의 발전과 도약을 위해 현재 양봉산업에 직면해 있는 문제들에 대한 심도 있는 논의와 안정화 방안을 찾을 수 있는 자리가 되었으면 합니다.

정책적 건의사항으로 양봉의 공익적 가치를 인정하여 꿀벌 법정 전염병으로 소실시 보상 받을 수 있는 법령 정비가 필요하며, 소멸 피해를 재해로 지정·지원해야 합니다. 과수 및 농작물은 자연재해 등에 의하여 피해 발생 시 자연재해를 직접 피해로 보고 보상체계 및 범위가 부여되나, 양봉업의 경우 전국적인 소멸 피해도 재해로 인정받지 못하여 지원이 불가능합니다. 또한 영세한 농가가 부담 없이 재해 보험을 가입할 수 있도록 꿀벌 재해보험의 국비 및 지자체 지원금 상향이 필요합니다.

또한 양봉직불금제를 반드시 실현하여 양봉 생산 농가의 생산 의욕을 고취하고 꿀벌의 고유 기능인 생태계 보존과 농산물 수정매개를 원활하게 하여야 할 것입니다.

국내에는 높은 봉군 밀도에 비해 밀원수 면적 확보가 동반되지 않고 있으며, 이상 기후로 인한 봄철 기후 변화로 아까시나무 개화 시기가 빨라지고 있고 전국적으로 동시에 진행되고 있어 채밀 기간이 짧아져 생산량이 지속적으로 감소하고 있습니다. 밀원 확보를 위해 산림청과 연계한 밀원수 조림 정책을 마련하고 개인 산주에게 산림 소득 분배 차원의 밀원수 산림 직불금 제도를 마련해야 할 것입니다.

그리고 꿀벌에 피해가 적고 양봉산물에 잔류가 없거나 적은 친환경 꿀벌 동물용 의약품 개발이 필요합니다. 특히 양봉 농가에 가장 문제가 되고 있는 꿀벌 응애류 구제 약품 개발이 시급합니다. 친환경 꿀벌 응애류 구제 약품 개발을 통해 꿀벌 응애류 방제 효과를 높여 농가의 생산성 향상에 기여하고 꿀벌 실종현상 방지에 큰 역할을 할 것이라 생각합니다.

항공방제 또는 드론을 이용한 농약 살포로 인한 꿀벌 피해가 매우 심각합니다. 무분별한 항공방제·드론 농약 살포는 꿀벌 건강과 생존에 위협을 가하며, 농약이 지속적으로 환경에 배출될 수 있어, 생태계에도 영향을 줄 수 있습니다. 따라서 항공방제·드론 농약 살포는 최소화하고, 꿀벌 환경 영향 평가 지도를 마련하여, 더욱 안전하고 환경 친화적인 대체 방법을 적극적으로 모색해야 합니다.

한국-베트남 FTA로 인하여 베트남에서 수입되는 벌꿀의 철저한 이력 관리가 필요합니다. 수입된 벌꿀의 출처, 생산 과정, 수출자 정보, 수입량 등을 철저히 관리해야 합니다. 이러한 관리는 수입 벌꿀의 안전성과 품질을 보장하고, 벌꿀 성분에 문제가 발생했을 때 신속한 대응을 가능하게 합니다. 따라서 수입 벌꿀에 대한 철저한 이력 관리는 중요한 과제입니다.

지난 12월 벌꿀 등급제 본사업이 시행되었습니다. 벌꿀 등급제의 참여는 우리의 양봉산업을 더욱 발전시키는 중요한 한 걸음입니다. 벌꿀등급제는 우리 벌꿀을 더욱 신뢰할 수 있게 만들어주며, 소비자들에게 더욱 신뢰받는 양봉산업을 구축하는 밑거름이 될 것입니다. 우리 양봉산업의 경쟁력을 향상시키고, 세계적인 수준으로 성장하고 발전하기 위해서는 함께하는 모든 분들의 참여가 성공의 열쇠입니다. 양봉인 여러분의 적극적인 참여 부탁드립니다.

한국양봉농협은 앞으로도 국내 양봉산업의 발전과 양봉농가의 밝은 미래를 위해 항상 노력하겠습니다.

감사합니다.

2024년 02월 19일

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## Dr. Jeff Pettis

(APIMONDIA President)  
Research Scientist and Consultant, Pettis and Associates LLC  
E-mail: pettis.jeff@gmail.com  
Pollinator Health Consultant, Salisbury, MD USA 2018 to present  
President of Apimondia, Rome Italy 2019 to present

### EDUCATION

PhD	Texas A&M University	Entomology	1991
MS	University of Georgia	Entomology	1985
BS	University of Georgia	Entomology	1982

### AWARDS AND FELLOWSHIPS

Japanese Society for the Promotion of Science Fellowship, Tuskuba, Japan, 2014;  
J.I. Hamilton Award winner (2007) and student award winner (1991) from the Eastern Apicultural Society, USA  
“Hoopingarner Best Scientific Research Presentation” American Beekeeping Federation meeting, 2007, 2008  
Post-Doctoral Fellow, Simon Fraser University, B.C., Canada 1992–1995

### RESEARCH GRANTS and PUBLICATIONS

5 grant projects with a total external funding of >6.0 Million USD **PUBLICATIONS**

Over 200 Articles in international peer reviewed journals (incl. *Annals of The Entomological Society of America*, *Apidologie*, *Insectes Sociaux*, *Journal of Economic Entomology*, *PLOS ONE*, *SCIENCE*, *Naturwissenschaften*), 6 book chapters, 12 popular articles, 14 conference proceedings  
(23,234 citations, h-index: 73, i10-index: 166)



## Beekeeping in a changing world, new pests and more!

Dr. Jeff Pettis

The world of beekeeping is changing and as beekeepers we must adapt. The way in which many of us learned to keep bees is no longer as valid with the introduction of new parasitic mites and diseases and the challenges brought on by climate change. Beekeepers can no longer go by a simple yearly bee calendar and expect flowers to bloom nor rainfall to be consistent and thus honey yields can vary widely. Additionally, globally, pests and diseases are spreading, and we must adapt our beekeeping.

One major pest that is spreading is the parasitic mite *Tropilaelaps*. This mite complex is composed of at least 4 recognized species and is thought to use the giant honey bees (*Apis dorsata* and *Apis laboriosa*) as primary hosts but the mite also infests colonies of both the Asian honey bee, *Apis cerana*, and the European honey bee, *Apis mellifera*, in Asia. Interestingly the mite does not appear to cause damage within the Asian honey bee but is a major pest of European honey bees in Asia. The reasons for this are unclear but may have to do with the same “suicidal” reaction from larvae and pupae when fed upon by Varroa (Page et al. 2016). This research showed that Varroa rarely infest worker brood of Asian bees, probably driven by the selective pressure of the worker brood dying when fed upon by Varroa. This is a plausible explanation for the lack of impact by *Tropilaelaps* on Asian honey bees, but this needs scientific confirmation. What we do know is that *Tropilaelaps* reproduces faster than Varroa on European bees in Asia and thus beekeepers focus their mite control on *Tropilaelaps* and Varroa is of little concern (deGuzmanetal.2017,Chantawannakuletal.2018). Many but not all of the mite control products used on *Tropilaelaps* work to control Varroa as well. Beekeepers beyond Asia must be prepared if this mite continues to spread.

Climate change is affecting beekeeping both directly and indirectly. Direct effects include droughts, floods and wildfires and these are happening all across the globe. Indirect effects are changes in weather and rising CO2 levels and these will be discussed as well. The impact of both pests and diseases, along with climate change, makes beekeeping even more challenging endeavor. Bees and beekeepers are resilient, but we must indeed adapt if we are to maintain healthy and productive beehives.



성 건 목 (Keon Mook Seong, Ph. D.)

충남대학교 농업생명과학대학

EDUCATION


University of Illinois Urbana-Champaign (UIUC)	May. 2017
Ph.D. Entomology (농학박사)	
Seoul National University (서울대학교)	Aug. 2010
M.A. Entomology (농학석사)	
Chungbuk National University (충북대학교)	Sept. 2007
B.A. Agricultural Biology (농학사)	

RESEARCH EXPERIENCE

2022 – current	Assistant professor, Chungnam National University (조교수, 충남대학교 응용생물학과)
2020 – 2022	Assistant professor, Kyungbuk National University (조교수, 경북대학교 곤충생명과학과)
2017 – 2020	Post-doctoral Researcher, Michigan State University (박사후연구원, 미시건주립대학교)
2012 – 2017	Research Assistant, University of Illinois Urbana-Champaign

SELECTED PUBLICATIONS

- Kim, S., Seong, K.M., Lee, S.H., (2023) Acetylcholine titre regulation by non-neuronal acetylcholinesterase 1 and its putative roles in honey bee physiology. *Insect Molecular Biology* 32: 4
- Seong, K.M., Pittendrigh, B.R., (2022) Comparative response of two seasonal spotted wing drosophila (*Drosophila suzukii*) morphs to different classes of insecticides. *Entomological Research* 52: 11
- Seong, K.M., Coates, B.S., Pittendrigh, B.R. (2020) Post-transcriptional modulation of cytochrome P450s, Cyp6g1 and Cyp6g2, by miR-310s cluster is associated with DDT-resistant *Drosophila melanogaster* strain 91-R. *Scientific Reports* 10: 14394



## **Development of RNAi method to control *Varroa destructor*: lethal effects of knockdown of coatomer proteins**

**Keon Mook Seong**

Department of Applied Biology, Chungnam National University, Daejeon, South Korea

The ectoparasitic mite, *Varroa destructor*, is one of the most destructive pests of the honey bee (*Apis mellifera*) leading to the collapse of the honey bee colony in the world. RNA interference (RNAi) is a novel approach recently proposed for pest control. In order to minimize acaricide exposure to honey bee, RNAi-based method has recently been suggested as an alternative control measure of *V. destructor*. To explore the possibility of using RNAi to control varroa mite, we determined the effects of knocking down genes encode a subunit of the cytoplasmic coatomer protein complex on varroa mite survival. Injection of dsRNA-COPB, COPD, and COPE caused a significant reduction in varroa mite survival rate based on lethal time 50 (LT<sub>50</sub>) afterpost-injection (hpi), respectively as compared to control mites injected with dsGFP. Amongthem, we showed thatdsRNA-COPB ingested by honey bees is transferred to the varroa mite, resultingin decreasing the survival rate of honey bee. Furthermore, we demonstrated that chitosan nanoparticles-dsRNA complexes were more stable for 7 days in honey bee tissue fluids (hemolymph, fatbody, and midgut). Additionally, we confirmed that no toxicity was observed from dsRNA fed nontarget insects, honey bees. Our finding suggests that the coatomer protein play an important role in survivaland is a potential target for the development of future RNAi-based control strategies against varroa mite.

**Key words:** *Varroa destructor*, *Apis mellifera*, RNA interference, Colony Collapse Disorder (CCD)



## Victoria Soroker

January 2024  
Chair of COLOSS Varroa TF (2019 - to date)

### Education, Positions and Employment

1980	B.Sc. in Biology, at University of Tel-Aviv, Ramat Aviv, Israel.
1984	M.Sc. in Zoology at University of Tel-Aviv, Ramat Aviv, Israel.
1990	Ph.D. Faculty of Agriculture, Hebrew University of Jerusalem, Israel.
1999-to date	Researcher at Department of Entomology, Institute of Plant Protection, Agricultural Research Organization, the Volcani Center
2016- to date	Senior Scientist (Rank A+), Department of Entomology, Chemistry and Nematology, Institute of Plant Protection, Agricultural Research Organization, the Volcani Center
2005 - to date	Lecturer at the Hebrew University, Faculty of Agriculture, Rehovot, Israel.

### Seminars, Conference and Workshop Presentations (last 5 years):

over 35 international workshops and conferences

**Major Governance and Service:** Member of the Management Committee of the COST - Action FA0803 Bee colony losses (Coloss) (2008-2013); Member of the Executive Committee of Coloss - Honey bee research association (2013-to date); Member of the Organizing Committee of the Annual Meetings of the Entomological Society of Israel (ESI) (2000, 2003, 2006, 2007, 2008); The Organizer of the Annual Meetings of the ESI (2010, 2014, 2017); Member of the Organizing Committee of the working group "Pheromones and Other Semio-Chemicals in Integrated Production" of The International organization for Biological Control (2015); Director and co-Director of international course R &D in Integrated pest management (2001-to date committee member of Israeli Entomological Society (IES) 2004-to date; Secretary of The IES 2006-2010; President of IES (2010-to 2021); Member of Editorial board of Journal of Apicultural Research (2019-to date); EdMember of the Council of the International Bee Research Association (IBRA) (2023-to date)

### Patents

2018 "Honey bee mite disruptive compounds and methods of application" Patent number 10022338

Selected Refereed Publications and a book chapter (out of 115 total refereed papers, 13 chapters and 2 books edited)

Mani, K., Nganso, B.T., Rodin, P., Otni, A., Rafaeli, A., Soroker, V. (2022) Effects of Niemann-Pick type C2 (NPC2) gene transcripts silencing on behavior of Varroa destructor and molecular changes in the putative olfactory gene networks. J. Insect Biochem and Molecular Biol 148:103817 DOI: 10.1016/j.ibmb.2022.103817

Jabal-Uriel, C, L. Barrios, A. Bonjour-Dalmon, S. Caspi-Yona, N. Chejanovskiy, T. Erez, D. Henriques M., Higes, Y. Le Conte, A R. Lopes, Aránzazu Meana, M. A. Pinto, M. Reyes-Carreño, Soroker V., and R. Martín-Hernández. (2022). Epidemiology of the Microsporidium Nosema ceranae in Four Mediterranean Countries. Insects 13: 844. <https://doi.org/10.3390/insects13090844>

## The chemosensory machinery of the Varroa mite

Victoria Soroker

Agricultural Research Organization, The Volcani Center, Rishon LeTzion, Israel  
sorokerv@volcani.agri.gov.il

The *Varroa*'s life cycle is well synchronized with that of its honey bee host and is largely odulated by chemical cues from the honey bee colony. To expose elements of Varroa chemosensory machinery transcriptomics, proteomics, gene silencing and chemosensory disruptive compounds were implemented. Transcriptomic analysis revealed the presence of transcripts belonging to eight chemosensory gene families in both forelegs and gnathosoma. Whilst the gnathosoma and the forelegs share similar expression of some putative lipid carrier proteins, membrane-bound receptors, and associated proteins, they also differ in the expression profiles of some transcripts belonging to these protein families. This suggests two functional chemosensory organs that may differ in their chemosensory function according to specific characteristics of compounds they detect.

**Acknowledge:** Beatrice T. Nganso, Nurit Eliash, Kannan Mani, Noa Sela, Alejandro Villar-Briones, Angelina Fat hia Osabutey, Ada Rafaeli, Alexander S. Mikheyev



**Huoqing Zheng**

(Zhejiang University, China)

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Prof. Huoqing Zheng obtained PhD degree from Zhejiang University, China.

He studied in University of Pretoria, South Africa from 2007–2008 and worked in the Bee Research Lab of USDA in Beltsville from 2012–2013. He is now leading a group working on honeybee diseases in Zhejiang University, China. He is also the Secretary-General of the Apiculture Association of Zhejiang Province.

Taking advantage of the presence of both *Apis cerana* and *Apis mellifera* in the area, he is particularly interested in the host shift of honeybee parasites and pathogens, e.g. *Varroa destructor* and viruses, between the two honeybee species. As is a duty scientist of National Beekeeping Industry Technology System supported by the Ministry of Agriculture and Rural Affairs of China, he is aiming to develop sustainable solutions against honeybee pests and pathogens.

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## Filling gaps in the understanding of the relationship between *Varroa* spp. and *Apis cerana*

**Huoqing Zheng<sup>a</sup>**, Peter Neumann<sup>b</sup>, Vincent Dietemann<sup>b</sup>

<sup>a</sup>College of Animal Sciences, Zhejiang University, Hangzhou, China

<sup>b</sup>Swiss Bee Research Center, Agroscope, Liebefeld, Switzerland

*Varroa* is a genus of ectoparasitic mite, which originally parasitises Asian honey bee colonies. It garnered attention after *Varroa destructor* spread from its original host, the Eastern honeybee (*Apis cerana*) to the Western honeybee (*Apis mellifera*) and emerged as a major threat for the new host worldwide. Understanding of the relationship between *Varroa* spp. and *A. cerana* will provide key information to develop strategies to mitigate *A. mellifera* colony losses caused by *V. destructor*. Notable progress has been made in the past few years. The resistance mechanism of the original host is now better known. The higher susceptibility of *A. cerana* worker pupae than *A. mellifera* pupae to the invasive Korean haplotype prevents successful mite reproduction and provide signal for hygienic behavior. The uncapping and recapping of comb cells were not found to be related to the resistance to *Varroa* spp. in *A. cerana*. Furthermore, the population structure of *Varroa* spp. is also better understood. For example, the Korean haplotype infesting *A. cerana* and *A. mellifera* in China were identified as two genetically different populations that differed in their reproductive abilities and thus in their host specificity, leading to unidirectional gene flow and genetic differentiation. We call for more studies on the relationship between *Varroa* spp. and their original hosts in Asia to identify the factors promoting host shifts and invasiveness in this genus.

**Key words:** *Varroa* spp., *Apis cerana*, host specificity, population structure

**Acknowledge:** This work was supported by China Agriculture Research System of MOF and MARA (CARS-44).



**Bajaree Chuttong**

(Chiang Mai University, Thailand)

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Bajaree Chuttong, PhD

I am currently serving as a lecturer in the Department of Entomology and Plant Pathology within the Faculty of Agriculture at Chiang Mai University, Thailand, a position I have held since 2020. I obtained my Ph.D. from the Postharvest Technology Research Institute at Chiang Mai University in 2015, following the completion of my M.Sc. and B.Sc. degrees in Entomology from the same institution. With over a decade of experience as a researcher at the Science and Technology Research Institute, Chiang Mai University, I have gained recognition in the field of entomology, particularly focusing on stingless bees and their products. My fascination with native bee species dates back to 2010, when I became intrigued by their colony composition and honey. These diminutive creatures are remarkable in their nest architecture, behavior, and, most notably, their honey, characterized by its captivating "sweet-sour-plant resin flavor," which has led me to explore numerous questions. My Ph.D. supervisor, Prof. Michael Burgett, played a significant role in inspiring and motivating me to investigate meliponiculture in Thailand, a subject previously unexplored. Together, we delved into the physicochemical profiles of stingless bee honey, sparking our interest in studying its post-harvest aspects. Our collaborative efforts extended to the study of native honey bee species, including *Apis dorsata* and *Apis florea*, resulting in significant contributions to their biology and ecology.

My research primarily centers on Meliponini and Apini, as demonstrated by my contributions to various publications and book chapters exploring topics such as the nutritional composition and properties of stingless bee products. Recently, my work has expanded to include the study of *Apis mellifera* nutritional supplements, pest management and brood production on a commercial scale, endeavors we believe will significantly benefit beekeepers. Additionally, I am actively collaborating with international colleagues from countries such as Korea, Taiwan, Malaysia, Singapore, Venezuela, and the USA.

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## Guidelines for establishing a quality standard for honey produced by the stingless bee genus *Tetragonula* in Thailand

**Bajaree Chuttong**<sup>1,\*</sup>, Rewat Phongphisutthinant<sup>2</sup>, Surat Hongsibsong<sup>3</sup>, Jakkrawut Maitip<sup>4</sup>, Supakit Chaipoot<sup>2</sup>, Sirikarn Sanpa<sup>5</sup>, Khanchai Danmek<sup>6</sup>, Michael Burgett<sup>7</sup>, and Patricia Vit<sup>8</sup>

<sup>1</sup>Meliponini and Apini Research Laboratory, Department of Entomology and Plant Pathology, Faculty of Agriculture, Chiang Mai University, Chiang Mai 50200, Thailand

<sup>2</sup>Multidisciplinary Research Institute, Chiang Mai University, Chiang Mai, 50200, Thailand

<sup>3</sup>School of Health Sciences Research, Research Institute for Health Sciences, Chiang Mai University, Chiang Mai 50200, Thailand

<sup>4</sup>Faculty of Science, Energy and Environment, King Mongkut's University of Technology North Bangkok, Rayong Campus, Bankhai, Rayong, 21120 Thailand

<sup>5</sup>School of Medical Sciences, University of Phayao, Phayao, 56000, Thailand

<sup>6</sup>School of Agriculture and Natural Resources, University of Phayao, Phayao 56000, Thailand

<sup>7</sup>Department of Horticulture, Oregon State University, Corvallis, OR 97331, USA

<sup>8</sup>Apitherapy and Bioactivity, Food Science Department, Faculty of Pharmacy and Bioanalysis, Universidad de Los Andes, Mérida 5101, Venezuela

Stingless bees (Meliponini) are a large group of bees that have been identified with about 600 species worldwide. In Thailand, 10 genera and approximately 40 species are recognized, and around 7 species in 4 genera are utilized in meliponiculture. Likewise, the most common genus that has been kept throughout the country is *Tetragonula*, which contains a cryptic species group. Stingless bee honey has a diverse composition between genera or species levels, and it differs more when compared to *Apis mellifera* honey. A total of 70 samples of honey were collected from stingless bee colonies in the genus *Tetragonula* from four regions of Thailand, and the analysis parameters followed the Codex Alimentarius Commission. The results are as follows: moisture (20.15–30.48%), ash (0.12–1.45%), electrical conductivity (0.39–1.73 mS/cm), pH (3.00–4.29), free acidity (48.38–118.61 meq/kg), total acidity (49.16–121.96 meq/kg), diastase activity (0.19–9.25 DN), hydroxymethylfurfural (ND, 0.01–35.80 mg/kg), reducing sugars (11.89–67.96%), non-sucrose disaccharide (3.19–57.11%), and sucrose (ND, 0.02–5.25%). According to our findings, some properties do not correspond to the Codex international standard for *A.mellifera* honey. The goal of this study is to provide guidance for a reference range in the physicochemical properties of *Tetragonula* honey to further contribute to the national standards for stingless bee honey in Thailand. Preliminary standards for *Tetragonula* honey were recommended based on the observed histogram distribution data.

**Key words:** Honey, Quality, Standards, Stingless bee, *Tetragonula*

**Acknowledge:** This research work was partially supported by Chiang Mai

### 초청강연 III

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**Norman L Carreck**

(Carreck Consultancy Ltd.)

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Norman Carreck has been keeping bees since the age of 15. He read Agricultural Science at Nottingham University and joined Rothamsted Research in 1987 as an agronomist working on nutrient uptake in cereal crops. Between 1991 and 2006 he was apiculturalist in the Plant and Invertebrate Ecology Division there, with responsibility for maintaining about 80 colonies of honey bees and was also fully involved in research on pollination ecology, bee behaviour, bee pathology and forage for bees. Since 2008 he has carried out research at the University of Sussex on bee breeding and pesticides and bees. Between 2007 and 2018 he was Senior Editor of the Journal of Apicultural Research, and between 2009 and 2018 he was employed as Science Director of the International Bee Research Association. He obtained the National Diploma in Beekeeping in 1996, was elected a Fellow of the Royal Entomological Society in 2004, and a Fellow of the Royal Society of Biology in 2011. He is a Trustee of the C B Dennis British Beekeepers Research Trust, Examinations Moderator for the Examinations Board for the UK National Diploma in Beekeeping, an Independent Science Advisor to the “Bee Health Advisory Forum” for the Defra “Healthy Bees Plan” and is the only UK member of the Executive Committee of the international honey bee research network "COLOSS". He is a director of Carreck Consultancy Ltd and Bee Publishing Ltd and is an Associate Fellow of the University of Sussex.

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## The COLOSS association and the *BEEBOOK* project

Norman L. Carreck<sup>1,2</sup>

<sup>1</sup>Carreck Consultancy Ltd., Woodside Cottage, Dragons Lane, Shipley, West Sussex, RH13 8GD, United Kingdom.

<sup>2</sup>School of Life Sciences, University of Sussex, Falmer, Brighton, East Sussex, BN1 9QG, United Kingdom.

Email: [norman.carreck@btinternet.com](mailto:norman.carreck@btinternet.com)

The COLOSS (prevention of honey bee Colony LOSSes) association was originally formed in 2008 as a European Union funded “COST Action”, aimed at understanding the causes of honey bee colony losses through organizing international cooperation between bee scientists and bee extension specialists. When this funding came to an end in 2012, it was decided that COLOSS should continue as an independent non-profit association based in Bern, Switzerland. It now has over 2,000 members in 121 countries worldwide, and diverse activities across three Core Projects and nine Task Forces. The *BEEBOOK* Core Project aims to standardize methods for carrying out research on honey bees. *BEEBOOK* Volumes I and II on “Standard methods for *Apis mellifera* research” and “Standard methods for *Apis mellifera* pest and pathogen research” were published in 2013, and *BEEBOOK* Volume III “Standard methods for *Apis mellifera* product research” was published in 2021. Together, they contain more than 2,000 individual experimental protocols written by more than 350 experts from more than 35 countries. Since publication, the individual chapters have been downloaded nearly 300,000 times and cited in other publications nearly 4,000 times, showing that the project has been embraced by the bee science community. Volume IV, instigated by the late Panuwan Chantawannakul, will be published in 2024, and will cover methods used for *Apis cerana* research, as well as a new section on the emerging subject of “omics” applied to honey bees. Meanwhile, several of the original chapters are being revised to take into account newly developed techniques, thus ensuring that the *BEEBOOK* remains a vital tool for honey bee research in the future.

**Key words:** COLOSS, *BEEBOOK*, Standard methods, research methods, *Apis*.



## Lekhnath Kafle

(National Pingtung University)

Associate Professor

Department of Tropical Agriculture and International Cooperation Pingtung, Taiwan

E-mail: kafle@mail.npust.edu.tw / kafleln@gmail.com

### Education

Degree Doctor of Philosophy (PhD) (Entomology)

Dates 2005 – 2010

University National Taiwan University, Department of Entomology, Taipei, Taiwan

Degree Master of Science (MS) (Entomology)

Dates 2003 – 2005

University NPUST, DTAIC, Pingtung, Taiwan

### Professional Experiences

Position Associate Professor

Dates February 2022 onward

Employer NPUST, Pingtung, Taiwan

Department of Tropical Agriculture and International Cooperation

### Research Scopes and Publications

Books / Booklets

2002: Alternative Plant Protection: an IPM guidebook. DADO-Makwanpur, Nepal

2002: Pesticides and Environment. DADO-Makwanpur, Nepal


2001: Major diseases and insect pests of vegetables and spices in Nepal

2001: Insects: Friends of Farmers. An IPM Booklet. World Education, Nepal (Co-author)

2000: IPM Program in Nepal: IPM Technical book. DADO-Ramechap, Nepal

### Significant Research Papers

1. Wen-Hsing Huang, Suwimol Chinkangsadarn, Ju-Yi Hsu and Lekhnath Kafle\*. Effects of honey bee larvae age on royal jelly yield under field conditions. Journal of Entomological Research. 2023: 47(3):569–572. [\*Corresponding author].
2. Muhammad, Faiz Nashiruddin, M. Bayu Mario, Hagus Tarno, Yogo Setiawan, Asri Ainun Amaliah, Nur Indah Sari, Muhammad Alifuddin Achmad, and Lekhnath Kafle. "Impact of urbanization on the ant diversity: a case study on teak plantation in South Sulawesi, Indonesia." In IOP Conference Series: Earth and Environmental Science. 1230 (1): 012095. [Online on: 2023-09-20]. DOI: :10.1088/1755-1315/1230/1/012095



## **Efficacy of probiotic and prebiotic supplements on honeybee productivity and strength**

**Lekhnath Kafle**

Department of Tropical Agriculture and International Cooperation,  
National Pingtung University of Science and Technology, Pingtung, Taiwan

Bee productivity plays a crucial role in crop pollination, and ecosystem health and sustainability. Due to various biotic and abiotic factors in the environment, honeybee populations are declining worldwide, thereby compromising their pollination services and hive productivity. Based upon these facts, a series of studies were conducted in order to find an effective feed supplement that could enhance bee's productivity and strength. EM probiotics, organic acids as prebiotics, and commercial probiotics were evaluated for their effect on honeybee productivity and strength. Honey production, pollen collection, and royal jelly production were used as indicators of bee strength and productivity. Based on the results of the studies, we found that EM probiotics, commercial probiotics and organic acids could increase honey and royal jelly production as well as pollen collection by honeybees. Probiotics and prebiotics can enhance honeybee gut microbiota, improving digestion and nutrient absorption. Consequently, honeybee strength and productivity can be improved.

**Key words:** Feed supplements, Prebiotics, Probiotics, Bee productivity, Bee products



## 초청강연 V

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**Delphine Panziera**

(Wageningen University & Research)

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Delphine Panziera is a researcher at Wageningen University & Research, the Netherlands. Her work encompasses several topics related to honey bee health, with a strong focus on Varroa and associated viruses. She is a member of the Coloss Virus Task Force since 2015 and the head of the Dutch national reference laboratory for bees' notifiable diseases since 2022.

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## **Chronic bee paralysis and winter mortality in the Netherlands**

**Delphine Panziera** & Harmen P. Hendriksma

Wageningen University and Research; The Netherlands

The Chronic Bee Paralysis Virus (CBPV) is an unclassified RNA virus found in honey bees. Infections in honey bee colonies can trigger symptoms of paralysis of worker bees; with individuals exhibiting hairless shiny bodies. Symptomatic individuals typically die within a week; which can cause colonies to decline. The increase of recorded CBPV outbreaks in the world prompted us to conduct a national monitoring of its prevalence in November 2022 in the Netherlands. A total of 300 bee colonies were sampled at 100 apiaries spread across the country. All beekeepers filled a questionnaire regarding the perceived increase of symptomatic infections at their apiary over the last years. Notable increasing CBPV infections were reported for the south of the Netherlands. Honeybee samples were analysed for the presence and quantity of CBPV fragment copies; as well as several other pathogens. 96% of the colonies were found CBPV-positive. The fate of each colony was checked after the winter. Despite the presence of a trend; CBPV infection levels did not strongly relate to colony mortality. Instead; high Deformed Wing Virus genotype B (DWV-B) infection levels were a highly significant explanatory variable to mortality over winter. DWV-B is typically associated with high infestation of the parasitic mite *Varroa destructor*.

## 초청강연 VI

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**Angus McPherson**

(NZ Trees for Bees Research Trust)


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Angus is a forestry consultant and farm planting adviser with over 40 years' experience in forestry in the Asia-Pacific region.

He has a B.For.Sc. (Hons) from University of Canterbury (New Zealand) and a PhD (Forestry) from the University College of North Wales (Bangor). Angus has worked on a wide variety of forestry projects throughout the Asia-Pacific region, including in Indonesia, Malaysia, the Philippines, Papua New Guinea and Fiji.

Angus has worked on farm planting projects throughout New Zealand, covering production and carbon forestry, farm greenhouse gas (GHG) balances, land stabilisation and riparian zones, farm shade and shelter, amenity planting, mānuka plantations and bee forage. With the Trees for Bees team, he has developed design templates and planning tools to assist farmers and beekeepers to install plentiful high-performance pollen and nectar sources to promote bee health, and co-authored several handbooks.

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## **Designing and Establishing Multi-function Bee Forage Planting to Support Beekeepers and Farmers**

**Angus McPherson**

**NZ Trees for Bees Research Trust**

The Trees for Bees Research Programme arose out of beekeeper concerns about the loss of bee forage, including during critical periods in spring and late summer/early autumn. The project has evolved over 15 years into a strong partnership between beekeepers, farmers and other landowners, honey companies, the government, and the Trees for Bees Research Trust.

Trees for Bees' goal is to determine the best plants that cover the critical flowering times in spring and autumn and provide the highest protein to boost bee nutrition. We incorporate these high-performance plants into effective on-farm and apiary planting designs to alleviate overcrowding of apiaries and exceeding carrying capacity, which will promote a long-term sustainable and profitable apiculture industry, for both pollination services and honey harvesting. Since 2009, more than 30 demonstration farms have been set up and 75,000 bee forage plants established, several guides and handbooks published, and online tools developed.

Riparian protection, land stabilisation, biodiversity loss, climate change and livestock welfare are all compelling reasons to plant. Bees and other pollinators also need increased forage availability to support their colonies year-round, to target flowering deficits, and to maximise bee health. Planting trees and shrubs for balanced and targeted bee forage can be incorporated into the above planting types, achieving multi-function planting.

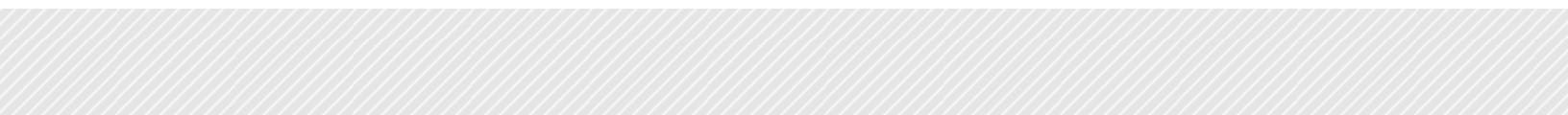
This presentation will take the audience through the New Zealand apiculture sector, the Trees for Bees project, and several case studies.



2024년 제40차

# 한국양봉학회 정기총회 및 COLOSS Asia 국제학술대회

“꿀벌의 건강과 지속가능한 양봉산업을 위한 공적기능 강화”





1

2024.02.19.

# 구두발표 무궁화홀

• 꿀벌 병해충 I  
(Bee Health)



O-01

## Oral presentation : 꿀벌 병해충 I (Bee Health)

### The influence of *Varroa destructor* on virus infection of honeybees from the perspective of virome analysis

Ruike Wei and Huoqing Zheng

College of Animal Sciences, Zhejiang University, Hangzhou 310058, China

*Varroa destructor* and the viruses it transmits are considered the most serious threats to the Western honeybee, *Apis mellifera*. To further investigate the association between *V. destructor* infestation and virus infection in honeybee colonies, we analyzed the viromes of two honeybee species, *A. mellifera* and *A. cerana*, and their associated *V. destructor* mites. Viruses of *A. mellifera* and *V. destructor* were mainly assigned to Ifflaviridae and Dicistroviridae, while the majority of *A. cerana* was assigned to Baculoviridae. The richness and evenness of the virus composition of *A. mellifera* are significantly negatively correlated with the infestation rate of *Varroa* mites. Besides Deformed Wing virus (DWV) and Israeli Acute Paralysis Virus (IAPV), Apis rhabdovirus-1 (ARV-1), Apis rhabdovirus-2 (ARV-2), Lake Sinai virus (LSV) and Varroa destructor virus 2 (VDV2) were commonly detected, which also had high strain diversity. In addition, two novel viruses were identified, and the genome data of 18 viruses were expanded. This study deepens the understanding of the impact of *Varroa* mites on host virus composition.

**Key words:** *Varroa destructor*, *Apis mellifera*, *Apis cerana*, virome analysis

**Acknowledge:** This work was supported by China Agriculture Research System of MOF and MARA (CARS-44).

O-02

## Oral presentation : 꿀벌 병해충 I (Bee Health)

### Acaricidal susceptibility of *Varroa destructor* and *Tropilaelaps mercedesae* in *Apis mellifera* colonies

Hyunha Oh<sup>1</sup>, Tekalign Begna<sup>2</sup>, and Chuleui Jung<sup>1,2</sup>

<sup>1</sup>Department of plant Medicals, Andong National University, Andong, Republic of Korea

<sup>2</sup>Agricultural Science and Technology Institute, Andong National University, Andong, Republic of Korea

*Varroa destructor* and *Tropilaelaps mercedesae* are the major parasitic mites of honeybee (*Apis mellifera*). In this study, five acaricidal products, Coumaphos, Amitraz, Thymol, Formic acid and Oxalic Acid were evaluated for acaricidal efficacy against *V. destructor* and *T. mercedease*. A total of 30 *A. mellifera* colonies were used, with five replicate per chemical product. The five chemicals were applied 2 times, followed by Fluvalinate application. Mite infestation and control efficacy was assessed based on the bottom whiteboard and sugar-shaking counts. For *Varroa* mites, Formic Acid had the highest efficacy with an average of 72.3%, while the lowest efficacy was Oxalic Acid with an average of 50.0%. Similarly, for *Tropilaelaps* mites, Formic Acid had the highest efficacy with an average of 59.2%, while Coumaphos had the lowest efficacy with an average of 37.9%. When comparing the efficacy of the chemical treatments between the two species, there was a statistically significant difference in Coumaphos, with higher efficacy in *Varroa*. The study method posed challenges for accurate chemical evaluation, highlighting the need to implement international test protocols in Korea.

**Key words:** Parasitic mites, Mite Infestation, Formic acid, Efficacy

O-03

Oral presentation : 꿀벌 병해충 I (Bee Health)

**Acaricidal Activity of major component from *Cymbopogon citratus* in Combination with Other Monoterpenes, on *Varroa destructor* and Honey bees**

**Tekalign Begna<sup>1</sup>, and Chuleui Jung<sup>1,2</sup>**

<sup>1</sup>Department of plant Medicals, Andong National University, Andong, Republic of Korea

<sup>2</sup>Agricultural Science and Technology Institute, Andong National University, Andong, Republic of Korea

*Varroa destructor* poses a severe threat to honey bee colonies globally, leading beekeepers to heavily rely on chemical acaricides for defense. However, resistance issues demand alternative solutions. This study examined the acaricidal activity of major component of *Cymbopogon citratus* and its combinations with thymol and carvacrol in binary and ternary mixtures against *V. destructor* by complete exposure method. Citral, the major component, displayed dose-dependent acaricidal activity with a 4 h-LC<sub>50</sub> of 322 µg/ml, nearly twice as toxic as the oil. Furthermore, citral interacts synergistically with thymol and carvacrol both in binary citral: thymol and citral: carvacrol mixture and ternary citral: thymol: carvacrol mixtures, with additive indices (AI) of 0.41, 0.6 and 0.72, respectively against *V. destructor*. Interestingly, safety assessments against *Apis cerana* and *A. mellifera* indicated a higher safety profile for citral and its mixtures, with a selectivity ratio exceeding eight. The study suggests that combining natural bioactive components in essential oils could provide an environmentally friendly solution to fight *V. destructor* without harming honey bees. Additional research in honey bee colonies and investigation into the delivery mechanism are recommended to validate the findings from the laboratory.

**Key words:** Citral; Mixture, Complete exposure; Selectivity, synergistic interaction

O-04

Oral presentation : 꿀벌 병해충 I (Bee Health)

**Development of a Multiplex RT-PCR Diagnostic Method for the Predominant Three Species of Honey Bee Viruses in Uzbekistan**

**So-yoon Jang<sup>1,2</sup>, Minhyeok Kwon<sup>1,2</sup> and Eui-Joon Kil<sup>1,2</sup>**

<sup>1</sup>Department of Plant Medicals, Andong National University, Andong, Republic of Korea

<sup>2</sup>Agriculture Science and Technology Research Institute, Andong National University, Andong, Republic of Korea

In Uzbekistan, the industry using honey bees is actively taking place. However, due to lack of research on the disease, we developed a multiplex RT-PCR kit targeting major viruses identified through virome analysis using honey bees. First, designed three sets of primers targeting deformed wing virus, scabrood virus, and black queen cell virus, and checked whether the primers worked using RNA extracted from honey bees collected in Uzbekistan. Primer multiplex testing was performed using cloning products to select a suitable primer set. Then proceeded with primer concentration optimization. After, it confirmed that the primers were detected with the same brightness even at a cloned products of concentration of 50 to 1 ng/µL. Finally, Multiplex RT-PCR with quantified primers was confirmed based on RNA extracted from Uzbekistan honey bee. The multiplex RT-PCR diagnostic method developed through this study is superior in time and economic terms as it can detect three types of viruses simultaneously with a single PCR, and will be of great help in diagnosing honey bee viruses in Uzbekistan.

**Key words:** Uzbekistan, Honeybee virus, Virome analysis, Multiplex RT-PCR



O-05

## Oral presentation : 꿀벌 병해충 I (Bee Health)

## Development and Application of RT-RPA Based Detection Methods for the Diagnosis of Bee Viruses

Man-Cheol Son<sup>1,2</sup>, Seongbin Park<sup>1,2</sup>, Chuleui Jung<sup>1,2</sup>, Eui-Joon Kil<sup>1,2</sup><sup>1</sup>Department of Plant Medicals, Andong National University, Andong, Republic of Korea<sup>2</sup>Agriculture Science and Technology Research Institute, Andong National University, Andong, Republic of Korea

Among the viral diseases considered to be one of the causes of colony collapse disorder (CCD) in honeybees, Israeli acute paralysis virus (IAPV) and deformed wing virus (DWV) are receiving the most attention and are being studied. Diagnosing pathogens using the commonly known diagnostic method using PCR takes about 150 minutes and specialized equipment must be used. Recombinase polymerase amplification (RPA) is one of the isothermal amplification methods. It can amplify target genes in 20-30 minutes under isothermal conditions and has recently been studied for diagnosing various pathogens. This study aimed to diagnose IAPV and DWV using a one-step RPA method with the addition of reverse transcriptase and confirmed the optimized composition by adjusting the primer, temperature, reaction time, and the amount of amplification inducer added. As a results, the total diagnostic time can be shortened by nearly one-third. Furthermore, by simplifying experimental equipment, it will also be possible to design an field diagnostic method.

**Key words:** Honeybee, IAPV, DWV, isothermal amplification method, RT-RPA

O-06

## Oral presentation : 꿀벌 병해충 I (Bee Health)

## The role of vaccination in sustainable hive health: a One Health discussion

Nigel Swift, Fernando Riaza Carcamo, Isaac Weinberg

Dalan Animal Health, USA

This study addresses the critical role of honey bees (*Apis mellifera*) in global food security, highlighting their contribution to pollination and agricultural output, estimated at \$165 billion annually. In Korea, with approximately 2.5 million hives, significant colony losses are attributed to various stressors including parasites, environmental changes, pesticides, and diseases. Among the predominant pathogens are Varroa and Tropilaelaps mites, along with American Foulbrood (AFB), and several viruses, contributing to antimicrobial resistance. We present a novel vaccination approach against AFB using Trans-Generational Immune Priming (TGIP). This method involves administering a *P. larvae* bacterin to the queen bee, inducing immunity in her offspring. The vaccine is transferred via nurse bees' royal jelly, leading to expression in the queen's ovaries and consequent larval protection. Conditional licensure of this vaccine in the USA and Canada marks a significant step towards sustainable apiary health management. Ongoing studies aim to assess the vaccine's field safety and efficacy, particularly its impact on hive productivity and viral disease management. Our findings suggest that alongside traditional methods like mite control and hive hygiene, vaccination offers a promising strategy to rebuild apiary strength and reduce antibiotic use and resistance, underpinning the essential role of bees in environmental and agricultural ecosystems.

**Key words:** *Apis mellifera*, *Paenibacillus Larvae*, Colony Collapse, American Foulbrood, Antimicrobial Resistance





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2024.02.19.

# 구두발표 목련홀

• 양봉산물  
(Bee Product)



O-07

### Oral presentation : 양봉산물(Bee Product)

#### Evaluating Royal Jelly Quality from Korean Commercial Apiaries and Analyzing the Nutrient Content impact of Honey bee Feed

Sampat Ghosh<sup>1</sup>, Dong-Hee Lee<sup>2</sup> and Chuleui Jung<sup>1,3</sup>

<sup>1</sup>Agriculture Science and Technology Research Institution, Andong National University, Korea

<sup>2</sup>Industry Academy Cooperation Foundation, Andong National University, Korea

<sup>3</sup>Dept. Plant Medicals, Andong National University, Korea

The quality of royal jelly is closely tied to its nutritional content, making it a crucial indicator. In our investigation, we scrutinized various aspects of the nutritional composition, such as moisture, carbohydrate content, 10-HDA, Carbon isotope ( $^{13}\text{C}$   $\delta\%$ ), minerals, and amino acid composition in commercial royal jelly samples sourced from different apiaries in Korea. The moisture content in the examined royal jelly samples fell within the range of 57.3 to 61.2%. The estimation of 10-HDA ranged from 1.9 to 2.6 g per 100g of royal jelly on an as-is basis. Hierarchical cluster analysis revealed two distinct clusters aligning with higher carbon isotope and high sucrose content. These findings, particularly with a more extensive analysis of samples, could contribute to the establishment of a standardized quality for Korean Royal Jelly. Additionally, to understand if the nutritional quality of royal jelly production is influenced by bee feed, we conducted experiments with honey bee (*Apis mellifera*) colonies. The bees were fed different pollen patties containing oak or rapeseed pollen. Post-harvesting royal jelly, we analyzed its chemical composition, including proximate nutrients, amino acids, proteins, fatty acids, and minerals. Results indicated that pollen patties with varying nutritional levels had no significant impact on the nutritional composition, except for crude fat. The levels of 10-HDA, a key indicator of royal jelly quality, showed no significant difference between the oak and rapeseed treatments, with values of 1.9 and 2.1 g/100g, respectively. However, variations were observed in protein intensity, specifically in MRJP3 precursor, MRJP3-like, and glucose oxidase. This study implies that honey bees possess mechanisms to adjust nutritional standards, ensuring the fulfillment of brood and queen nutritional requirements during bee pollen collection and the secretion of bee bread and royal jelly.

**Key words:** Bee pollen, Pollen patty, Protein, Amino acid, Zinc, Iron, Nutrition supplement

**Acknowledge :** National Research Foundation of Korea (NRF), Ministry of Education, grant number NRF-2018R1A6A1A03024862

O-08

### Oral presentation : 양봉산물(Bee Product)

#### Unveiling Floral Diversity and Nutritional Profiling of Bee Pollens from Uzbekistan

Sukjun Sun<sup>1</sup>, Saeed Mohamadzade Namin<sup>2</sup> and Chuleui Jung<sup>1,2</sup>

<sup>1</sup>Department of Plant Medicals, Andong National University, Korea

<sup>2</sup>Agriculture Science and Technology Research Institute, Andong National University, Korea

Uzbekistan has a long history of beekeeping and rich tradition of bee product consumption. However, there exists a notable gap in research regarding the botanical origin and nutritional profile of honey and pollen in Uzbekistan. This study explored the floral diversity of three bee pollen products from Uzbekistan by morphological and molecular palynology. Also, the protein content and amino acid composition of the bee pollen samples were analyzed. A total of 31 plant taxa were detectable using molecular identification while only 12 plant taxa were identified using morphological palynology. The main plant taxa in the three bee pollen products were *Capparis spinosa*, *Onobrychis* sp. and Papaveraceae. The protein content was  $20.25 \pm 0.11$ ,  $16.93 \pm 0.16$  and  $17.23 \pm 0.11$ . The top five amino acids were Glutamic acid ( $2.57 \pm 0.02$ ), Aspartic acid ( $1.66 \pm 0.02$ ), Lysine ( $1.67 \pm 0.04$ ), Leucine ( $1.58 \pm 0.02$ ) and Alanine ( $1.25 \pm 0.01$ ). The study provides valuable information for beekeepers, indicating that diverse plant environments may contribute to the production of bee pollen with enhanced nutritional value.

**Key words:** Pollen, Nutrition, Palynology, Metabarcoding, Uzbekistan beekeeping

O-09

## Oral presentation : 양봉산물(Bee Product)

### Characterization of volatile compound detected in drone pupa (*Apis mellifera* L.) fat extract

Seonmi Kim, Soon Ok Woo, Se Gun Kim, Hyo Young Kim, Hong Min Choi, Sung Kuk Kim, and Sang Mi Han\*

Department of Agricultural Biology, National Institute of Agricultural Sciences, Rural Development Administration, Wanju 55365, Republic of Korea

The fat extract from drone pupa using water as as solvent possesses a distinctive aroma. The chemical characteristics and functional properties of this scent are not yet fully understood. Therefore, we utilized an electronic nose(e-nose) device based on gas chromatography to investigate its characteristics. The results revealed the detection of 16 volatile compounds in the drone pupa fat extract, with 2-methylthiophene being the most prominently detected. This substance is known for its distinctive sulfide aroma and its potential to influence the flavor of food through various chemical reactions. Consequently, drone pupa fat extract is anticipated to be utilized as a new functional raw material in the field of natural additives.

**Key words:** Drone pupa(*Apis mellifera* L.), Fat extract, Volatile compound

O-10

## Oral presentation : 양봉산물(Bee Product)

### The R&D of immunity strengthening functional propolis products by the water-soluble cocktail method

Hadong Kim, Jiheon Lee, Seungwan Lee

Seoul Propolis Co., Ltd. R&D Center

프로폴리스는 항산화 및 항염, 항균 효능이 있으며 항바이러스 효능도 최근 확인되었다. 400여 종의 polyphenol 과 flavonoid, terpenoid가 발견되어 프로폴리스를 기능성 소재로 활용하는 연구개발이 활발하게 추진되고 있다. 건강에 대한 관심 증가로 면역력 증진효과가 있는 기능성 소재나 건강기능식품이 주목받고 있어서, 프로폴리스와 기능성 천연소재를 결합하여 기능성이 증강된 수용성 프로폴리스 제품개발 연구가 요구되고 있다. 우리는 면역증진 건강기능식품 개발을 위해 각테일 공법 및 천연유화기술을 적용하여 항산화 및 면역력이 증강된 복합 기능성 제품을 개발함으로써 건강기능식품 시장 트렌드인 다중 기능성과 천연소재 활용에 맞춘 제품개발 연구를 진행하였다. 먼저, 각테일 공법 기술로 2~3개 원산지의 프로폴리스 원료를 브렌딩하고, 천연유화기술을 적용한 수용성 프로폴리스 추출 물을 제조하였고, 8종의 면역기능성분을 분석하였으며, 면역기능 강화를 위해 아연 등 기능성 소재를 추가하였다. 천연유화기술로 만든 수용성 프로폴리스 추출물의 안정성 시험을 실시하였으며, 제조된 시료의 항염효능시험을 실시하고, 면역기능 효능을 in vitro assay로 확인하였다. 면역기능 효능이 대조군 대비, IL-6 시험에서는 39%, TNF- $\alpha$  시험에서는 59%, NO 시험에서는 6.5%가 각각 증가되는 결과를 얻었다.

**Key words:** Soluble Propolis Extract, Cocktail Method, Natural Emulsion Technology, Immune Activity, Multi-Function



## O-11

## Oral presentation : 양봉산물(Bee Product)

**Pancreatic cancer cell death and blood sugar regulation by propolis and honey mixture**

Kim Sung-Kuk, Moon Si Won, Kim Hyo Young, Choi Hong Min, Kim Seon Mi, Lee Mun Seon and Woo Soon Ok

Division of Apiculture, National Institute of Agricultural Science

꿀벌이 수집하여 생산하는 프로폴리스는 수많은 식물에서 유래되기 때문에 매우 다양하면서도 뛰어난 생물학적 기능성을 가진 물질이다. 그러나 프로폴리스의 맛과 향이 독특하기 때문에 다양한 부형제를 혼합하여 섭취가 용이하도록 하고 있다. 본 연구에서는 국산 프로폴리스를 국산 아까시꿀과 혼합하여 제형을 제작하고 두 물질의 혼합에 따른 췌장암세포 사멸에 대한 기능성 효과를 검증하였다. 특히, 본 혼합 제형을 제작할 때 혼합과 필터링을 하는 순서에 따라 암세포에 대한 사멸 효과가 다르게 나타났으며, LC 분석을 통해 암세포 사멸에 효과가 있는 프로폴리스의 성분을 확인하였다. 췌장암세포에 대한 프로폴리스의 사멸 효과를 확인하고자 수행한 Western blotting에서 apoptosis에 관여하는 AIF, Bak, Bax, PARP 그리고 caspase-3의 경우 단백질 발현 증가 및 활성화가 나타나지 않았다. 그러나 세포 분열에 직접적으로 관련이 있는 Akt의 인산화, PCNA 발현 등이 감소되었고, 특히  $\beta$ -catenin과 mTOR에 의한 신호 경로가 프로폴리스에 의해 조절되는 것으로 보아 프로폴리스에 의한 췌장암세포 사멸 기전은 Wnt 신호 경로에 의한 것임을 알 수 있다. 특히 꿀과 프로폴리스를 혼합하였을 때 기능성 상승 효과가 일부 나타났으며, insulin 신호 경로에 의한 IRS-1, IRS-2의 발현이 프로폴리스에 의해 증가되는 것으로 보아 혈당 조절에도 관여하고 있음을 알 수 있다. 앞으로 프로폴리스에 의한 암세포 사멸 및 혈당 조절에 대해 보다 면밀한 연구가 필요하고, 다른 국가의 양봉산물과 비교하여 국산 양봉산물의 기능성 우위와 차별화를 구명해야 할 것이다.

**Key words:** Acacia honey, Propolis, Pancreatic cancer, Cell signaling**사사 :** 본 연구는 농촌진흥청 연구지원(과제번호:PJ01745701)으로 수행되었습니다.



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2024.02.19.

## 심포지엄 I 수련홀

• 디지털양봉의 현재와 미래  
(the current Status and Future Prospects of Digital  
(smart) Beekeeping)



## S-01

## Symposium : 디지털양봉의 현재와 미래

(the current Status and Future Prospects of Digital (smart) Beekeeping)

Controlling *vespa velutina* nest using drone

Su-Bae Kim, Yong-Soo Choi, Dongwon Kim, Bo-Sun Park, Chang hoon Lee, Daegun Oh

Apiculture Division, Department of Agricultural Biology, National Institute of Agricultural Sciences, RDA

2004년 국내 등검은말벌 최초 발견 이 후, 등검은말벌은 전국 확산 하여 국내 양봉 농가에 크나큰 피해를 입히고 있다. 등검은말벌은 평균 수고 높이 10m이상에 등지를 짓는 생태적 특징이 있는데, 이를 제거하기 위해서는 안전상의 문제점이 발생한다. 이 연구에서는 등검은말벌집을 방제하기 위하여 맞춤형 드론을 설계 및 제작을 하였고, 맞춤형 드론을 이용하여 등검은말벌집을 방제하는 연구를 수행하였다. 먼저 등검은말벌을 대상으로 클로티아니딘 30ppm을 처리 하였을 때, 접촉, 경구에서 240분 이후 모두 사멸하는 것을 확인 할 수 있었고, 등검은말벌집에 30ppm 클로티아니딘을 6L를 분사하였을 때, 말벌집 내 성충이 모두 사멸한 것을 확인 할 수 있었다. 또한 외부 여건 환경상 클로티아니딘을 처리 하기 힘든 조건에서 등검은말벌집을 방제하기 위하여, 제충국추출물을 이용하여 말벌집에 처리 하여 효과를 확인 해 본 결과, 제충국추출물 15%의 이상의 농도 처리 후 7일 경과 후 1분간 말벌 출입 개체가 발견 되지 않아 등검은말벌집의 방제 효과를 확인 할 수 있었다.

검색어: 등검은말벌, 말벌집 방제, 드론

## S-02

## Symposium : 디지털양봉의 현재와 미래

(the current Status and Future Prospects of Digital (smart) Beekeeping)

## 비주얼 카메라를 이용한 등검은말벌집 탐색

최인찬<sup>1</sup>, 정유석<sup>1,3</sup>, 전문석<sup>1,3</sup>, 이재수<sup>1</sup>, 유승화<sup>1</sup>, 김수배<sup>2</sup>, 김동원<sup>2</sup>, 김경철<sup>1</sup>, 이창우<sup>3\*</sup>,<sup>1</sup>국립농업과학원 농업공학부, <sup>2</sup>국립농업과학원 농업생물부, <sup>3</sup>군산대학교 컴퓨터소프트웨어학부

등검은말벌은 한국 양봉산업에 매년 1,700억원의 피해액을 주는 생태계 교란종으로 강한 번식력을 가지고 높은 위치에 서식함으로써 사람이 찾기에는 많은 어려움이 있다. 따라서 영상 데이터로 등검은말벌집을 탐색하고 실시간 위치 정보를 제공하여 드론 방제에 도움을 주고자 연구하였다. 드론으로 등검은말벌집 영상 데이터를 획득하고 YOLO-v5를 사용하여 학습하였다. 영상은 드론에 컴퓨터 Jetson Xavier와 RTK모듈, LTE 모듈, 카메라 등을 탑재하여 실시간으로 획득한다. 드론으로 획득한 4종류의 영상(해상도 640, 1,280, 1,920, 3,840) 데이터를 인공지능으로 학습 비교 분석하였다. 그중 3,840 해상도 모델이 검증 영상에 대해 오검출이 없었고 정밀도(Precision) 100%, 재현율(Recall) 92.5%, 정확도(Accuracy) 99.7%, F1 score 96.1%로 가장 좋게 검출하였다. 그리고 영상 정보를 통해 등검은말벌집 탐색과 위치 정보를 사용자에게 전달한다. 드론 비행 속도는 1m/s, 고도 25m로 설정하여 전라북도 완주군 경천면 일대 4곳에서 실제 비행 실험을 진행하였고 등검은말벌집을 탐색할 수 있었다. 추후 드론을 활용한 탐색에서 고도에 따라 달라지는 객체들에 대한 인공지능 탐지 정확성을 높이는 연구가 필요하며 이를 다른 분야에도 적용할 수 있을 것이다.

**Key words:** Artificial Intelligence, *Vespa Velutina* nest, Detection

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S-03

Symposium : 디지털양봉의 현재와 미래

(the current Status and Future Prospects of Digital (smart) Beekeeping)

Development of Unmanned Aerial Vehicles-based Wasp Tracking and Habitat Search Technology

Bosung Kim<sup>1,2</sup>, Jeonghyeon Pak<sup>1,2</sup>, and Hyoung Il Son<sup>1,2,3\*</sup>

<sup>1</sup>Department of Convergence Biosystems Engineering, Chonnam National University

<sup>2</sup>Interdisciplinary Program in IT-Bio Convergence System, Chonnam National University

<sup>3</sup>Research Center for Biological Cybernetics, Chonnam National University

생태계 관리 및 보호 관점에서 등검은말벌(*Vespa velutina*)과 같은 유해종 추적은 중요한 분야 중 하나다. 최근 개체수 조절을 통한 생태계 관리를 위해 센서네트워크 기반 추적 연구가 활발하지만, 곤충에 부착하기 위한 소형 센서는 불가피한 추적 오차를 포함하여 서식처 탐색에 문제가 된다. 본 연구는 이러한 오차를 보완할 수 있는 무인항공기 기반 말벌류 추적 및 서식처 탐색 기술을 제안한다. 본 탐색 및 기술은 추적 대상에 센서를 부착 및 방생 후 지향성 안테나를 장착한 무인항공기가 대상을 추적한다. 지향성 안테나는 모터 기반으로 회전하고, 수신된 신호 중 가장 강한 신호를 대상의 위치로 추정한다. 이후 추적 종료 시점에서 카메라를 장착한 드론이 추적 종료 지점 기준 반경 100m에 대한 항공 이미지를 촬영한다. 이후 촬영된 이미지를 사용해 3D 지도를 제작하고, 결과물에 대한 딥러닝 기반 객체 인식을 통해 서식처를 탐색 및 GPS 정보를 추출한다.

**Key words:** 무인항공기, 말벌, 추적, 서식처, 탐색

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S-04

Symposium : 디지털양봉의 현재와 미래

(the current Status and Future Prospects of Digital (smart) Beekeeping)

딥러닝 기반 말벌탐지 및 모니터링

이철희, 박희진

안동대 컴퓨터공학과

말벌방제는 양봉산업에서 해결해야 할 중요한 문제 중 하나다. 본 초록에서는 말벌을 탐지하고 모니터링하는 과정에 고려되어야 하는 주요 요소와 결과에 대하여 간략히 소개한다. 딥러닝 기반 말벌 모니터링에서는 학습데이터구축, 말벌탐지를 위한 딥러닝모델의 개발, 모니터링체계의 구축 등이 필요하다. 본 연구는 5종의 말벌과 1종의 꿀벌을 탐지하고 분류하는 연구로, 종별로 실험을 통해 적정데이터를 구축했으며 몸통중심 라벨링, 데이터정제에 동일한 데이터 양에서 mAP 측면에서 5.24% 개선되는 결과를 얻었다. 딥러닝 모델의 구성을 위해서 YOLOv2 ~ YOLOX까지의 모델을 최적화하는 연구와 YOLOX를 자체적으로 개선하는 방법을 모두 수행하였다. 결과 YOLOX가 말벌 탐지에 가장 우수하다는 결과를 얻었고 테스트 데이터 기준 평균 정확도는 96.13%이며 Pascal mAP기준으로 91.83%의 결과를 얻었다. 그리고 YOLOX의 백본을 개선함으로써 비슷한 정확도에서 35% 빠른 모델을 개발하였다. 그리고 작은 객체의 특성상 영상을 나누어 검출하는 타일링이 필요하다는 것을 확인하였고 타일링 기법을 적용하여 검출성능을 개선할 수 있었다. 모니터링 체계로는 독립형과 에지컴퓨팅을 활용한 검출 후 검출 정보를 text기반으로 전송하는 시스템 및 서버를 이용한 검출시스템을 구성하였다. 독립형 및 에지컴퓨팅방법에서는 YOLOx-nano모델에서 Jetson Xavier NX 기준으로 83.6% mAP@50(COCO), 13.3 FPS를 보였고 서버의 추론속도는 3090ti 기준 YOLOX 세부 모델에 따라 31~108 FPS 이며 서버기반 전체 모니터링 시스템의 종정확도 및 갯수정확도는 YOLOv4 모델에서 등검은 말벌 1,982프레임 기준으로 각각 약 85% 및 86%이며 1개의 3080ti GPU로 5개 봉군에 설치된 카메라로 동시 20 FPS처리가 가능함을 확인하였다. 그러나 실 적용시에는 지도 학습의 특성상 모든 모델은 객체와 카메라의 거리에 따라 성능저하가 발생하며, 타일링을 적용한 YOLOX모델로 최대 1m에서 말벌탐지가 됨을 확인하였다.

**Key words:** Vespa detection, Monitoring, Deep learning, Dataset





## S-05

## Symposium : 디지털양봉의 현재와 미래

(the current Status and Future Prospects of Digital (smart) Beekeeping)

## 지속가능한 양봉산업을 위한 디지털 양봉 기술 현황과 전망

정원기

농업회사법인 (주)온팜

최근 꿀벌 생태계는 기후변화에 따른 이상기온과 밀원지 감소, 해충 및 질병 만연 등의 심각한 위협과 맞닥뜨리고 있다. 이는 양봉 농가들의 생산량 저하 및 소득 감소로 이어지고, 꿀벌 화분매개 작물의 생산량 급감 등으로 지속가능한 양봉산업을 위태롭게 만드는 요인으로 작용될 것이다. 본 연구는 꿀벌 생태계 복원과 유지, 해충 및 질병을 조기 진단하거나 치료하는 등 디지털 양봉 기술을 활용한 국내외 사례를 살펴보고 앞으로 양봉산업이 나아갈 방향에 대해 제시하고자 한다. 디지털 양봉 기술은 벌통 환경 모니터링 및 제어 시스템, 해충 및 질병 진단 및 치료 솔루션, 영농일지 분석 및 밀원분포 지도 등의 빅데이터 기반 AI 시스템 등으로 나누어 볼 수 있다. 먼저 꿀벌의 생육환경을 모니터링하고 이상기온에 대응하는 온도조절 및 자동사양 등의 기초적인 시스템과 꿀벌의 증식 상황과 벌꿀 생산량을 계량화할 수 있는 활동량 분석, 벌통 내부 소리 변화에 따른 봉군 건강상태 유추 및 분봉시기 알람 등 벌통 내부 환경변화에 따른 정보수집 범위가 확대되고 있다. 또한 이스라엘의 비와이즈(Beewise)는 독일 연구진의 고온 처리 연구를 바탕으로 꿀벌 응애(Tropilaelaps Mercedesaе)에 대한 치료율을 60%까지 올렸으며, 2024년 국내에서 중국가시응애(Tropilaelaps Mercedesaе)에 대한 치료 검증 작업에 나설 계획이다. 그 외에도 산림청 임상도 빅데이터를 기반으로 꿀벌의 먹이가 되는 밀원수 정보를 선별하고 양봉농가 이용 효율을 높이기 위해 등급 분류된 전국 밀원수 분포도가 구글맵 기반으로 공개될 전망이다.

**검색어:** 디지털 양봉, 양봉산업, 지속가능한 농업

## S-06

## Symposium : 디지털양봉의 현재와 미래

(the current Status and Future Prospects of Digital (smart) Beekeeping)

## 꿀벌 해충 관리를 위한 공학기술의 접목

Changyeun Mo<sup>1\*</sup>, Hong-Gu Lee<sup>1</sup>, Jeong Yong Shin<sup>1</sup>, Su-Bae Kim<sup>2</sup>, Sujin Lee<sup>2</sup>

<sup>1</sup> Department of Interdisciplinary Program in Smart Agriculture, Kangwon National University, Chuncheon-si, Republic of Korea

<sup>2</sup> Sericulture and Apiculture Division, National Institute of Agricultural Science, Wanju-gu, Republic of Korea

기후변화와 병해충으로 인해 양봉산물의 생산성 감소, 군집 붕괴 등과 같은 양봉 농가의 피해가 발생하고 있다. 이러한 피해를 예방하기 위해 봉군 상태를 지속적인 관찰 및 관리를 하고 있다. 그렇지만 꿀벌응애류는 생애주기가 짧고, 벌통 외부에서 유입되는 경우도 있기 때문에 꿀벌 응애류의 감염률을 진단하고 관리하는 것이 어렵다. 현재 벌통 관리는 작업자의 전수검사에 의존하고 있으므로 이를 대체할 수 있는 기술 개발이 필요하다. 따라서 본 연구에서는 영상 기술과 인공지능을 이용하여 꿀벌응애로 인한 병해충을 모니터링하는 기술을 개발하였다. 양봉 병해충 모니터링을 위해 영상 획득 장치를 구축하고 영상 데이터를 획득하였다. 수집한 영상을 사용하여 데이터셋을 구축하였으며, 꿀벌응애 인식성능을 개선할 수 있는 영상처리 방법을 구명하였다. Convolutional Neural Network(CNN)과 You Only Look Once(YOLO) 알고리즘을 이용하여 꿀벌응애 식별 모델을 개발하였다. 꿀벌응애 식별 모델은 봉군의 상태를 진단하기 위한 양봉 객체를 포함하였다. 최종적으로 해당 인공지능 모델을 적용할 수 있는 모니터링 시스템을 개발하고 현장 적용 시험을 수행하였다. 현장 적용 시험 수행 결과, 꿀벌응애에 대해 92.47%의 식별 성능을 보였다. 본 연구 결과는 꿀벌응애류 병해충종합관리 시스템 개발의 주요 요소 기술로 사용할 수 있을 것으로 기대된다.

**Key words:** Integrated pest management, Digital beekeeping, Object detection, Computer vision, Deep Learning  
본 연구는 농촌진흥청 공동연구사업(과제번호 : RS-2023-00232224)의 지원에 의해 이루어진 것임



S-07

## Symposium : 디지털양봉의 현재와 미래

(the current Status and Future Prospects of Digital (smart) Beekeeping)

### Current Status and Perspectives of Intelligent Beekeeping Management Device Developments

Pingan Wang<sup>2</sup>, Sujin Lee<sup>3</sup>, Subae Kim<sup>3</sup>, Dongwon Kim<sup>3</sup> and Xiongze Han<sup>1,2\*</sup>

Department of Biosystems Engineering, Kangwon National University, Korea<sup>1</sup>  
Interdisciplinary Program in Smart Agriculture, Kangwon National University, Korea<sup>2</sup>  
Apiculture Division, National Institute of Agricultural Sciences, Korea<sup>3</sup>

To address the issues of an aging workforce, low automation, and the difficulty in transporting and inspecting bee frames and beehives in the South Korean beekeeping industry, which can further impact beekeepers' income, an intelligent beekeeping management device based on an electric tracked vehicle was developed. This device features a multi-functional loading box for transporting bee frames and beehives. It is equipped with a 5-joint auxiliary mechanism to assist beekeepers in opening and inspecting the lower hives. Through modeling and static-dynamic analysis in SolidWorks and RecurDyn, the device's safety and field passability were verified through multiple trials. Additionally, EEG experiments were conducted to determine the device's capability to alleviate fatigue in beekeepers and identify the specific regions affected. Finally, satisfaction surveys and surveys for improvement direction were conducted among dozens of beekeepers. In the future, the goal will be to further develop the automatic gripping function and autonomous driving capabilities of the beekeeping management device to enhance the automation level of beekeeping in South Korea.

**Key words:** Beekeeping, Automated auxiliary equipment, Mechanical analysis, Fatigue analysis.

S-08

## Symposium : 디지털양봉의 현재와 미래

(the current Status and Future Prospects of Digital (smart) Beekeeping)

### Conditions and functions of smart honey bee house for overwintering study

Yongrak Kang<sup>1</sup>, Chuleui Jung<sup>1,2</sup>

<sup>1</sup>Department of Plant Medicals, Andong National University  
<sup>2</sup>Agricultural Science and Technology Research Institute, Andong National University

The ecology and physiology of honey bees are sensitive to temperature, and their activities are greatly influenced by temperature changes, so it is necessary to find optimal conditions for honey bees in various environments. The objective is to design the bee houses and determine the optimal conditions for bees during the winter and the function of the house. Before and after the completion of the bee house, the temperature and humidity inside and outside the bee colony were monitored and flying activities were investigated. The temperature of inside honeybee colonies was  $7.9 \pm 1.35^\circ\text{C}$  in open field,  $8.5 \pm 1.78^\circ\text{C}$  in open field with shading,  $6.1 \pm 2.83^\circ\text{C}$  in rain cover house, and  $6.7 \pm 1.95^\circ\text{C}$  in shaded houses. The temperature of outside was  $1.8 \pm 3.83^\circ\text{C}$  in open field,  $1.6 \pm 4.35^\circ\text{C}$  in open field with shading,  $-0.9 \pm 5.02^\circ\text{C}$  in rain cover house, and  $-0.8 \pm 4.98^\circ\text{C}$  in shaded houses. The number of flying activities was confirmed to be 25 honeybees in the open field colonies. It appears that shading treatment and honeybee house can prevent the death of bees by suppressing their external activities.

**Key words:** Smart beekeeping, Abnormal climate, overwintering, Monitoring



S-09

## Symposium : 디지털양봉의 현재와 미래

(the current Status and Future Prospects of Digital (smart) Beekeeping)

## Utilizing Sensing Technology for Honeybee Colony Monitoring

Byoung-Jo Choi<sup>1</sup>, Sungtek Kahng<sup>2</sup>, Hyung-Wook Kwon<sup>3</sup>, Woogon Kim<sup>2</sup> and Jinseong Lee<sup>1</sup><sup>1</sup>Dept. of Embedded Systems Engineering, Incheon National University<sup>2</sup>Dept. of Information and Telecommunication Engineering, Incheon National University<sup>3</sup>Dept. of Biological Sciences, Incheon National University

효율적인 꿀 생산과 꿀벌의 건강을 위해 꿀벌의 행동과 주변 환경을 모니터링하고 보호하기 위한 센싱 기술은 전 세계에서 기업, 국가를 막론하고 다양한 방식으로 연구개발되고 있다. 본 연구에서는 꿀벌과 꿀벌 주변의 환경의 데이터를 수집에 필요한 다양한 종류의 센서와 기술, 방법론 등에 대한 고찰을 진행한다. 벌통 내부의 환경 모니터링과 주변 환경의 모니터링에 사용되는 온습도 센서와 기체관련 센서, 풍량 센서를 비롯한 양봉 모니터링 시스템에 사용되는 센서의 종류와 현황, 벌통에서의 꿀벌 이출입량을 계수하는 시스템과 시스템들의 방법론에 대해 다룬다. 또한 해당 기술들이 활용되고 있는 사례에 대해 알아본다. 이러한 봉군 모니터링 기술의 발전은 응애와 이상기상 등의 꿀벌 군집 붕괴현상을 막는데 일조하고 꿀벌의 건강과 생산성에 큰 기여를 할 수 있을 것이다.

**Key words:** honey bee population monitoring, environmental conditions, Sensors, Data, Scientific beekeeping

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S-10

## Symposium : 디지털양봉의 현재와 미래

(the current Status and Future Prospects of Digital (smart) Beekeeping)

## Utilization of ChatGPT in Beekeeping Industry and Apiculture Research

오대근, 조유영, 손민웅, 피터 아콩테, 이창훈, 박보선, 김수배, 최용수, 김동원

Apiculture Division, Department of Agricultural Biology, National Institute of Agricultural Science

최근 급격한 인공지능(AI; artificial intelligence)기술의 발달로 다양한 분야에서 AI 기술이 활용되고 있다. 특히 OpenAI에서 개발한 Chat GPT는 고객 서비스, 교육, 콘텐츠 생성, 초안 작성, 연구 및 데이터 분석 분야에서 복잡한 정보를 요약하고 분석하는데 사용되고 있다. 본 발표에서는 Chat GPT가 양봉산업과 연구에 어떠한 방식으로 사용될 수 있는지 이점과 단점을 검토하였다. 양봉산업에서의 Chat GPT의 활용은 양봉 지식에 대한 데이터베이스, 교육자료 작성, 시장 동향 및 분석, 마케팅, 최신 양봉 기술 검색, 양봉일지 작성 등에 사용될 수 있다. 양봉 연구 분야에서는 국제 연구 동향 파악, 문헌 검토 및 정보수집, 연구데이터 분석, 발표 ppt 작성, 영문 교정 등 다양한 방면에서 사용될 수 있다. Chat GPT는 다양한 방면으로 사용될 수 있지만 한계도 존재한다. 정확도와 신뢰성, 개인정보 및 데이터 보안 등이 문제 될 수 있다. 다른 매체를 통해 정확도와 신뢰성을 보완하고 민감한 데이터를 철저히 관리하며 사용하면, 빠르고 광범위한 정보 접근과 데이터 분석, 창의적인 아이디어를 얻을 수 있으며 이를 통하여 연구의 질과 범위를 넓히는 데 기여하고 양봉산업의 발전에 도움이 될 것으로 생각된다.

**Key words:** Honey bee, Beekeeping industry, Apiculture research, Chat GPT, Artificial intelligence, Ai.



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2024.02.20.

# 구두발표 무궁화홀

- 꿀벌 병해충 II  
(Bee Health)



## O-12

## Oral presentation : 꿀벌 병해충 II (Bee Health)

## The task forces of the COLOSS association and its missions

Victoria Soroker

Agricultural Research Organization, The Volcani Center, Rishon LeTzion, Israel  
sorokerv@volcani.agri.gov.il

The global activities of COLOSS (prevention of honey bee Colony LOSSes) association is organized in three Core Projects and nine Task Forces (TF), but the number of the Core projects and Task forces is flexible according to the emerging needs and threats to the apiculture. The work of the monitoring core project is done by using annual survey of beekeepers by questionnaire that is systematically revised and updated by the members. The questionnaire focuses mainly on revealing the extent of *Apis mellifera* colony losses and their potential risk factors. There is a large interest not only to increase the number of participating countries, but also to extend the survey to the other honey bee species. Lessons learn from *A. mellifera* monitoring can provide good basis for such a task. Regarding the biotic risk factors COLOSS TF addresses pathogens, predators and parasites. For example, Varroa control TF work as a team to promote sustainable solutions for management of this ectoparasite in the frame of integrated Varroa Management. In my talk I will present some group findings and current projects and invite all researchers, veterinarians and extensions to join our efforts.

**Key words:** *Apis mellifera* L., queen caging, Acaricide resistance.

**Acknowledge:** COLOSS members around the globe

## O-13

## Oral presentation : 꿀벌 병해충 II (Bee Health)

## Taxonomic notes on parasitic mites on honeybee in Korea

Jaeseok Oh<sup>1</sup>, and Seunghwan Lee<sup>1,2</sup>

<sup>1</sup>Laboratory of Insect Biosystematics, Department of Agricultural Biotechnology, Seoul National University

<sup>2</sup>Research Institute of Agriculture and Life Sciences, Seoul National University

The honey bee mite surveys in Korea, began in 1984, with additional investigations conducted in 1993 and 1995. Throughout this series of surveys, *Varroa destructor* (Anderson & Trueman), *Varroa underwoodi* (Delfinado-Baker & Aggarwal), and *Tropilaelaps mercedesae* (Delfinado & Baker) were recorded. However, *V. underwoodi* was not observed again after the initial record (Woo, 1992), and no further survey has been conducted. As the *Varroa* mites became one of the major factor of honeybee decline recently in Korea, a year-long survey was conducted in collaboration with beekeepers in 2023. A total of 480 samples were collected from 45 bee hives in 8 regions using the sugar powder shaking method. *V. destructor* dominated in most regions, while *Tropilaelaps* was found only in Gwangju city. The records of *V. underwoodi* will be discussed based on a literature review and re-examination of the deposited specimens, with the taxonomic review of the parasitic mites on honey bee in Korea.

**Key words:** Honeybee mite, *Varroa* mites, *Tropilaelaps*, *V. destructor*, *V. underwoodi*

O-14

Oral presentation : 꿀벌 병해충 II (Bee Health)

**The larvae of greater wax moth, *Galleria mellonella* affects the health of adult honeybees**

Yanling Xie and Huoqing Zheng

College of Animal Sciences, Zhejiang University, Hangzhou 310058, China

The greater wax moth (*Galleria mellonella*, GWM), is a ubiquitous pest of the honeybees. The impact of GWM on honeybee colony is inferred to be the damage on honeybee larvae and pupae caused by the feeding of GWM larvae on honeybee comb. Little is known about the impact of GWM on adult honeybees. We reared GWM larvae and honeybee (*A. cerana* or *A. mellifera*) workers in the same cages under various experimental conditions. We found that the survival of *A. cerana* workers was significantly affected when the bees coexisted with the GWM larvae in all experimental conditions. While for *A. mellifera* workers, this effect was only observed when bees were restricted from pollen nutrition. High-throughput sequencing revealed significant alterations in the microbial composition of *A. cerana* gut contents due to the presence of GWM, with no discernible differences observed in *A. mellifera*. Our study indicates an extra impact of GWM on the health of honeybee colonies. The alteration of gut microbial composition can be an explanation for the damage. However, research is needed to further explore the underlying mechanism.

**Key words:** *Galleria mellonella*, *Apis cerana*, *Apis mellifera*, survival, gut bacteria

**Acknowledge:** This work was supported by China Agriculture Research System of MOF and MARA (CARS-44).

O-15

Oral presentation : 꿀벌 병해충 II (Bee Health)

**Potential control of *Vespa velutina nigrithorax* using sex pheromone**

Dongui Hong<sup>1</sup>, Sungchae jung<sup>2</sup> and Chuleui Jung<sup>1,3</sup>

<sup>1</sup>Department of Plant medicals, Andong National University <sup>2</sup>

<sup>2</sup>AD Corporation

<sup>3</sup>Agriculture Science and Technology research Institute, Andong National University

Following the invasion of *Vespa velutina* in South Korea, adversely impacting biodiversity through honey bee predation and ecosystem disruption. This study explores the potential of using sex pheromones as a effective control *V. velutina nigrithorax* overwintering density. We synthesized pheromones reported in China, 4-OOA, 4-ODA, and 5-ODA, and made dispensers with rubber septum, silicon + polyethylen (PE) , and halloysite + PE. Field experiments were conducted in both China and South Korea. The emission pattern results concluded in the following order: silicon, rubber septum, silicon + PE, and halloysite + PE. In China, an average of  $0.9 \pm 0.3$  drones were captured per trap. In Korea, an average of  $0.7 \pm 0.3$  drones were captured per trap across. In this study, we tested the attraction of *V. velutina* drones to the sex pheromone in the field. Additionally, we addressed the potential impact on the overwintering density of queens.

**Key words:** Honeybee pest, invasive species, selective control. dispenser

**Acknowledgement:** This study was conducted with the support of the Rural Development Administration research project, 'Analysis of non-adapting patterns of honeybees according to climate changing environment.'



## O-16

## Oral presentation : 꿀벌 병해충 II (Bee Health)

Phenological and compositional changes of *Vespa* species from the long term monitoring data in KoreaSeongbin Bak<sup>1</sup>, Chuleui Jung<sup>1,2</sup><sup>1</sup>Department of plant Medicals, Andong National University, Andong, Republic of Korea<sup>2</sup>Agricultural Science and Technology Institute, Andong National University, Andong, Republic of Korea

Climate change has significant effects not only on individual level of development and reproduction but also on population and community level such as dynamics and interaction. During last 3 decades, average temperature increased by 1.4°C. We monitored *Vespa* hornets from apiaries nationwide to check the distribution and compositional changes among species. Additionally seasonal occurrence was monitored from 3 fixed points to check the phenological shift. In Jeju, no other *Vespa* species were found except for the *Vespa similima xanthoptera*, and *V.s.xanthoptera* was not found in other areas. The capture rate of the *Vespa velutina* increased until 2021, when it began to decline. When comparing native *Vespa* separately, only *Vespa mandarinia* showed a steady rate of occurrence, while the other *Vespa* showed some variability, with *Vespa similima similima* and *Vespa dybowskii* appearing to decrease with the increase of *V.velutina*, but *V.s.similima* began to increase again in 2021 when *V.velutina* decreased. In point surveys, the emergence of *Vespa* began at the lowest latitudes, and the earliest *Vespa* to emerge was the *V. velutina*.

**Key words:** Honeybee predator, Indicator species, Long-term observation, Community dynamics

**Acknowledgement:** This study was partly supported by the National Institute of Agricultural Sciences R&D grant(Pj01480803)

## O-17

## Oral presentation : 꿀벌 병해충 II (Bee Health)

## Effects of imidacloprid on Hypopharyngeal glands and GST isoenzyme profile

Makrina Tsinoglou<sup>1</sup>, Mirsini Charikleous<sup>2</sup>, Athanasios Papadopoulos<sup>2</sup>, Fani Hatjina<sup>1</sup><sup>1</sup>Department of Apiculture, Inst. of Animal Science, Ellinikos Georgikos Organismos 'DIMITRA', Nea Mou-dania, 63200, Greece<sup>2</sup>Laboratory of Animal Physiology, Department of Biology, Aristotle University of Thessaloniki, Thessaloniki 54006, Greece

It has been previously shown that sublethal doses of imidacloprid have behavioural and physiological effects on both *Apis mellifera* honey bee individuals and colonies. We applied physiological and molecular methods to detect intoxication of imidacloprid in honey bees. More specifically we measure the size of the hypopharyngeal glands (HPGs) and the isoenzyme profile of the GST detoxification enzyme. Our results showed that the observed changes were influenced by the mode of intoxication (chronic or acute), meaning that the chronic exposure to imidacloprid decreased more the diameter of the acini, than the acute exposure always compared to control bees. The exposure to imidacloprid resulted also to significant alterations in the expression profile of the isoenzymes of GST group. The implications of the effects are discussed.

O-18

Oral presentation : 꿀벌 병해충 II (Bee Health)

### Enhancing Honeybee Resilience: Curcumin as an Antidote to Mitigate Carbaryl-Induced Harm and Promote Sustainable Pollination

Saeed Mohamadzade Namin<sup>1</sup>, Tekalign Begna<sup>1</sup>, Youngrak Kang<sup>2</sup>, Daniel Bisrat<sup>3</sup>, Delgermaa Ulziibayar<sup>2</sup>, Arezoo Najarpour<sup>2</sup>, Chuleui Jung<sup>1,2</sup>

<sup>1</sup>Agriculture Science and Technology Research Institute, Andong National University, Republic of Korea

<sup>2</sup>Department of Plant Medicals, Andong National University, Republic of Korea

<sup>3</sup>Department of Pharmaceutical Chemistry and Pharmacognosy, School of Pharmacy, College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia

Honeybees play a crucial role as vital pollinators in global food production, yet their populations are under severe threat due to exposure to agrochemicals like carbaryl. This study investigates the potential of curcumin as an antidote to mitigate carbaryl-induced harm to honeybees. In the acute toxicity test, honeybees were divided into two groups. The first group underwent topical intoxication with carbaryl, followed by exposure to varying concentrations (50, 100, and 200 ppm) of curcumin (post-feeding) for 48 hours. In contrast, the second group was initially fed with curcumin for 48 hours and then subjected to a lethal dose of carbaryl through topical exposure (pre-feeding). This experimental protocol was applied separately to both newly emerged bees and foragers. Additionally, the impact of curcumin at a concentration of 100 ppm on honeybees subjected to chronic oral intoxication through continuous feeding of carbaryl at concentrations of 2.5 and 5 ppm was assessed. Results from the acute toxicity test revealed that curcumin 100 ppm significantly decreased the mortality of both newly emerged honeybees and foragers only in post-feeding experiments. Transcriptome analysis indicated a significant enhancement in the expression of detoxification related enzymes in the abdomen and gut of the honeybees treated with curcumin after exposure. In chronic tests, curcumin demonstrated a capacity to decrease carbaryl toxicity in both low and high pesticide concentrations. This study encourages the adoption of curcumin as a supplementary component in honeybee diets, emphasizing its potential to safeguard honeybee populations and sustain global food production.

**Key words:** Honeybee, Pesticide, Pollination, phenolic compounds, detoxification

O-19

Oral presentation : 꿀벌 병해충 II (Bee Health)

### Exploring the Impact of Different Carbohydrate Types on Honeybee Longevity and Hypopharyngeal Gland Dimensions

Arezoo Najarpour<sup>1</sup>, Saeed Mohamadzade Namin<sup>2</sup>, Sampat Ghosh<sup>2</sup> and Chuleui Jung<sup>1,2</sup>

<sup>1</sup>Department of Plant Medicals, Andong National University, Republic of Korea

<sup>2</sup>Agricultural Science and Technology Institute, Andong National University, Republic of Korea

Carbohydrates play a crucial role as a primary energy source for honeybees, influencing their overall fitness and resilience. Given the potential implications for colony dynamics, foraging efficiency, and long-term survival, it is imperative to analyze the effects of various carbohydrates on honeybees. This study aimed to investigate the impact of diverse carbohydrate sources on honeybee longevity. Newly emerged honeybees were provided with a range of carbohydrates, including white sugar, brown sugar, corn syrup, maltose, acacia honey, and chestnut honey, at libitum and their effect on honeybee longevity was analyzed. The study also assessed the influence of diet on other parameters such as food consumption and the size of hypopharyngeal glands. Results revealed significant disparities in honeybee longevity, with the group fed corn syrup exhibiting the highest longevity, followed by acacia honey and white sugar syrup. Conversely, the group consuming chestnut honey demonstrated the lowest longevity. Additionally, notable variations in hypopharyngeal gland size were observed, with honeybees fed corn syrup displaying larger glands compared to other treatment groups. Increased food consumption was noted in the group fed lower concentrations of carbohydrate sources, while honeybees consuming higher concentrations (such as acacia honey, chestnut honey, and corn syrup) exhibited significantly higher water consumption. Contrary to prevailing beliefs that a higher proportion of monosaccharides and disaccharides benefits honeybees, our findings challenge this notion. Specifically, corn syrup, containing a substantial portion of higher-order carbohydrates, demonstrated higher longevity, offering a potential avenue for understanding this intriguing phenomenon. Further detailed analysis is required to unravel the sources of these differences and deepen our understanding of their implications.

**Key words:** *Apis mellifera*, nutrition, lifespan, carbohydrate.



O-20

Oral presentation : 꿀벌 병해충 II (Bee Health)

### Identifying Effects and Markers Related to *Apis mellifera ligustica* Honey Bee Health

Olga Frunze<sup>1,2,†</sup>, Hyun Jee Kim<sup>1,2,†</sup>, Byung-ju Kim<sup>1,2</sup>, Jeong-Hyeon Lee<sup>1,2</sup>, Hyung-Wook Kwon<sup>1,2\*</sup>

<sup>1</sup>Department of Life Sciences, Incheon National University, Republic of Korea;

<sup>2</sup>Convergence Research Center for Insect Vectors (CRCIV), Incheon National University, Republic of Korea

\* Correspondence: hwkwon@inu.ac.kr; †These authors contributed equally to this work

Honey bees are crucial for ecology, but the molecular markers indicating their health are unknown. To identify these markers, we analyzed ten defense system genes in *Apis mellifera ligustica* honey bees from winter (Owb) and spring (Fb for foragers and Nb for newly emerged) populations sampled in February and late April 2023. Focusing on colonies free from SBV and DWV, we found five health markers. Seasonal markers domeless and spz genes were significantly downregulated in Owb compared to Nb and Fb bees. The task-related marker gene apid-1 was downregulated in Owb and Nb compared to Fb bees, while recommended general health markers, SOD and defensin-2, were upregulated. These markers allow for bee health diagnosis without colony intervention, especially during low-temperature months, helping beekeepers make timely adjustments to prevent seasonal losses.

**Key words:** Honey bee, Health markers, Innate immunity, Defense system, Antioxidant system, *Apis mellifera ligustica*  
This work was carried out with the support of Cooperative Research Program for Agriculture Science & Technology Development (RS-2023-00232749) and the Priority Research Centers Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2020R1A6A1A03041954).





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2024.02.20.

## 심포지엄 II 무궁화홀

- 산림밀원의 확대 및 공적 기능 강화  
(Expanding honey forest and enhancing public service)



S-11

### Symposium : 산림밀원의 확대 및 공적 기능 강화 (Expanding honey forest and enhancing public service)

#### Major honey plants in the central region of Korea, evaluated by foraging preferences of honeybees

Seunghun Jung<sup>1</sup> and Seunghwan Lee<sup>1,2</sup>

<sup>1</sup>Laboratory of Insect Biosystematics, Department of Agricultural Biotechnology, Seoul National University

<sup>2</sup>Research Institute of Agriculture and Life Science, Seoul National University

Honeybees and other wild bees that visit flowers, contribute greatly to the ecosystem and agriculture by acting as pollinators for various plants. Additionally, honeybees produce a variety of beekeeping products, such as honey, through their foraging activities on honey plants. In this study, we selected two national forests in the central region of Korea, Mt. Gariwang and Mt. Yumyeong to investigate the regional diversity of honey plants and their flowering period. The honey plants are also evaluated by the preference of honeybee foraging. As a result, we identified that the diversity of honey plants in Mt. Gariwang was higher than in Mt. Yumyeong. In the two regions, we identified 13 species of major honey plants that are highly preferred by honeybees, and 31 species of supplementary honey plants. The flowering period of honey plants was about one to two weeks earlier in Mt. Yumyeong from April to June, due to the higher altitude of Mt. Gariwang.

**Key words:** Honey bee, Honey plant, Foraging preference, National forest, Korea

**Acknowledgments:** This study was carried out with the support of 'R&D Program for Forest Science Technology (2021362B10-2323-BD01)' provided by Korea Forest Service (Korea Forestry Promotion Institute).

S-12

### Symposium : 산림밀원의 확대 및 공적 기능 강화 (Expanding honey forest and enhancing public service)

#### Threats to Honeybee: Investigation of Potential Predators in Apiary

Jong-Hwa Oh<sup>1,2</sup>, Deokyoung Park<sup>1</sup>, Seunghun Jung<sup>1</sup> and Seunghwan Lee<sup>1,3</sup>

<sup>1</sup>Laboratory of Insect Biosystematics, Department of Agricultural Biotechnology, Seoul National University

<sup>2</sup>Forest Insect Pests and Disease Division, National Institute of Forest Science, Seoul, Republic of Korea

<sup>3</sup>Research Institute of Agriculture and Life Science, Seoul National University

Honeybees are vulnerable to attacks throughout their developmental stages from various natural enemies, including parasites, pests, predators, and diseases. These adversities disrupt honeybee colonies, leading to a significant decline in honey production and honeybee population itself. In this study, we investigated the arthropod fauna in Mt. Yumyeonsan and Mt. Gariwangsan, both identified as a potentially ideal habitats for beekeeping models. Specifically, we explored potential predators in apiculture, with a focus on the composition of spiders and vespid wasps. In Mt. Yumyeongsan, we identified 33 species of spiders and 16 species of vespid wasps that are considered potential honeybee predators. Similarly, 28 species of spiders and 18 species of vespid wasps were identified as a potential hazard to honeybees in Mt. Gariwangsan. Additionally, key predators of each spider species, such as *Trichonephila clavata*, and vespid wasp species, including *Vespa simillima simillima*, were identified.

**Key words:** Honeybee, Spider, Wasp, National forest, Korea

**Acknowledgments:** This study was carried out with the support of 'R&D Program for Forest Science Technology (2021362B10-2323-BD01)' provided by Korea Forest Service (Korea Forestry Promotion Institute).

S-13

**Symposium : 산림밀원의 확대 및 공적 기능 강화**  
(Expanding honey forest and enhancing public service)

**Habitat Suitability Assessment of Major Honey Tree Species in Mt. Gariwang and Mt. Yumeong**

Yong-Ju Lee<sup>1,2</sup>, Min-Ki Lee<sup>2,3</sup>, Hae-In Lee<sup>1,2</sup> and Chang-Bae Lee<sup>1,2,3</sup>

<sup>1</sup> Department of Climate Technology Convergence (Biodiversity and Ecosystem Functioning Major), Kookmin University

<sup>2</sup> Forest Carbon Graduate School, Kookmin University

<sup>3</sup> Department of Forest Resources, Kookmin University

본 연구에서는 우리나라의 대표 천연림인 가리왕산과 인공림 위주의 유명산에 자생하는 주밀원수종인 음나무, 피나무류, 뽕나무류, 쪽동백나무를 대상으로 머신러닝기법 중 하나인 MaxEnt 모델을 활용하여 서식지 적합성 분석을 수행하였다. 모형 분석 결과, 모형의 설명력을 나타내는 AUC 값은 대부분의 밀원수종이 0.7 이상이었다. 주밀원수종의 서식지 적합성에 대한 환경 변수 반응 곡선 결과, 서식지 적합성에 영향을 미치는 주요 환경 변수는 고도, 연평균 강수량, 연평균 기온으로 나타났다. 이는 주밀원수종의 분포 패턴 설명에 있어 고도 구배에 따른 기후 인자가 주요한 환경 변수임을 의미한다. 본 연구는 우리나라 밀원수림 조성 및 관리 전략수립 뿐만 아니라 밀원수종의 잠재적 분포도 제작 시 근거 자료로써 사용될 수 있을 것이다. 향후 다층위 밀원수림의 조성을 통한 꿀과 화분의 생산량 증대 및 꿀의 주년 생산을 위해서는 생물학적 변수를 반영한 추가적인 지역 단위의 다양한 데이터 수집과 분석이 필요할 것이다.

**Key words:** Habitat suitability. Machine learning, Major honey tree, MaxEnt, Species distribution model  
**사사:** 본 연구는 산림청(한국임업진흥원) 산림과학기술 연구개발사업 '(2021362C10-2323-BD01)'의 지원으로 이루어진 것입니다.

S-14

**Symposium : 산림밀원의 확대 및 공적 기능 강화**  
(Expanding honey forest and enhancing public service)

**Economic valuation of pollination resources in national forests of Mt. Gariwang and Mt. Yumyeong relative to beekeeping**

Kwanhui Lee<sup>1</sup> and Chuleui Jung<sup>1,2</sup>

<sup>1</sup>Insect ecology Lab, Department of Medicals, Andong National University

<sup>2</sup>Agriculture Science and Technology Research Institute, Andong National University, Korea.

Pollination dependency (PD) is an important plant trait for successful production and reproduction. PD interact with pollinator diversity which are closely related to the flower reward such as pollen and nectar. We studied the PD and amount of pollen and nectar for the potential honey plants in the national forest of Mt. Gariwang and Mt. Yumyeong. Additionally we estimated the total seed production from those honey plants relative to PD. A total of 50 plant species were surveyed in the two mountains, with an average PD of 56.5%. The nectar were dominated by *Tilia amurensis*, *Kalopanax septemlobus*, *Acer ginnala*, and *Styrax obassia*. Pollen sources were dominated by *Tilia amurensis*, *Kalopanax septemlobus*, and *Aralia elata*. Further, based on the honey plant composition and distribution in these two mountains, Based on these data, economic value of pollen and nectar as well as the seed production was estimated as KRW 176 million in Mt. Gariwang and KRW 80 million in Mt. Yumyeong. The results are expected to provide basic information for the selection of tree species for the forestation of honey trees and for assessing the economic value of the bee products obtained.

**Key words:** pollination, nectar resources, forest beekeeping, honey bee

**Acknowledgement:** This study was partly supported by the Korean Forest Service R&D grant (20211362A00-2123-BD01).



S-15

### Symposium : 산림밀원의 확대 및 공적 기능 강화 (Expanding honey forest and enhancing public service)

#### Development of evaluation indicators and case application research for the creation of honey plant complex

Sora Kim, Suhui Min, Hogeun Yun, Hyerim Lee, and Jungeun Song

Forest Research Bureau, Korea Forest Conservation Association

기후변화, 병해충 발생, 아까시나무의 노령화 등으로 국내 밀원자원이 감소함에 따라 국가차원에서 밀원자원의 확충을 위한 정책수립이 이루어지고 있으나 세부적인 사항은 제시되지 않는 한계가 있다. 이에 기후대 및 지역특성 등을 고려한 밀원단지 조성 관련 세부적인 지침이 필요하다. 본 연구에서는 고정식 양봉을 위한 밀원단지를 조성하기 위하여 사례조사를 기반으로 밀원단지 조성 관련 평가지표를 도출하였으며, 도출된 평가지표를 사례지역에 적용하여 고정식 밀원단지 조성안을 제시하였다. 평가지표는 국내외 밀원단지 및 밀원수 식재 등에 관한 국내외 선행연구, 지침, 조성사례 등을 검토하고 한봉·양봉 관련자 인터뷰를 기반으로 도출하였다. 밀원단지 조성을 위한 평가지표는 입지, 수종선정, 조성으로 구분하였다. 입지 평가지표는 밀원 자원 분포 지역, 벌채 및 조림 가능지역, 임도 시설 구축 지역으로, 수종 선정 평가지표는 조성단지 기능, 개화 시기, 생육 조건, 밀원자원 생산성, 선호 수종, 다층림 임분으로, 조성 평가지표는 식재간격으로 도출하였다. 유명산자연휴양림과 가리왕산 경영계획구를 대상으로 평가지표를 적용하여 고정식 밀원단지 조성계획안을 작성하였다. 밀원 단지는 상·중·하층으로 구분하고 3계절 밀원 자원을 생산할 수 있도록 수종을 구성하였다. 밀원단지 조성을 위한 평가지표는 향후 산림자원분야 사업계획의 밀원수립 조성 계획 수립시 활용할 수 있다.

**Key words:** 밀원자원, 평가지표, 입지, 수종선정, 밀원단지 조성계획

S-16

### Symposium : 산림밀원의 확대 및 공적 기능 강화 (Expanding honey forest and enhancing public service)

#### Proposals for the Expansion of Honey Plant Complexes in Koera

Sung-Joon Na

Forest Bioresources Department, National Institute of Forest Science

As the scale of the beekeeping industry in South Korea continues to grow, there is a need for the expansion of honey plant complexes. This study proposes three multi-functional honey plant complex development methods based on Korea's forestry policies, aiming to satisfy various stakeholders while providing food resources for pollinators. The first method is 'specialized honey forest'. This type of forest is primarily focused on honey production and can be integrated with timber production forests in Korea. Recommended trees for honey resource that can also be utilized as timber production include Black locust, tulip tree, and *Tilia* spp. The second method is 'Ecological Landscape-Honey Forest'. It involves using honey plants used in landscaping to provide food resources for pollinators while conserving the landscape. Plants suitable for this special purpose include camellia, Box-leaf holly, and Seven Son Flower. Lastly, utilizing forest produce production sites, the 'Integrated Management Honey Forest' is proposed. A forest primarily dedicated to forest produce production can serve as an excellent honey plant complex. Trees such as Oriental raisin tree, chestnut, and Bee bee tree are valuable resources for this purpose.

**Key words:** honey plant, multi-Purpose, wood production, ecological landscape, forest byproduct

**Acknowledge :** This study was carried out with the support of 'R&D Program (Project No. FG403-2023-01-2024)' provided by NIFoS.

S-17

**Symposium : 산림밀원의 확대 및 공적 기능 강화**  
(Expanding honey forest and enhancing public service)

**Effects of Rising Winter Temperatures and Day Length on Spring Flowering Time in Future Warm Climates**

**Sukyung Kim<sup>1</sup>, Dayoung Kang<sup>1</sup>, Minsu Lee<sup>1</sup>, and Hyun Seok Kim<sup>1,2,3</sup>**

<sup>1</sup>Department of Agriculture, Forestry and Bioresources, Seoul National University, Republic of Korea

<sup>2</sup>Interdisciplinary Program in Agricultural and Forest Meteorology, Seoul National University, Republic of Korea

<sup>3</sup>Research Institute for Agricultural and Life Sciences, Seoul National University, Republic of Korea

To understand the response of flowering time to climate change, we quantified the effect of spring warming, fall/winter chilling, and day length on flowering time of seven species (*Cornus officinalis*, *Rhododendron mucronulatum*, *Forsythia koreana*, *Prunus yedoensis*, *R. yedoense* var. *poukhanense*, *R. schlippenbachii*, and *Robinia pseudoacacia*) using process-based models and flowering data collected from nine arboreturns across South Korea over nine years. The models considering both warming and chilling did not outperform those focusing solely on warming, and the performance change upon adding a day length term to the model differed by species. These findings suggest that winter chilling has little effect on the flowering time of these seven species, and the effect of day length on the flowering time is associated with species-specific characteristics. If daylength-sensitive species show minimal changes in flowering time compared to other species in future climates, this may result in phenological mismatch with pollinators and threaten their reproduction.

**Key words:** Spring flowering, Spring warming, Winter chilling, Day length, Process-based model

**Acknowledge :** This research was funded by the National Institute of Forest Science and Korea Forest Service (FE0500-2018-02).

S-18

**Symposium : 산림밀원의 확대 및 공적 기능 강화**  
(Expanding honey forest and enhancing public service)

**A report on changes in spring flowering duration of seven Korean tree species over the last 52 years and the potential resultant effect at the community-level**

**Min-Jung Kim<sup>1</sup>, and Chuleui Jung<sup>2</sup>**

<sup>1</sup>Forest Entomology and Pathology Division, National Institute of Forest Science, Seoul 02455, Republic of Korea

<sup>2</sup>Department of Plant Medicals, Andong National University, Andong 36729, Republic of Korea

Despite numerous reports on shifts in flowering times, studies focusing on the duration of flowering have been relatively limited, often due to the lack of comprehensive data. This study utilizes phenological datasets from 1970 to 2021 that include both first and full flowering dates of seven temperate tree species across 16 locations in Korea. We analyzed trends in these phenological events over time on a day-of-year (DOY) basis and assessed floral seasonality at both national and regional scales, specifically focusing on these seven tree species. Our findings reveal a more rapid advancement in the full flowering dates compared to first flowering dates for most species, except for the Japanese apricot. This indicates a general trend of shortened flowering duration. These trends suggest potential shifts in the floral community, including a reduction in the connectivity of flowering times among species with non-overlapping flowering seasons. Nationally, regional variations in flowering times seem to be decreasing. Although our analysis is based on a limited number of plant species, the potential impacts identified underscore the need for strategies to manage plant-pollinator mismatches, such as by enhancing the diversity of the spring flora.

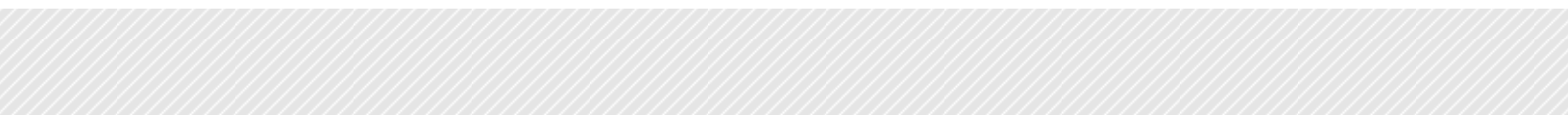
**Key words:** Flowering phenology, spring flower, phenological shift, flowering duration, connectivity, co-flowering



2024년 제40차

# 한국양봉학회 정기총회 및 COLOSS Asia 국제학술대회

“꿀벌의 건강과 지속가능한 양봉산업을 위한 공적기능 강화”





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2024.02.20.

## 구두발표 목련홀

• 화분매개 및 밀원식물  
(Pollination & Honey Plant)



O-21

## Oral presentation : 화분매개 및 밀원식물(Pollination & Honey Plant)

### Assessing niche overlap of bees, butterflies, and hoverflies in plant-pollinator networks

Ehsan Rahimi<sup>1</sup>, and Chuleui Jung<sup>1,2\*</sup>

<sup>1</sup>Agriculture Science and Technology Research Institute, Andong National University, Republic of Korea

<sup>2</sup>Department of Plant Medicals, Andong National University, Republic of Korea

Pollinators play a critical role in maintaining biodiversity and ensuring the reproduction of many angiosperm plants. By studying plant-pollinator networks, researchers can develop targeted conservation and restoration strategies to ensure the long-term sustainability of both plant and pollinator communities. In this context, the objective of this research is to assess niche overlap among bees, butterflies, and hoverflies in plant-pollinator networks at different taxonomic levels. Using data from approximately 37000 interactions between plants and pollinators, we identified highly visited pollinators and host plants across 205 networks worldwide. All pollinators and plant species were classified into 25 and 48 orders, respectively. By comparing attractive genera for the three pollinator groups, we identified commonalities. Among the top 10 attractive genera, there are four shared attractive genera for bees and hoverflies, three for bees and butterflies, and four for butterflies and hoverflies. For bees, the appealing plant genera were *Rubus*, *Echium*, and *Cirsium*; for butterflies, they were *Senecio*, *Cirsium*, and *Potentilla*; and for hoverflies, they were *Potentilla*, *Rubus*, and *Senecio*. This suggests that overall niche overlap is not extensive across all groups. Each group seems to have specific preferences for certain plant genera, indicating distinct desires and interactions. Certain plant families such as Asteraceae, Fabaceae, and Rosaceae were found to be attractive to all pollinator groups, which could be useful in designing effective pollination strategies. In conclusion, the results of this study provide valuable insights into the dynamics of pollinator-plant interactions and highlight the importance of considering the taxonomic relationships between these groups.

**Key words:** Plant-pollinator networks, taxonomic attractiveness, pollinators, niche overlap.

O-22

## Oral presentation : 화분매개 및 밀원식물(Pollination & Honey Plant)

### Environmental Big Data based Implementation of the Honey Production Environment Grade Map

Jea-Chul Kim, Hyeon Seung Shin and Jin-Hwan Jeong

AirTech Inc

Increased frequency of extreme weather events due to climate change is causing regional shifts in flowering times and constraining beekeeping activities, which has impacted bee populations and productivity. To minimize this damage, we have developed a system that allows beekeepers to manage their apiary environment and support efficient activities during swarming season. The honey production environment grade map is based on land use data from the Ministry of Environment and uses gust generation information based on slope and extreme weather index using MK-PRISM as the main variables. The built environment DB was normalized to build a grid-like regional dense environment grade map. In addition, the high-resolution grid data of the Korea Meteorological Administration was built as an average year DB, and a system to analyze the beehive environment of the target year was established. In this study, we created a productivity class map using high-resolution grid data from the Korea Meteorological Administration and forest environment data. Through this, the productivity of the target area was identified and indicators for services were derived. The decision-making service for beekeeping activities that considers local weather information can be used as a basis for stable beehive operation and bee population management.

**Key words:** Migratory beekeeping, Extreme weather, Activity index, Environment Grade Map



O-23

Oral presentation : 화분매개 및 밀원식물(Pollination & Honey Plant)

주요 밀원식물 찰피나무의 특성과 우량개체 선발

김세현<sup>1,2</sup>, 이경미<sup>2</sup>, 이재천<sup>2</sup>, 최완용<sup>2</sup>, 이문호<sup>2</sup>

<sup>1</sup>순천대학교, <sup>2</sup>국립산림과학원

주요 밀원식물 찰피나무의 특성과 우량개체를 선발한 결과는 다음과 같다. 찰피나무의 성장양상, 자람새 및 우점도를 고려하여 계곡부(A형), 산복부(B형), 산허리형(C형) 등 15개 집단을 선발하였다. 선발 집단의 임분 구성은 생육권역, 입지환경, 임분내력 등에 따라 다르게 나타났으며, 상층 임관은 신갈나무, 찰피나무, 물푸레나무, 고로쇠나무, 층층나무 등이 우점하였으나 진도 임회 집단은 후박나무, 구실잣밤나무 등 난대성 상록수가 우점하는 것으로 나타났다. 종 다양성에서 출현종수 11.5종, 유효종수 7.5종, 우점하고 있는 3수종의 점유율은 55%로 나타났다. 찰피나무의 점유율은 11.7%로 가시나무(12.3%), 종가시나무(19.3%)보다 다소 낮게 나타나 비교적 군집성이 낮은 수종으로 확인되었다. “활엽수 수형목 선발 기준”을 근간으로 목측선발, 기선선발을 병용하고 백두대간을 중심으로 주 분포지 11개 집단에서 82본, 유전다양성 확대를 위해 경기 양평, 경북 문경, 전남 곡성, 진도 등 주 분포지 외 4개 집단에서 11본 등 총 93본을 선발하였다. 성장 및 적응특성 지표는 개별집단(GVp) 및 전체집단(GVt) 수준에서 표준화하여 통합지표(GVh)를 산출하여 이를 근거로 선발 기준인 기선(base line) (BL) > GVh(상위 55%)인 0.1874로 설정하여 42본을 2차 선발하였다. 선발된 GVp(상위 55%), GVt(상위 55%)의 조건을 충족시키는 개체 중에서 동일 생육권에 서 과다 선정된 3본을 제외하였고, 입지환경이 열악한 측면과 유전적 다양성을 고려하여 3집단 3본을 추가하여 최종 42본을 우량개체로 선발하였다.

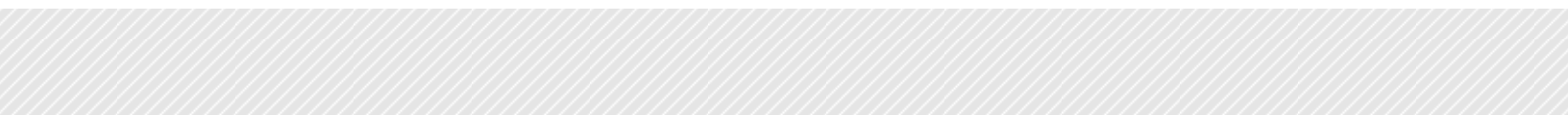
**Key words:** *Tilia mandshurica* Rupr. & Maxim. Superior tree, Selection, Honey plants, Tree breeding  
**사사:** 위과제는 국립산림과학원 2023년 위탁연구과제(FG0040-2019-01)로 수행된 과제입니다.



2024년 제40차

# 한국양봉학회 정기총회 및 COLOSS Asia 국제학술대회

“꿀벌의 건강과 지속가능한 양봉산업을 위한 공적기능 강화”



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2024.02.20.

# 구두발표 목련홀

• 꿀벌생리  
(Bee Biology)



## O-24

## Oral presentation : 꿀벌생리(Bee Biology)

## Stingless Bees Tongue Morphology is Different Compared to Honeybees

Sarah Najiah Ramli<sup>1</sup>, Suhaila Ab Hamid<sup>2</sup> and Norasmah Basari<sup>1,3</sup><sup>1</sup>Faculty of Science and Marine Environment, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia<sup>2</sup>School of Biological Sciences, Universiti Sains Malaysia, 11800 Minden, Pulau Pinang, Malaysia<sup>3</sup>Special Interest Group Apis and Meliponine, Universiti Malaysia Terengganu

In Malaysia, stingless bee species such as *Tetragonula laeviceps*, *Heterotrigona itama*, and *Geniotrigona thoracica* are bred to pollinate crops and produce honey. The bees extract nectar from the flowers with their mouthparts, which are attracted by different concentrations. It is important to understand the morphology of these bee species in order to understand their robust foraging habits. This study aims to investigate the detailed structure of the mouthparts of the three species of stingless bees, focusing on the tongue (glossa) structure. The results showed that each species has a different flabellum geometry. Contrary to honey bees, each sensilla on the flabellum of stingless bees consists of a single sensilla strand, indicating a possible difference in nectar extraction efficiency between honey bees and stingless bees. This knowledge can help optimize pollination efficiency, promote plant reproduction, conserve habitats, and aid in the restoration of native plants. Protecting these interactions can ensure the sustainable survival of these pollinators and the plants on which they depend.

**Key words:** Foraging, Morphology, SEM, Stingless bee, Tongue.

**Acknowledge :** Fundamental Research Grant Scheme (FRGS) From the Ministry of Higher Education Malaysia For the Research Program “Understanding of Flowers Characteristics Preferred by the Stingless Bees for Landscaping Configuration to Sustain the Bees Colonies and Honey Yield” under grant No: FRGS/1/2020/STG03/UMT/02

## O-25

## Oral presentation : 꿀벌생리(Bee Biology)

Morphological Exploration of *Apis cerana* with different colors in South KoreaHyeonjeong Jang<sup>1</sup>, Sukjun Sun<sup>2</sup>, Hyunha Oh<sup>2</sup>, Sunho Kwon<sup>2</sup>, Dongeui Hong<sup>2</sup>, Yeonjeong Lee<sup>2</sup>, Kwanhui Lee<sup>2</sup>, Saeed Mohamadzade Namin<sup>1</sup>, Chuleui Jung<sup>1,2</sup><sup>1</sup>Agriculture Science and Technology Research Institute, Andong National University, Korea<sup>2</sup>Department of Plant Medicals, Andong National University, Korea

Recently, the yellow-colored *Apis cerana* has captured the attention of Korean beekeepers, yet comprehensive research on this particular variant, as well as its morphometric characteristics has been limited. This study *A. cerana* with 3 different body color groups. *A. cerana* samples were collected from more than 150 apiaries in Gyeongsangbuk-do, Korea and subsequently categorized into three distinct groups: black, black-yellow, and yellow bees. Morphological measures included the length of forewing and proboscis, as well as the number of wing hooks and cubital index were conducted. Both the length of forewing and cubital index were notably larger in black and black-yellow bees, compared to their yellow counterparts. However, no significant differences were observed in the number of wing hooks across all bee color variations. Notably, the proboscis length exhibited a distinct pattern, with black bees recording the highest length, followed by black-yellow bees and yellow bees with the smallest proboscis length. To deepen our understanding of these morphological variations, further investigations are essential, particularly involving genomic analyses of honey bees based on color.

**Key words:** *Apis cerana*, Color variation, Morphometric, Beekeeping

O-26

## Oral presentation : 꿀벌생리(Bee Biology)

### Honeybee genetic resource and national diffusion system in korea

**Chang-hoon Lee, Dong-won Kim, Su-bae Kim, Bo-Sun Park, Peter Njukang Akongte, Dae-Geun Oh, Minwoong-Son and Yong-Soo Choi**

Division of Apiculture, Department of Agricultural Biology, National Institute of Agricultural Science, RDA

농촌진흥청에서는 서양종꿀벌 6계통, 토종벌 2계통을 국가 유전자원으로 보존 관리하고 있다. 보유종인 계통들은 특정한 형질이 고정되어 유지되고 있으며, 이러한 자원들을 활용하여 품종 육성과 평가를 진행한다. 평가 결과가 기존 품종보다 높을 경우 품종으로 등록할 수 있으며, 등록된 품종을 농가에 확산시키기 위하여 농촌진흥청 고시 제 2023-34호 「꿀벌 우수품종 지정 및 공급요령」에 따라 국가적 차원에서 보급을 진행한다. 현재 개발된 품종은 대표적으로 삼원교배(AxCxD) 품종인 장원벌과 고품질 로열젤리 다수확 품종인 젤리킹(FxD) 등이 있다. 개발된 꿀벌 우수품종을 전국 농가에 원활히 보급하기 위하여, 현재 충남, 전남, 전북, 경남에 위치한 도서격리 지역에 증식장 구축 사업을 진행하고 있다. 증식장이 갖춰질 경우 농촌진흥청에서 생산한 우수품종 원원여왕벌을 각 도에 보급하고, 보급받은 각 도 기술원과 시군에서는 원여왕벌과 보급여왕벌을 증식시켜 전국 양봉농가에 확산시키며 결과적으로 양봉농가의 생산성, 소득 증대 및 양봉산업 발전에 기여할 것으로 예상된다.

**Key words:** 꿀벌, 우수품종, 국가보급체계

O-27

## Oral presentation : 꿀벌생리(Bee Biology)

### Predictive Modeling of Honeybee Winter Mortality in Response to weather Anomalies: Utilizing 'Honeybee Meteorological Index'

**Sunghyun Min, Daegun Oh, Minwong Son, Bosun Park, Subae Kim, Dongwon Kim, and Yongsoo Choi**

Apiculture Division, Department of Agricultural Biology, National Institute of Agricultural Science

This research investigates the recent phenomena of aberrant high temperatures followed by low temperatures during winter seasons and its consequential impact on honeybee winter mortality. In an effort to analyze the effect of weather anomalies on honeybee survivability, annually collected data on honeybee winter mortality from the National Institute of Agricultural Science. A predictive model based on the 'Honeybee Meteorological Index' was developed, incorporating comprehensive data such as seasonal bee activity, and variations in maximum, minimum, and average temperatures, diurnal temperature range, and precipitation during the hibernation period. The model, established with meteorological and apicultural data from 2022, was validated with data from 2023, demonstrating a coefficient of determination ( $r^2$ ) of 0.30, mean Bias of 11%, and a Root Mean Square Error (RMSE) of 30%. This study elucidates the significant influence of climatic conditions on honeybee survival during wintering periods and provides essential foundational data for the formulation of protective and management strategies for honeybees.

**Key words:** Honeybee, Winter mortality, Honeybee meteorological index, hibernation period.



O-28

## Oral presentation : 꿀벌생리(Bee Biology)

**Comparison of the expression levels of cytochrome P540 monooxygenases  
between *Apis cerana* and *Apis mellifera* (Hymenoptera: Apidae) in response to various  
insecticides**

**Youngcheon Lim<sup>1</sup>, Susie Cho<sup>1</sup>, Joonhee Lee<sup>1</sup>, and Si Hyeock Lee<sup>1,2</sup>**

<sup>1</sup> Department of Agricultural Biotechnology, Seoul National University

<sup>2</sup> Research Institute for Agriculture and Life Sciences, Seoul National University

*Apis cerana* and *Apis mellifera* are two major species of honey bees in Korea. These two honey bee species are known to show different sensitivity to various pesticides due to various ecological and physiological differences, although *A. cerana* has not been well studied compared to *A. mellifera*. The final goal of this study is to elucidate the reasons for the different toxicological responses of the two species, focusing on their different detoxification processes mediated by cytochrome P450 monooxygenases (P450s). The higher sensitivity of *A. cerana* to some insecticides was determined by comparing lethal doses. The expression levels of major P450s were compared between different tissues of the two species. The basal and induced expression levels of major P450s following exposure to the test insecticides were also compared, and P450s with species-specific expression patterns were identified. The current study provides basic insights into understanding differences in the P450-based metabolic potential between the two honey bee species.

**Key words:** *Apis mellifera*, *Apis cerana*, detoxification, cytochrome P450, expression levels



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2024.02.20.

## 심포지엄 III 목련홀

• 꿀벌질병

(Control of infectious diseases in honeybee)



## S-19

## Symposium : 꿀벌질병(Control of infectious diseases in honeybee)

## Evaluation of efficacy of lactic acid bacteria from Honeybee for American foulbrood and Nosemosis

Mi-Sun Yoo, So Youn Youn, Su-Kyoung SEO, Se-Ji Lee, Jaemyung Kim and Yun Sang Cho\*

Parasitic and Honeybee Disease Laboratory, Bacterial Disease Division, Animal and Plant Quarantine Agency, Korea

Honeybee gut microbiome is known to help to protect against harmful pathogens and nourish the host. Furthermore, it has been reported that honeybee probiotic administration has a positive effect on the resistance of honeybee infectious diseases, such as American and European foulbrood and Nosemosis. In this study aimed to isolate and identify lactic acid bacteria(LAB) from honeybee-gut. Seventy-one strains of lactic acid bacteria (LAB) were isolated from *Apis mellifera* and *Apis cerana*, and 6 strains (*L. kullabergensis*, *L. apis*, *L. panisapium*, *L. mellis*, *L. melliventris*, *L. kimbladii*) were finally selected through the measurement of antimicrobial against *P. larvae* and antioxidant activity. In addition, the efficacy of these strains in controlling Nosemosis was evaluated. Based on Real-time PCR, a significant lower level of Nosema after 7-day infection. In field application, it was confirmed that these strains decreased *P. larvae* and Nosema cerana. These results indicate that LAB isolated from honeybee-gut possess beneficial properties for honeybee health.

**Key words:** lactic acid bacteria(LAB), American foulbrood(AFB), Nosemosis

## S-20

## Symposium : 꿀벌질병(Control of infectious diseases in honeybee)

## Prevalence and Trends of Honeybee Diseases in the Republic of Korea

Thi-Thu Nguyen, Mi-Sun Yoo, So Youn Youn, Se-ji Lee, Su-Kyung Seo, Ji-Yeon Lim, Jae Myung Kim and Yun Sang Cho\*

Parasitic and Honey Bee Disease Laboratory, Bacterial and Parasitic Disease Division, Department of Animal and Plant Health Research, Animal and Plant Quarantine Agency, Gimcheon 39660, Republic of Korea

The prevalence and trends of honeybee diseases in Republic of Korea (ROK) have been a subject of increasing concern among researchers and beekeepers. This study aims to provide a comprehensive overview of the current disease landscape within honeybee populations in the country. Through a systematic survey employing advanced molecular techniques such as PCR and RT-PCR, we identified and characterized various pathogens and parasites affecting *Apis Mellifera*. The study reveals the presence of novel strains, including Lake sinai virus (LSV2, LSV3, and LSV4), *Apis mellifera* Filamentous virus (AmFV), *Spiroplasma* (*Spiroplasma* sp. and *S. apis*), *Trypanosome*, *Varroa destructor virus 1* (VDV-1), recombinant VDV-DWV, Kakugo virus, and as well as the emergence of new mite species such as *Tyrophagus*, *Caroglyphus lactis*, and *Neocypholaelaps*. This survey provides information regarding an important update on the current status of honeybee pathogens and parasites in South Korean Honeybees. The emergence of both new and existing diseases, alongside extreme temperature fluctuations, may lead to an increase in colony loss and the outbreak of diseases in honeybee in ROK. Our findings contribute and provide essential knowledge for the development of effective disease management strategies.

**Keywords:** *Apis mellifera*, Disease, Pathogens, Parasites, Prevalence, Republic of Korea.

**Acknowledgements:** This work was supported by the Animal and Plant Quarantine Agency, the Republic of Korea (Project No. N-1543081-2021-25-03).



S-21

Symposium : 꿀벌질병(Control of infectious diseases in honeybee)

Point-of-care-testing 기법에 의한 꿀벌질병 진단

최옥란

(주)진시스템

세계보건기구(WHO)는 합리적인 가격, 우수한 민감도와 특이도, 사용자 친화적인 사용법, 빠르고 정확한 진단 결과, 장비 없이 진단이 가능하며 수급이 용이한 물품으로 가격, 성능, 사용법, 결과확인, 장비 및 수급등을 제시하여 이상적인 현장 검사 기준(ASSURED criteria)을 발표하였다. 현재 분자진단의 트렌드는 점차 실험실에서 실시하던 진단을 현장 진단 분야로 옮겨 가고 있으며 WHO가 제시한 이상적인 현장 검사 시스템이 시장에 공급된다면 진단 및 치료에 많은 변화를 가져올 것으로 기대하고 있다.

전 세계 식량의 90%를 차지하는 100대 농작물 중 70% 이상은 꿀벌과 같은 화분 매개 동물의 수분활동에 도움을 받아 생산하고 있다. 꿀벌 개체수의 감소는 자연에만 영향을 미치는 것이 아니라, 농업과 경제 전반에 있어 큰 영향을 미침에 따라 세균이나 바이러스 및 진균등 다양한 병원체에 의해 발생하는 질병 감염 시 신속하고 정확한 조기진단과 조기방역이 필수적으로 요구되고 있다.

본 연구는 꿀벌 질병 진단에 적용된 당사의 현장 분자진단 기술과 실제 현장에서 사용한 현장 검사 시스템에 대해 소개하고자 한다.

**Key words:** Point-of care-testing, ASSURED criteria, 다중타겟 동시진단, 꿀벌 진단, 현장 분자진단 시스템

S-22

Symposium : 꿀벌질병(Control of infectious diseases in honeybee)

Efficacy of complex plant extracts(Winning bee plus) for varroa mite

Sung-Min Lee<sup>1</sup>, Se-Jee Lee<sup>2</sup>, Mi-Sun Yoo<sup>2</sup>, Yun-Sang Cho<sup>2</sup>, Ho-Kyoung Jung<sup>3</sup>

<sup>1</sup> CTC VAC & Soo Animal Hospital

<sup>2</sup> Parasitic and Honeybee Disease Laboratory, Bacterial Disease Division,  
Animal and Plant Quarantine Agency, Korea

<sup>3</sup> CTC VAC

국내 꿀벌 응애 구제제에 대한 내성으로 인하여 식물 천연추출물 합제(위닝비플러스)를 개발하여 본 제에 대한 효능시험(성충 및 애벌레 안전성, 바로아응애 살충력, 야외 임상시험)과 안정성시험을 농림축산검역본부 세균질병과 기생충 꿀벌질병연구실과 함께 실시하였다. 본제는 식물 추출물 합제로 마늘, 암라, 모링가, 천연 비테인으로 구성되어 있으며 phytochemical이 풍부하다. 본제에 대한 애벌레에 대한 안전성은 원액, 각각의 희석배수(10, 20, 50, 100, 200, 500)와 대조군으로 모든 실험에서 90% 이상의 생존율을 확인하였다. 바로아응애 살충력 효능시험은 대조, 원액, 희석배수별(10, 20, 50, 100, 200, 500) Fiter paper method로 실험하였으며, 원액, 10배, 20배 희석에 대하여 바로아응애 50% 이상의 살충력을 확인하였다. 또한 제품에 유효성분 및 안정성 실험으로 유효기간은 2년으로 확인되었다. 본제에 대한 봉장시험은 20배 희석액으로 2월부터 채밀전까지 7-10일 간격으로 시트지를 활용하여 진행하였으며, 대조군과 비교하여 응애 살충력에 효과가 있음을 확인하였으며, 봉산물(꿀) 안전성 확인을 위해 채밀전까지 20배 희석액으로 매주 분무 또는 흘림 처리하여 꿀에 대한 전성분 검사를 한국양봉농협에 의뢰하여 꿀에 대한 안전성도 확인하였다. 식물 추출물 합제에 대한 효능 및 안정성과 유밀기 및 채밀기에도 사용 가능한 안전한 응애 구제제임을 확인할 수 있었다

**검색어:** phytochemical, 바로아응애, Fiter paper method, 안전성

본 연구는 농림축산검역본부와 (주)씨티씨백 산업체 공동연구과제(M-1543081-2022-2024-02)로 수행하였다.



## S-23

## Symposium : 꿀벌질병(Control of infectious diseases in honeybee)

## 꿀벌의 주요 법정 감염병에 대한 현장용 분자진단법 개발 및 임상평가

천두성<sup>1</sup>, 허주행<sup>2</sup>, 이희규<sup>1</sup>, 김대용<sup>3</sup>, 유미선<sup>4</sup>, 조윤상<sup>4</sup><sup>1</sup>포스트바이오(주), <sup>2</sup>한국양봉농협, <sup>3</sup>서울대학교 수의과대학, <sup>4</sup>농림축산검역본부 세균질병과

꿀벌에서 문제시되는 감염병은 30종 이상 다양하게 보고되어 있으며 이 중에서 낭충봉아부패바이러스 (SBV) 등을 포함한 바이러스 감염병 7종, 미국부저병 (AFB) 등 세균감염병 2종, 노제마 등 곰팡이 감염병 3종으로 이들 병원체에 대한 진단 및 감시를 지속적으로 수행하고 있다. 이들 다양한 꿀벌 감염병 가운데 경제적인 피해 등을 고려하여 낭충봉아부패병은 2종 법정감염병으로 부저병은 3종 법정감염병으로 지정되어 관리되고 있다.

본 연구를 통해 3종의 법정 감염병에 대해 임상현장에서 1시간 내외에 진단하기 위한 2종의 고감도 통합형 유전자 진단키트의 개발을 완료하였으며 다양한 임상시료를 활용한 현장적용시험 및 임상시험을 통해 국내 동물의료기기인허가를 위한 임상시험자료 확보하였다. 본 연구의 산물인 현장용 분자진단키트는 현장에서 가장 효과적인 진단툴을 제공하여 진단시간을 최소 2일에서 1시간 내외로 단축하며 봉군관리를 할 수 있는 실효성있는 수단을 제공할 수 있을 것으로 기대된다.

**Key words:** 꿀벌, 법정감염병, 낭충봉아부패병, 미국부저병, 유럽부저병, 현장진단키트

사사 : 농기평 농축산물안전유통소비기술개발사업 (120067 - 1), 검역본부 용역과제 (Z-1543081-2023-2024-01)

## S-24

## Symposium : 꿀벌질병(Control of infectious diseases in honeybee)

Association between Honeybee (*Apis mellifera* L.) diseases and CCD in Korea

Juhaeng Heo and Yongrae Kim

Korea Apicultural Agriculture Cooperative

Korea's beekeeping industry has been facing a major crisis due to Colony Collapse Disorder (CCD), which has been occurring for two years since the winter of 2021. It's presumed that the causes of the CCD in Korea are a combination of various factors, including abnormal climate, pesticide use, a decline in honey plants, and an increase in bee diseases. To date, about 36 types of diseases are known to affect bees, including viruses, bacteria, fungi, protozoa, and parasitic diseases. The Korea Apicultural Agriculture Cooperative, which is comprised of full-time beekeepers, conducted PCR tests for 14 major bee diseases that frequently occur and cause significant damage to bees from 2020 to 2023. The test results show that viral diseases occur most frequently in Korea. This seems to be due to the characteristics of bees, which have difficulty with quarantine and lack an acquired immune system. In addition, the spread of bee mites is considered to be the main cause of the recent CCD in Korea.

**Key words:** *Apis mellifera* L., CCD, Honeybee disease.



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2024.02.20.

## 심포지엄 IV 수련홀

• 꿀벌 바이러스와 병원체  
(Honeybee Viruses and Pathogens (with COLOSS VTF))



## S-25

## Symposium : 꿀벌 바이러스와 병원체 (Honeybee Viruses and Pathogens (with COLOSS VTF))

## Is commercial trade of queens a way for virus spread?

Anne Bonjour-Dalmon<sup>1\*</sup>, Luca Perisse<sup>1</sup>, Christophe Klopp<sup>2</sup>, Marianne Cousin<sup>1</sup>, Virginie Diévert<sup>1</sup>, Benjamin Basso<sup>1</sup> and Jean-Luc Brunet<sup>1</sup><sup>1</sup>INRAE, Bees and the Environment research department, France<sup>2</sup>INRAE, GenoToul, France

\* Email: anne.bonjour-dalmon@inrae.fr

In a context of French beekeeping industry suffering economic losses from variation in honey production all factors affecting honeybee colony health need to be controlled as well as possible. In France, *Deformed wing virus* (DWV), *Black queen cell virus* (BQCV), *Sacbrood virus* (SBV) are the most prevalent viruses in honeybee colonies, when *Acute bee paralysis virus* (ABPV) and *Chronic bee paralysis virus* (CBPV) occur more occasionally. Beekeepers face frequent co-infections in their colonies, and viral infections have been suggested to trigger winter losses. Among the various routes for virus transmission, vertical transmission from the queen to its progeny has been poorly investigated. The introduction of queens from outside the beekeeping operation could encourage the spread of viruses and/or the introduction into the farmstead of virus strains or variants with increased virulence. Here 20 queens from 15 providers trough Europe and South America were tested for virus quantification (qPCR) and characterization (RNA-sequencing). High prevalence of DWV, both DWV-A and DWV-B variants, was detected from individual queens, with significantly different prevalences depending on the origins. Acute and chronic paralysis viruses were rarely detected. Most queens were free of BQCV, even if some queens exhibited virus loads superior to quantification thresholds. SBV was not significantly detected. In parallel high throughput sequencing was performed for pools of queens from the same origin. DWV variants composition was compared. These data show evidence that queens are infected with several viruses and may serve as virus sources when introduced into new colonies.

**Key words:** vertical transmission, honeybee health, epidemiology, virus diversity**Acknowledge :** Volunteers beekeepers and breeders who participated in the study, Lune de Miel for funding

## S-26

## Symposium : 꿀벌 바이러스와 병원체 (Honeybee Viruses and Pathogens (with COLOSS VTF))

## Habitat structure and virome examination in newly field-exposed bumble bees

Orlando Yañez<sup>1\*</sup>, Laura Bosco<sup>2,3</sup>, Alexandria Schauer<sup>1</sup>, Corina Maurer<sup>2,4,5</sup>, Samuel A. Cushman<sup>6</sup>, Raphaël Arlettaz<sup>3</sup>, Alain Jacot<sup>3,7</sup>, Torsten Seuberlich<sup>8</sup>, Peter Neumann<sup>1</sup>, Daniel Schläppli<sup>1,9</sup><sup>1</sup>Institute of Bee Health, Vetsuisse Faculty, University of Bern, Schwarzenburgstrasse 161, 3003 Bern, Switzerland, <sup>2</sup>LUOMUS-Finnish Museum of Natural History, PL17-P.O.Box17, 00014 University of Helsinki, Finland, <sup>3</sup>Division of Conservation Biology, Institute of Ecology and Evolution, University of Bern, Baltzerstrasse 6, 3012 Bern, Switzerland, <sup>4</sup>Agroecology and Environment, Agroscope, Reckenholzstrasse 191, 8046 Zürich, Switzerland, <sup>5</sup>Ecosystems Landscape Evolution, Institute of Terrestrial Ecosystems, Department of Environmental Systems Science, ETH Zürich, 8092 Zürich, Switzerland, <sup>6</sup>Wildlife Conservation Research Unit, Department of Biology, University of Oxford, Oxford, United Kingdom, <sup>7</sup>Swiss Ornithological Institute, Regional Office Valais, 1950 Sion, Switzerland, <sup>8</sup>Division of Neurological Sciences, University of Bern, Bern, Switzerland, <sup>9</sup>School of Biological Sciences, University of Bristol, Life Science Building, 24 Tyndall Avenue, BS8 1TQ Bristol, United Kingdom

\* Email: Orlando.yanez@unibe.ch

Pest and pathogens are often closely associated with reports of insect declines. The intra- and inter-specific host shift of viral agents may play an important role in this context. These shifts have been widely demonstrated under laboratory conditions using managed bees. However, the dynamics of virus acquisition on field populations remain poorly understood. We experimentally deployed bumble bee colonies in an agricultural landscape to study changes in the bumble bee virome under varying habitat composition and configuration. The results show an increase in prevalence of viruses common in *Bombus* spp. while the honey bee virus DWV-B decreased during field exposure. The reported changes in the virome composition showed no effect on colony development, suggesting that immediate impacts are unlikely in the field. Notably, we further demonstrate that increased habitat diversity results in fewer viruses in *Bombus* colonies. To mitigate the decline of bumble bees and other wild pollinators, we suggest focusing conservation efforts on habitat diversification and restoration.

**Key words:** Bees, cross-species virus transmission, habitat fragmentation, habitat heterogeneity, pollinators**Acknowledge :** We thank all farmers and the VITIVAL (Valais association for viticulture) groups for their collaboration and allowing us to do this study on their vineyards.

S-27

Symposium : 꿀벌 바이러스와 병원체(Honeybee Viruses and Pathogens (with COLOSS VTF))

### RNAi as a honeybee virus repressor: case studies and potentials

June-Sun Yoon

Department of Agricultural Convergence Technology, Jeonbuk National University, Jeonju 54596, Republic of Korea

RNA interference (RNAi) is a post-transcriptional gene silencing phenomenon where long double-stranded RNAs induce the silencing of the target gene in insects. RNAi has been widely used as a reverse genetic tool to reveal the function of the genes. Since the discovery of RNAi, the fields in which RNAi can be used have diversified, from pharmaceuticals to pesticides. In this study, I would like to focus on honey bee studies, specifically on the use of RNAi as a honeybee virus repressor. In previous decades, there have been successful cases with a variety of viruses, including the Israeli acute paralysis virus and the Sacbrood virus. Occurrence of the above viruses and the results of experiments to suppress the above viruses through RNAi will be discussed.

**Key words:** RNA interference, Virus suppressor, Sacbrood virus, Israel Acute Paralytic Virus

S-28

Symposium : 꿀벌 바이러스와 병원체(Honeybee Viruses and Pathogens (with COLOSS VTF))

### The chronicle of dsRNA for apiculture; a new agent to control pathogens of the honeybees

Woojin Kim and Minlee Kim

R&D Center, Genolution Inc., Seoul 07793, Korea

Since the outbreak of colony collapse disorder of European honeybee (*Apis mellifera*) in North America, and Sacbrood virus (SBV) of Asian honeybee (*Apis cerana*) in Korea in late 2000s, dsRNA has been focused as a novel antiviral agent which utilizes RNA interference mechanism. In the last decade, successful applications of dsRNAs to control the Israeli acute paralysis virus and SBV in the field trials shed light on the development of a new class of medicine for apiculture. Despite the hurdles of mass-production and regulation/registration, Genolution Inc. is about to launch HoneyGuard-R, a new antiviral dsRNA agent to control SBV of *A. cerana* in Korea officially based on those previous studies. To widen the applications of dsRNA for apiculture in future, numerous efforts have been made to control pathogens and parasites such as *Nosema ceranae*, *Varroa destructor* and its related viruses with aid of latest technologies. Next generation sequencing technology and bioinformatics are the tools to trace the honeybee viruses in the ecosystem and monitor their variants which are indispensable to help the robust beekeeping practices.

**Key words:** *Apis mellifera*, *Apis cerana*, dsRNA, varroa mite, bee viruses, SBV, NGS



## S-29

## Symposium : 꿀벌 바이러스와 병원체 (Honeybee Viruses and Pathogens (with COLOSS VTF))

### Proteomics and immune response differences in *Apis mellifera* and *Apis cerana* inoculated by three *Nosema ceranae* isolates

**Terd Disayathanoowat<sup>\*1,2</sup>, and Thunyarat Chantaphanwattana<sup>1,2</sup>**

<sup>1</sup>Department of Biology, Faculty of Science, Chiang Mai University, 50200, Thailand

<sup>2</sup>Research Center of Deep Technology in Beekeeping and Bee Products for Sustainable Development Goals (SMART BEE SDGs), Chiang Mai University, Chiang Mai, Thailand 50200

*Nosema ceranae* infects midgut epithelial cells of *Apis* species and jumped from its original host *A. cerana* to *A. mellifera*. worldwide asking questions on how the new host is responding. We compared *A. mellifera* and *A. cerana* responses to *N. ceranae* isolates from *A. cerana*, *A. mellifera* from Thailand and *A. mellifera* from France. Proteomics and transcriptomics results were merged to deeper understand the impact on immunity of the two species. This represents the first combination of omics analysis to evaluate the impact of *N. ceranae* spores from different origin and provides new insights into the differential immune responses in honeybees inoculated by *N. ceranae* from original *A. cerana*. No difference in the antimicrobial peptides (AMP) was observed in *A. mellifera*, while these peptides were altered in *A. cerana* when compared to controls. Inoculation of *A. mellifera* or *A. cerana* with *N. ceranae* caused up-regulation of the AMP genes and cellular mediated immune genes but did not greatly alter apoptosis-related gene expression. *A. cerana* showed a stronger immune response than *A. mellifera* after different *N. ceranae* isolate inoculation. *N. ceranae* from *A. cerana* caused a highly negative impact on *A. mellifera* and *A. cerana* health compared to other *Nosema* isolates.

**Key words:** *Nosema ceranae*, *Apis* bees, Proteomics, Immune response

**Acknowledge:** Authors thanks Prof.Dr. Philippe Bulet and his team from CR University Grenoble Alpes, France, for collaboration and methodology.

## S-30

## Symposium : 꿀벌 바이러스와 병원체 (Honeybee Viruses and Pathogens (with COLOSS VTF))

### Unveiling Novel and Unreported Honeybee Viruses in South Korea, 2023: A Fresh Perspective on Beekeeping Epidemiology

**Minhyeok Kwon<sup>1,2</sup> and Eui-Joonkil<sup>1,2</sup>**

<sup>1</sup>Department of Plant Medicals, Andong National University, Andong, Republic of Korea

<sup>2</sup>Agriculture Science and Technology Research Institute, Andong National University, Andong, Republic of Korea

To examine the present viral landscape in apiaries in the Gyeongsangbuk-do region, researchers performed virome analysis using high-throughput sequencing on honey bees (*Apis mellifera*) gathered from 15 locations in Gyeongsangbuk-do. The analysis identified a total of 20 honey bee viruses and 15 plant viruses, including three novel viruses. The virome analysis revealed the presence of black queen cell virus in all regions of the samples, while Lake Sinai virus 3 and Sacbrood virus were confirmed in 14 regions. In plant viruses, Blueberry latent spherical virus, previously unrecorded in South Korea, was found in 12 regions. This analysis has provided valuable insights into the distribution of honey bee viruses in the Gyeongsangbuk-do region and has demonstrated the potential for analyzing plant viruses through honey bees.

**Keyword:** *Apis mellifera*, Plant virus, Virome analysis, High-throughput sequencing, Virology

S-31

Symposium : 꿀벌 바이러스와 병원체 (Honeybee Viruses and Pathogens (with COLOSS VTF))

## Harnessing the Bee Virome: A Novel Tool for Unearthing Unreported and Emerging Plant Viruses

Jiho Jeon<sup>1,2</sup>, Minhyeok Kwon<sup>1,2</sup> and Eui-Joon Kil<sup>1,2\*</sup>

<sup>1</sup>Department of Plant Medicals, Andong National University, Andong, Republic of Korea

<sup>2</sup>Agriculture Science and Technology Research Institute, Andong National University, Andong, Republic of Korea

\*E-mail: viruskil@anu.ac.kr

Over the past two years, to comprehend the rapid decline of domestic honey bee populations, we conducted a comprehensive investigation into the potential increase in virus activity and the possibility of the introduction of novel viruses. Employing high-throughput sequencing on honey bees collected from various farms, we conducted extensive virus analysis. The research findings revealed the presence of previously unreported viruses such as Lake Sinai virus, and an observed trend of increased transmission of other viruses like black queen cell virus. What is noteworthy is that the research outcomes extend beyond honey bee viruses. A substantial number of diverse plant viruses were discovered, particularly indicating an elevated reading of plant viruses in honey bees collected during the Acacia flowering period. Among these, the inclusion of the blueberry latent spherical virus, not previously reported in Korea, was notable. These results suggest the possibility of honey bees transmitting plant viruses while pollinating flowers. Given the extensive range of honey bee activities, allowing contact with various pollens, it implies that honey bees could potentially serve as carriers for these viruses. This study proposes the effective utilization of honey bees as a vital component in monitoring systems for plant viruses. Through this innovative approach, we anticipate the identification of plant viruses transmitted by honey bees and the investigation of infections in potential host plants during their pollination activities.

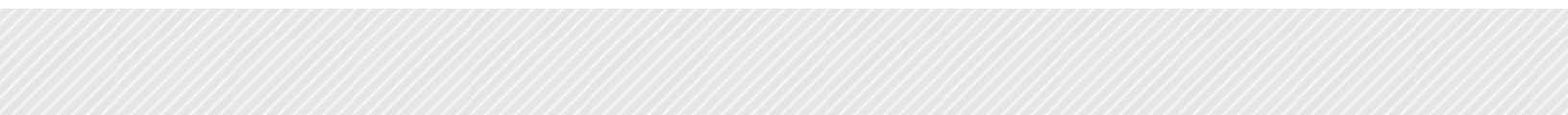
**Key words:** Honey bee, High-throughput sequencing, *Lake Sinai virus*, *Blueberry latent spherical virus*, Plant viruses, pollinator, Monitoring system



2024년 제40차

# 한국양봉학회 정기총회 및 COLOSS Asia 국제학술대회

“꿀벌의 건강과 지속가능한 양봉산업을 위한 공적기능 강화”





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2024.02.20.

# 구두발표 수련홀

• 사양관리  
(Bee Keeping)



O-29

## Oral presentation : 사양관리(Bee Keeping)

## Conservation of honey bees in Britain and Ireland

Norman L Carreck<sup>1,2</sup>

<sup>1</sup>Carreck Consultancy Ltd., Woodside Cottage, Dragons Lane, Shipley, West Sussex, RH13 8GD, United Kingdom. <sup>2</sup>School of Life Sciences, University of Sussex, Falmer, Brighton, East Sussex, BN1 9QG, United Kingdom. Email: norman.carreck@btinternet.com

In Britain and Ireland, the native bee was the dark European honey bee *Apis mellifera mellifera*, but over the last 150 years many imports of mainly Italian and Carniolan bees have taken place. Brother Adam, who developed the hybrid “Buckfast” bee in south west England, claimed that the old native bee had become extinct due to disease. Recent molecular studies have shown, however, that *A. m. mellifera* is alive and well in many parts of Britain, and indeed in Ireland remains the dominant bee. In recent years, however, the number of queens being imported into the UK has increased, despite work by the COLOSS RNSBB Task Force which has shown that “locally adapted” bees survive better than exotic strains. Efforts to conserve native strains can be hampered by imports of exotic bees, and can such bees act as “invasive alien species” outside their native range? UK beekeepers say they would favour local bees, but queen rearing in the UK is hampered by the weather. Nonetheless, nationwide efforts could be made to improve the quality of UK’s existing stock of bees for varroa tolerance and docility.

**Key words:** *Apis mellifera mellifera*, local adaptation, conservation,

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## Oral presentation : 사양관리(Bee Keeping)

## Stingless bee-friendly garden for the sustainability of beehives

Norasmah Basari<sup>1,2\*</sup>, Sarah Najiah Ramli<sup>1</sup>, Shamsul Bahri Abdul Razak<sup>1,2</sup>, Nur Aida Hashim<sup>1,2</sup>

<sup>1</sup>Faculty of Science and Marine Environment, Universiti Malaysia Terengganu, Kuala Nerus, 21030, Terengganu, Malaysia.

<sup>2</sup>Center of Excellence Apis and Meliponine, Universiti Malaysia Terengganu, Kuala Nerus 21030, Terengganu, Malaysia.

\*Corresponding email: norasmah@umt.edu.my; Tel.: +609-6683645

Meliponiculture or stingless beekeeping offers new opportunities to improve household income in Malaysia through the sale of honey and other bee products. *Heterotrigona itama*, is one of the most common species domesticated in the country, mainly for honey collection. The bee visits a variety of flowers in search of nectar and pollen. Our previous research on the foraging preferences of *H. itama* has shown that this bee species prefers flowers with a high concentration of nectar (35% or more) and prefers to forage close to its hive. However, when given the opportunity to choose between nectar reward and distance, this bee species was found to make a trade-off between these two factors, with reward being more important than distance to the foraging site. It is important to understand bee behaviour in order to manage the food sources for the bees on the farm so that the bees can better utilise the sources and may provide a higher yield to the beekeepers as well as for the sustainability of the beehives.

**Key words:** Meliponiculture, stingless bees, foraging activity, tropical species, honey.

**Acknowledge :** Fundamental Research Grant Scheme (FRGS) From the Ministry of Higher Education Malaysia For the Research Program “Understanding of Flowers Characteristics Preferred by the Stingless Bees for Landscaping Configuration to Sustain the Bees Colonies and Honey Yield” under grant No: FRGS/1/2020/STG03/UMT/02/3.

O-31

Oral presentation : 사양관리(Bee Keeping)

**Robotic System Design In Royal Jelly Production**

**Sedat Sevin<sup>1,2,3</sup>, Hakan Aktan<sup>2</sup>, Jibran Qadri<sup>2</sup>, Hidayet Tutun<sup>4</sup>, Chuleui Jung<sup>3,5</sup>**

<sup>1</sup>Ankara University, Faculty of Veterinary Medicine, Department of Pharmacology and Toxicology, Ankara, Turkiye

<sup>2</sup>The Company of Sentezfarma, Ankara University Technopolis, Ankara, Turkiye

<sup>3</sup>Agricultural Science and Technology Research Institution, Andong National University, Republic of Korea

<sup>4</sup>Burdur Mehmet Akif Ersoy University, Faculty of Veterinary Medicine, Department of Pharmacology and Toxicology, Burdur, Turkiye

<sup>5</sup>Department of Plant Medicals, Andong National University, Andong, Republic of Korea

Royal jelly is a bee product secreted from the hypopharyngeal and mandibular glands of young honey bees and used for feeding both larvae and queens. Royal jelly the highest nutritional value amongst all other bee products. However, its production is tedious and can only be done within a limited time range. The most time-consuming process in production is larval transfer and royal jelly collecting by humans. In order to speed up this process and increase royal jelly production, human labor should be reduced. For this, larvae between 1.5-1.8 mm, which is the ideal size for royal jelly production, should be detected and transferred to suitable thimbles and hives. The designed royal jelly machine was designed to detect the location and characteristics of healthy larvae in the combs with image processing, automatically collect the larvae without damaging them, and transfer them to the thimbles. The design was made according to Langstroth and Dadant hive dimensions. Design and laboratory work is ongoing on the same module for the collecting of royal jelly.

**Key words:** Beekeeping, Image processing, Royal jelly, Larva transfer

O-32

Oral presentation : 사양관리(Bee Keeping)

**Responses of the Climate Change impact on *Apis cerana* beekeeping in Korea**

**Yeonjeong Lee<sup>1</sup>, Hyunha Oh<sup>1</sup>, and Chuleui Jung<sup>1,2</sup>**

<sup>1</sup>Department of plant Medicals, Andong National University, Andong, Republic of Korea

<sup>2</sup>Agricultural Science and Technology Institute, Andong National University, Andong, Republic of Korea

A comprehensive survey, employing questionnaires to explore the impacts of climate change on *Apis cerana* beekeeping was conducted in 2019 and 2024. Primary responses were collected from Gyeongbuk provinces but also covered nationwide. The average age of *Apis cerana* beekeepers are in their 60s, with an average of 10 year of experience. All respondents, except one, answered feeling the effects of climate change. In both 2019 and 2024, temperature and heatwaves were the most significant impacts on honeybees. Respondents indicated that Sacbrood is the most significant disease, and *Vespa* hornets are the most significant pests. Sacbrood mortality was higher in August and September in 2019, and July and August in 2024. The average overwintering success rate was at around 70% for both years, with a significantly lower seasonal mortality rate in 2024 compared to 2019. Regarding the reason for overwintering failure, 65.7% of the beekeepers in 2019 answered pests, while 37.9% of the respondents in 2024 answered food shortage. In 2019, the preferred honey plants for *Apis cerana* were *Hovenia dulcis* (20%), followed by *Fagopyrum esculentum*. In 2024, the most preferred honey plants was *Castanea crenata*(21.2%), followed by *Hovenia dulcis*.

**Key words:** Sacbrood, Mortality, Overwintering, Honey plant



O-33

Oral presentation : 사양관리(Bee Keeping)

### Development of a Separator-Free Gate to Count the Entry and Exit of Bees

**Si-u Bak, Kwangjin Choi, Jinseong Lee and Byoung-Jo Choi**

Dept. of Embedded Systems Engineering, Incheon National University

본 연구에서는 이상기온에 의한 꿀벌 봉군의 월동 폐사 원인을 규명하고 효과적인 해결 방법 모색을 목적으로 꿀벌 개체 수 모니터링을 위해 꿀벌 출입을 계수하는 실시간 시스템의 설계 및 구현 방안을 고찰한다. 꿀벌 농가에 보급을 쉽게 하기 위하여 가격이 저렴한 적외선 센서를 사용한 방식의 하드웨어를 제안하였다. 기존에는 일반적으로 한 마리가 지나갈 수 있는 통로를 만들어 사용해 왔으나, 본 연구에서는 적외선 센서를 보다 촘촘히 배치하여 계수장치를 설계한다. 본 연구에서 개발된 하드웨어를 사용할 경우 꿀벌의 진행경로에 영향을 미치지 않으면서도 적은 컴퓨팅 파워로 정확한 출입 계수가 가능할 것으로 보이며, 이를 통해 더욱 효율적인 꿀벌 관리 시스템의 설계가 가능할 것으로 기대한다.

**Key words:** honey bee population monitoring, infrared sensor, real-time, abnormal temperature, winter die-off

**Acknowledgements :** This study was supported by the Joint Research Project of the Rural Development Administration(RS-2023-00232847) in Rep.Korea.

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Oral presentation : 사양관리(Bee Keeping)

### Consideration of Existing Beehive Entry-Exit Counting Systems and the Necessity of a Dedicated Image-Based Algorithm

**Jinseong Lee, Si-u Bak, Hyerim An and Byoung-Jo Choi**

Dept. of Embedded Systems Engineering, Incheon National University

벌통에서의 꿀벌 이출입 데이터는 군집의 건강상태, 환경에 따른 영향 파악, 꿀 생산 모니터링 등 다양한 방면에서 중요한 데이터로 여겨진다. 본 연구에서는 주로 사용되는 적외선 센서 베이스 이출입 계수 장치의 작동방식과 이미지 취득 후 머신러닝으로 작동하는 시스템에 한계에 대한 고찰을 진행한다. 기존에 사용되는 적외선 센서 베이스 이출입 계수 장치는 통로 형태로 작동한다는 특성에 의해 꿀벌의 자유로운 이동을 일부 제한하는 등 부정적인 영향을 미칠 수 있다. 머신러닝을 통해 이미지를 분석하는 시스템은 입구에 직접적인 하드웨어가 설치되지 않아 앞의 상황에 비해 자유롭지만, 머신러닝 모델을 사용하기 위한 고가의 시스템이 필요하다는 점에서 대량보급에는 실질적인 어려움이 있다. 본 연구에서는 이러한 문제들로부터 자유로운 이미지 베이스 전용 알고리즘에 대한 필요성과 현재 개발중인 알고리즘에 대해 기술한다. 이를 통한 이출입 계수 장치의 대량보급을 통해 관련 연구의 지원과 함께 양봉농가의 생산성의 증대 등 긍정적인 영향을 미칠 수 있을 것으로 기대한다.

**Key words:** bee entry-exit counting, infrared sensor, machine learning, image-based algorithm, mass distribution

**Acknowledgements :** This study was supported by the Joint Research Project of the Rural Development Administration(RS-2023-00232847) in Rep.Korea.

O-35

Oral presentation : 사양관리(Bee Keeping)

# Development of a multi-beekeeping object detection model for Integrated pest management of Beekeeping

Hong Gu Lee<sup>1</sup>, Jeong Yong Shin<sup>1</sup>, Su-Bae Kim<sup>2</sup>, Sujin Lee<sup>2</sup>, Changyeun Mo<sup>1\*</sup>

<sup>1</sup> Department of Interdisciplinary Program in Smart Agriculture, Kangwon National University

<sup>2</sup> Sericulture and Apiculture Division, National Institute of Agricultural Science

Managing the health of beehives is crucial in beekeeping. Beekeepers routinely inspect the internal condition of beehives to assess the health status of the colony. Currently, visual inspection methods are used to determine the health of the beehive. This method requires constant labor and causes variation depending on the beekeeper's capability. To tackle this problem, technology to objectively and automatically measure object information in the beehives. In this study, an object detection model to simultaneously identify pests and various beekeeping objects was developed using imaging technology and artificial intelligence algorithms. Normal objects encompass bees and pollen, while pests include *Varroa destructor*, and disease objects comprise abnormal larvae and deformed wing bees. RGB image data of the beehive and the hive entrance was measured and images containing selected objects were collected from these images for deep learning training. The beekeeping object detection model was developed using YOLO v8. The YOLO model had excellent recognition accuracy for pest, and normal objects. These results showed that the multi-object recognition technology could be applied to integrated pest management in beekeeping.

**Key words:** Integrated pest management, Bee mite, Object detection, Computer vision, beekeeping, YOLO

This study was supported by the Rural Development Administration as "Cooperative Research Program for Agriculture Science and Technology Development [Project Nos. RS-2023-00232224]

O-36

Oral presentation : 사양관리(Bee Keeping)

# Development of the migratory beekeeping information system by GIS (Geographic Information Systems)

Kyeong Yong Lee, Jongho Park, Young Bo Lee, Su Jin Lee, Kyu-Won Kwak,

Department of Agricultural Biology, The National Academy of Agricultural Science

국내에는 아까시 개화시기에 맞추어 벌통을 옮겨 채밀하는 '이동양봉'이 보편되어있으나 밀원수 개화 시기에 벌통이 어떻게 이동하는지 벌통 주변의 기상변화 등에 대한 연구는 거의 없는 실정이다. 이에 벌통에 GPS와 온습도 센서를 부착하여 벌통의 위치정보와 벌통 주변의 기상상황을 실시간으로 측정할 수 있는 '벌통위치추적기'를 개발하였다. 또한 측정된 데이터를 바탕으로 지리정보시스템(GIS)과 결합하여 산림청에서 제공하는 밀원수 분포, 기상청의 기상정보를 양봉농가에게 제공할 수 있는 '이동양봉 정보제공시스템'을 구축하였다. 이 시스템을 2023년 4월, 전국 39개 양봉농가에 적용한 결과, 벌통을 이동시키는 농가는 51%로 나타났고, 월별로는 5월과 6월에 벌통의 이동이 가장 많은 수의 이동 데이터가 수집 되었다. 지역별 거주하는 양봉농가의 동선역시 4가지 패턴이 확인 되었다. 이 시스템을 통해 기후에 따른 작물의 개화와 양봉농가 이동을 예측과 함께 양봉농가의 위치기반으로 밀원식물 개화정보, 기상, 농약살포 정보, 농가간 상호정보교류 등 서비스 제공이 가능해 질 수 있을 것으로 기대된다.

**Key words:** Flight speed, deep leaening, *Apis mellifera*, *Bombus terrestris*

This work was supported by a grant from the National Institute of Agricultural Sciences (Project No.: PJ01727311).



O-37

Oral presentation : 사양관리(Bee Keeping)

## Effects of Clothianidin Pesticide Application on the Strength of Honey Bee Colonies and Stress-Related Genes in the Vicinity of Rice Fields in the Republic of Korea

Minwoong Son<sup>1</sup>, Jisoo Kim<sup>2</sup>, Dongwon Kim<sup>1</sup>, Chang-Hoon Lee<sup>1</sup>, Peter Njukang Akongte<sup>1,3</sup>, Daegeun Oh<sup>1</sup>, Yong-Soo Choi<sup>1</sup> and Bo-Sun Park<sup>1</sup>

<sup>1</sup>Department of Agricultural Biology, National Institute of Agricultural Science, Wanju 55365, Republic of Korea

<sup>2</sup>Jeollanamdo Agricultural Research and Extension Services, Naju 57214, Republic of Korea

<sup>3</sup>Institute of Agricultural Research for Development (IRAD), Buea PMB 25, Cameroon

This study aimed to assess the impact of pesticide treatment on honey bee (*Apis mellifera*) colonies near rice cultivation areas. We observed changes in the colonies as they progressed beyond the pesticide application period and collected honey bees exposed to clothianidin for analysis of stress-related gene expression. The monitoring results showed that the toxicity from pesticides near the rice cultivation area did not have a significant impact on the honey bee colonies. However, we did observe significantly higher expression levels of stress-related genes in honey bees collected from the treatment group compared to the control. These findings suggest that the use of pesticides near rice cultivation areas is unlikely to cause acute toxicity issues for honey bees. However, it also serve as evidence of the potential impact on honey bee stress-related genes.

**Key words:** neonicotinoids, honey bees, rice field, colony strength, qRT PCR, toxicity stress genes



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2024.02.20.

# 포스터

- Bee Health
- Bee product
- Pollination & Honey Plant
- Bee Biology
- Bee Keeping



## P-01

## Poster presentation : Bee Health

## Efficacy of Lithium Chloride against Varroa mites on Honeybees under Field Conditions

Florvil CLERGER, Alliyah Krystal ALBERTSON and Lekhnath KAFLE\*

Department of Tropical Agriculture and International Cooperation, National Pingtung University of Science and Technology, Pingtung, Taiwan

\* Corresponding email: kafle@mail.npust.edu.tw

The varroa mite (*Varroa destructor*) causes the most damage to honeybee colonies in the areas where it is prevalent. The colonies can completely collapse in less than a year if they are not treated. A recent trend in research has focused on lithium salts as an effective means of combating varroa mites. Thus, the purpose of this study was to evaluate the field efficacy of different doses of lithium chloride against the varroa mite on honeybees (*Apis mellifera lugistica*). The study was conducted using lithium chloride, oxalic acid, and fluvalinate for 35 days and compared with the negative control group. The sugar powder method has been used to determine the level of infestation of varroa mites in each colony on a weekly basis. Lithium Chloride has been successfully proven to effectively control varroa mites after 35 days of administrations, similar to Oxalic Acid, and Fluvalinate, and its effectiveness was significantly higher than that of the control group, according to the results of this study.

**Key words:** *Apis mellifera*, Lithium Chloride, *Varroa destructor*, Oxalic Acid, Fluvalinate

## P-02

## Poster presentation : Bee Health

Nutritional improvement of mulberry leaf protein concentrates (LPC) using fibrolytic enzymes from *Aspergillus terreus* for use as an LPC-supplemented diet for honey bees

Khanchai Danmek<sup>1</sup>, Suphakom Klaitanod<sup>1</sup>, Chidanai Chanmaneevech<sup>1</sup>, Wannapon Suradach<sup>1</sup>, Ming-Cheng Wu<sup>2</sup>  
 Kanokwan Klaithin<sup>2,4</sup>,  
 Chuleui Jung<sup>3</sup>, and Bajaree Chuttong<sup>4</sup>

<sup>1</sup>School of Agriculture and Natural Resource, University of Phayao, Thailand<sup>2</sup>Department of Entomology, College of Agriculture and Natural Resources, National Chung Hsing University, Taiwan<sup>3</sup>Department of Plant Medicals, Andong National University, Republic of Korea<sup>4</sup>Department of Entomology and Plant Pathology, Faculty of Agriculture, Chiang Mai University, Thailand

Mulberry (*Morus alba* L.) is an economically important tree, providing many valuable inputs for food and feed. It is known as a potential animal feed resource because of its beneficial bioactivities and reported health-promoting effects on insects. Honey bees face challenges in directly digesting the plant's cell wall proteins, unlike ruminants. To address this, the potential utilization of mulberry leaf proteins by honey bees involves the creation of leaf protein concentrates (LPC). This study focuses on assessing the impact of fibrolytic enzymes derived from *Aspergillus terreus* on the quality of LPC. *A. terreus* is renowned for its production of fibrolytic enzymes, including cellulases and xylanases, exhibiting optimal activities at pH 6.0 and 60°C. Treatment with 5.0% (v/v) of crude extracted enzymes from *A. terreus* demonstrated the most plant fiber reduction compared to the control. Newly emerged worker bees were provided *ad libitum* diets in cages within an insect growth chamber, maintaining a temperature of 33 °C, a relative humidity of 60%, and darkness for 21 days. The formulated feed incorporated LPC in varying amounts (0%, 2.5%, and 5.0% w/w) supplemented with *Bidens pilosa* L. pollen patty. The introduction of mulberry LPC yielded honey bee lifespan results comparable to the control with only pollen patty. Based on the results of this study, we concluded that adding 5.0% (w/w) mulberry LPC to pollen patty could be a novel approach for optimizing honey bee lifespan through a plant LPC-supplemented diet.

**Key words:** mulberry, leaf protein concentrate, fibrolytic enzymes, pollen supplement, honey bee

**Acknowledge:** National Research Council of Thailand 2023 (NRCT:N71A660404)



P-03

Poster presentation : Bee Health

**New complete mitochondrial genome of four *Vespa* species and comparison to genus *Vespa***

**Jee-Young Pyo, Jeong Sun Park, Seung Hyun Lee, Min Woo Park and Iksoo Kim\***

Department of Applied Biology, College of Agriculture & Life Sciences, Chonnam National University

벌목은 곤충강 중 4번째로 높은 종 다양성을 가진 목으로 그 중 말벌속은 전 세계적으로 148종이 존재하며 우리나라에는 10종이 존재한다. 본 연구에서는 우리나라 말벌 4종(*Vespa analis*, *V. binghami*, *V. crabro*, *V. dybowskii*)의 완전 마이토지놈 염기서열을 분석하고, 말벌속 내 종간 비교를 통해 말벌속의 마이토지놈 특징을 알아보고자 하였다. 4종의 마이토지놈 크기는 15,957 ~ 17,488 bp로 확인되었으며 전형적인 유전자 구성을 가지고 있었다. 13개 PCGs, srRNA, lrRNA, 및 22개 tRNA genes의 A/T 함량은 80.6 ~ 82.8%, 78.5 ~ 79.6%, 83.4 ~ 84.9%, 및 85.8 ~ 86.5%였으며 A+T-rich region의 A/T 함량은 89.0~93.5%로 다른 종들과 유사하였다. 4종의 유전자 배열은 일반적인 곤충 조상과 비교하였을 때, *trnY-trnI-trnM-trnQ*, *trnN-trnE-trnS<sub>L</sub>-trnF*, 그리고 *trnS<sub>2</sub>-trnL<sub>1</sub>*의 배열을 가져 차이가 존재하였으나, 말벌속 내 종들은 모두 동일한 유전자 배열로 구성되었다. 말벌속 마이토지놈 사용하여 계통 분석을 수행한 결과, *V. analis*는 *V. velutina*, *V. simillima*, 그리고 *V. bicolor*와 그룹을 이루었으며, *V. binghami*, *V. crabro*와 *V. dybowskii*는 *V. orientalis*와 그룹을 이루었다. 본 연구를 통해 말벌속 내 4종의 완전 마이토지놈 정보를 추가하였으며 이는 향후 말벌속 마이토지놈의 유전체 특성과 계통분류학적 연구의 기초자료로 사용될 것으로 기대된다.

**Key words:** Mitogenome, *Vespa analis*, *Vespa binghami*, *Vespa crabro*, *Vespa dybowskii*, *Vespa*

P-04

Poster presentation : Bee Health

**Mitochondrial genome of *Tropilaelaps mercedesae* Anderson and Morgan, 2007 (Acari: Laelapidae)**

**Min Woo Park, Jeong Sun Park, Jee-Young Pyo, Seung Hyun Lee, and Iksoo Kim\***

Department of Applied Biology, College of Agriculture & Life Sciences, Chonnam National University

*Tropilaelaps mercedesae* Anderson and Morgan, 2007 (Acari: Laelapidae) is a serious ectoparasite of several honey bee species. Among the four recognized species of *Tropilaelaps* Korean populations was renamed as *T. mercedesae* on the basis of morphological evidences, but genetic is not yet available. In this study, we report the mitochondrial genome (mitogenome) sequences of *T. mercedesae*, which is yet to be completed. Phylogenetic analysis using a portion of mitochondrial *COI*, clearly showed that current sample belongs to *T. mercedesae*, with the highest nodal support. The 13,765-bp long mitogenome, excluding *ND1*, *lrRNA*, *tRNA<sup>Tyr</sup>*, and the A+T-rich region is almost identical in size to that of Chinese sample reported previously, with an identical gene arrangement. Comparison of two geographic samples showed *COII*, *ND5*, *ND4*, *ND6*, and *CytB* to have higher number of variable sites than that of *COI*, which is often used for population-level study, suggesting these genes to have potential usefulness for population genetic study. The mitogenome sequences of *T. mercedesae* from Korea could be useful for species identification for geographic samples, trace of the origin of local populations, and illustration of evolutionary distinction among *Tropilaelaps* species either using part of or whole genome.

**Key words:** *Tropilaelaps mercedesae*, Mitochondrial genome, Laelapidae.



P-05

## Poster presentation : Bee Health

## The effect of supplementary feeding with probiotics on worker development and lifespan of stingless bee

**Jakkrawut Maitip<sup>1\*</sup>, Bajaree Chuttong<sup>2</sup>, Khanchai Danmek<sup>3</sup>, Surat Hongsibsong<sup>4</sup>,  
Sunisa Ungwiwatkul<sup>1</sup> and Wankuson Chanasit<sup>5</sup>**

<sup>1</sup> Faculty of Science, Energy and Environment, King Mongkut's University of Technology North Bangkok, Rayong Campus, Bankhai, Rayong, 21120 Thailand

<sup>2</sup> Meliponini and Apini Research Laboratory, Department of Entomology and Plant Pathology, Faculty of Agriculture, Chiang Mai University, Chiang Mai 50200, Thailand

<sup>3</sup> School of Agriculture and Natural Resources, University of Phayao, Phayao 56000, Thailand

<sup>4</sup> School of Health Sciences Research, Research Institute for Health Sciences, Chiang Mai University, Chiang Mai 50200, Thailand

<sup>5</sup> Department of Biology, Faculty of Science, Thaksin University, Patthalung 93210, Thailand

\* Email: jakkrawut.m@sciee.kmutnb.ac.th

Stingless bees are increasingly requested as crop pollinators and honey production within the tropics and subtropics. However, nutrition knowledge must be improved to maximize its potential and enhance productivity, especially during food shortages. This study aimed to study the influence of artificial supplements on the development of stingless bee *Tetragonula pagdeni* under laboratory conditions. The newly emerge bees were supplemented with pollen, commercial bee supplements, artificial supplements with probiotics, and without supplementation (control). The supplements were fed as a paste (3g/cage) to newly emerged bees in cages (30 bees/cage) and replaced every two days. The worker's longevity, fat body, hypopharyngeal glands (HPG) size, and protein contents were determined. The results reveal that all supplements were accepted and consumed by *T. pagdeni*, which allows them to be used for nutritional supplementation. There was an effect in time on the worker's longevity, fat body, acini size in hypopharyngeal glands (HPG), and protein contents in HPG characteristics at 21 days of evaluation. Artificial supplements with probiotics are presented as efficient alternatives for *T. pagdeni* feed.

**Key words:** Tetragonula, stingless bee supplementary, hypopharyngeal gland, fat body

**Acknowledge :** This project is funded by National Research Council of Thailand (NRCT)

P-06

Poster presentation : Bee Health

**Estimation of control efficiency against Varroa mite using herbaceous plants**

김동원, 조유영, 손민웅, 피터 아콩테, 이창훈, 박보선, 김수배, 최용수, 오대근

Apiculture Division, Department of Agricultural Biology, National Institute of Agricultural Science

최근 꿀벌 월동 폐사 발생으로 인해 양봉산업은 어려움을 겪고 있다. 그 원인으로는 기후변화, 병해충 발생 등으로 인해 폐사하고 있으며, 주요 원인으로 꿀벌응애류를 지목하고 있다. 꿀벌응애는 꿀벌 외부 기생성 응애는 꿀벌응애 (*Varroa destructor*), 중국가시응애(*Tropilaelaps mercedesae*)가 있다. 이를 방제하기 위해서는 화학적, 생태적 방제법이 있으며, 화학적 방제를 통한 방제 선호도가 높다. 화학적 방제는 약제 저항성 발현으로 인해 이용에 제한적이다. 친환경 화합물을 이용한 응애 방제 연구는 과거부터 최근까지도 지속해서 연구하고 있으나 낮은 방제 효율과 사용의 어려움으로 농가 사용에 한계가 있다. 본 연구는 약용 초본류를 이용하여 꿀벌응애 방제가와 꿀벌안전성 평가를 하였다. 약용 초본류는 정향, 백리향, 죽자초, 멀구슬나무 등을 이용하였다. 우선, 대부분 초본류들은 꿀벌에 독성이 나타나지 않았다. 방제 효율은 처리 후 72시간에서는 75% 이상으로 나타났으며, 멀구슬나무는 79%, 정향 68%, 백리향 95%, 죽자초 85%였다. 백리향, 죽자초는 산업화 추진 가능성을 확인하였다. 이들에 대한 정제, 사용법 등을 간소화 연구를 통해 응애 방제 약제로 등록할 수 있도록 추가 연구가 필요하다. 이를 통해 꿀벌응애 방제 약제 선택의 폭을 넓혀 합성화합물에 대한 저항성 문제 등을 해결할 수 있을 것으로 기대한다.

**Key words:** *Varroa destructor*, *Tropilaelaps mercedesae*, control, herbaceous plants

P-07

Poster presentation : Bee Health

**Metagenomic Analysis of Viral Diversity in *Apis cerana* Genome**

Ji-Young Kim<sup>1</sup>, Hyun-Soo Kim<sup>1</sup> and June-Sun Yoon<sup>1</sup>

<sup>1</sup>Department of Agricultural Convergence Technology, Jeonbuk National University, Jeonju 54596, Republic of Korea

One of the viruses that infects honey bees (*Apis cerana*) is the Sacbrood virus (SBV). Across the country, SBV affects honey bees, preventing them from pupating and killing them after capping. The first outbreak in South Korea was recorded in 2009-2010 leading to substantial colony collapses in *A. cerana*. Virome analysis was performed using *A. cerana* gut tissue obtained in South Korea. SBV had the most readings (161,191) out of all the viruses with 198,973 totals. Also, Deformed wing virus, Black queen Cell virus, and Kashmir bee virus were detected in the genome. Once the complete SBV genome was assembled, the genome sequence was compared to other viruses isolated from South Korea and other countries. Our KSV sequence showed a high degree of similarity with those sequences isolated from South Korea; however, different regions were observed among SBVs. Here, we assembled and performed a variety of analyses on the SBV genome that was isolated from South Korea

**Key words:** *Apis cerana*, Sacbrood virus, Virome analysis, Metagenomic



## P-08

## Poster presentation : Bee Health

### Analysis of Sacbrood virus and Israeli acute paralysis virus infecting honey bees using bioinformatics approach

Ju Hyeon Baek<sup>1</sup>, Hyeon Jun Koo<sup>1</sup> and June-Sun Yoon<sup>1</sup>

<sup>1</sup>Department of Agricultural Convergence Technology, Jeonbuk National University, Jeonju 54596, Republic of Korea

Honeybees have played a crucial role in pollination throughout the history of human agriculture. The eastern honeybee (*Apis cerana*) and the western honeybee (*Apis mellifera*) have been raised in South Korea. Honeybees have an economic worth of more than 50% of domestic fruit and vegetable production and contribute to domestic agriculture about 6 trillion KRW. Colony Collapse Disorder (CCD) is a term used to describe the disappearance of honey bee colonies that has been documented since early 2007. Unfortunately, this phenomenon turns into a global issue. Israeli Acute Paralysis Virus (IAPV) is one of the causes for the CCD in *A. mellifera*. The primary cause of *A. cerana* colony losses is infection with the Sacbrood virus (SBV). In this study, we collected genomic sequences of SBVs and IAPVs in NCBI database. Then, we analyzed the occurrences of those viruses in terms of outbreak location, time, genetic diversity, and so on. This study will serve as the foundation for future research on viruses and the analysis of viral trends.

**Key words:** *Apis cerana*, *Apis mellifera*, Sacbrood virus, Israeli Acute Paralysis Virus, virus genome

## P-09

## Poster presentation : Bee Health

### Survey of seasonal population dynamics against honeybee mites in 2023

김동원, 조유영, 손민웅, 피터 아콩테, 이창훈, 박보선, 김수배, 최용수, 오대근

Apiculture Division, Department of Agricultural Biology, National Institute of Agricultural Science

꿀벌 기생 응애는 외부 기생과 내부 기생으로 나눌 수 있다. 최근 꿀벌 폐사에 직접적인 영향을 주는 외부 기생 응애는 꿀벌응애(*Varroa destructor*)와 중국가시응애(*Tropilaelaps mercedesae*)가 있다. 이들 응애류에 대한 생리, 생태, 방제 연구는 전 세계적인 화두이며 국내에서 활발한 연구가 진행되고 있다. 이들 생태 연구는 지속적으로 이루어져야 이들에 대한 발생 최성기에 따른 방제 전략을 수립할 수 있다. 언론 및 양봉농가에서는 꿀벌응애 밀도가 기존 대비 증가하였으며, 대발 역시 조기에 이루어진다고 보고하고 있다. 이에 연중 꿀벌, 꿀벌응애, 중국가시응애 발생 예찰을 통해 꿀벌응애 방제 체계 확립을 위해 본 연구를 수행하였다. 꿀벌 세력 조사는 육안 및 격자를 활용하여 측정하였으며, 꿀벌응애류는 가루설탕법, 소방조사법, 벌통바닥조사법을 사용하여 봄철 시작부터 월동 전까지 일주간 격으로 조사하였다. 꿀벌응애 발생 최성기는 6월, 9월로 나타났으며, 약제 횟수 처리 봉군별 봉군 폐사율은 22~23년 월동 약제 미처리는 6월 폐사 70%, 23년 약제 미처리, 3-6월 약제 처리는 8월 70%, 3월 약제처리는 8월 80% 폐사, 3-6-9월 3회 약제 처리는 현재 2봉군 생존하였다. 따라서 꿀벌응애류 방제를 위해 지속적인 예찰을 통해 봉군 폐사를 방제해야 한다.

**Key words:** *Varroa destructor*, *Tropilaelaps mercedesae*, population dynamic

P-10

## Poster presentation : Bee Health

### Evaluation of the Efficacy in *Varroa destructor* Control Against Fumigation with Amitraz and Diesel Mixture

오대근, 민성현, 손민웅, AKONGTE PETER NJUKANG, 이창훈, 박보선, 김수배, 김동원, 조유영, 최용수

Apiculture Division, Department of Agricultural Biology, National Institute of Agricultural Science

현재 양봉산업은 꿀벌 봉군에 기생하는 꿀벌응애류에 의한 피해가 증가하고 있다. 피해 절감을 위해 다양한 꿀벌응애 방제 방법이 사용되었다. 하지만 살비제로 허가된 약제에 대한 저항성의 발달로 효과적으로 방제되지 않아 새로운 방제 방법이 필요한 실정이다. 본 연구에서는 꿀벌응애 방제에 사용되는 Amitraz의 기본 방제법과 다른 방법인 Amitraz에 경유를 혼합하여 훈증기를 통해 봉군에 직접 처리하는 방제법에 대한 효과를 검증하였다. 실험 처리구는 무처리, 플루바리네이트, 훈증으로 나누어 진행하였다. 약제 처리 기간 동안 봉군 세력의 변화는 그룹 간 유의한 차이를 보이지 않았다. 훈증 처리구는 무처리구 보다 높은 응애 방제 효과를 보였으며, 플루바리네이트 처리구보다 높은 평균 꿀벌응애 낙하가 관찰되었으나 유의하지 않았다. 하지만 훈증 처리구에서 일부 애벌레가 폐사하는 현상이 관찰되었다. 아미트라즈+경유 훈증 방제법의 적정 농도와 처리 시간에 대한 추가적인 실험을 진행하여 부작용을 최소화 한다면 효과적인 꿀벌응애류 방제 방법으로 사용될 수 있을 것이다.

**Key words:** *Varroa destructor*, *Apis mellifera*, Amitraz, Diesel, Fumigation, Acaricide, honeybee, Varroa mite, Control efficacy

P-11

## Poster presentation : Bee Health

### Anti-pancreatic cancer activity of various bee genome-derived peptides

Ye-eun Kim<sup>1</sup>, and Ki-Young Kim<sup>1,2</sup>

<sup>1</sup>Graduated School of Biotechnology, Kyung Hee University, <sup>2</sup>College of Life Science, Kyung Hee University

Pancreatic cancer ranks as the third leading cause of cancer-related mortality globally, contributing to approximately 7% of all cancer-related deaths. The 5-year survival rate remains at a mere 9%, with a worrisome annual increase in incidence rates by 0.5 to 1%. Peptides with an amino acid added to the N-terminus of the peptide sequence derived from *Apis mellifera*, which is mainly used in honey bee research, and several other species of bees indicated anticancer effects through different mechanisms. Upon conducting MTT and 3D Spheroid assays to assess anti-cancer efficacy, N0820, N0821, and notably, N0850 exhibited efficacy. Particularly, N0821 demonstrated robust anti-cancer efficacy, even within a 3D environment. In elucidating the anti-cancer mechanisms, experiments revealed that both N0820 and N0821 induce apoptosis by causing S/G2 cell cycle arrest, leading to an upregulation of apoptosis-related gene expression attributed to increased levels of c-jun and c-fos. Notably, N0821 exhibited these effects more prominently. Conversely, N0850 with Histidine added to the N-terminus, did not induce cell cycle arrest. Apoptosis in this case occurred through a mechanism unrelated to c-jun and c-fos. Taken together, further research is warranted to explore how the addition or removal of an amino acid in bee-derived anti-cancer peptides influences the underlying anti-cancer mechanisms.

**Key words:** pancreatic cancer, anti cancer peptide, bee peptide



## P-12

## Poster presentation : Bee Health

***Varroa destructor* resistance to *tau*-fluvalinate and amitraz miticides in Korean apiary**

**Se-ji Lee, Mi-Sun Yoo, So Youn Youn, Thu Thi Nguyen, Keun-Ho Kim, Su-Kyeong Seo, Jaemyung Kim, and Yun Sang Cho\***

Parasitic and Honeybee Disease Laboratory, Bacterial Disease Division,  
Animal and Plant Quarantine Agency, Korea

*Varroa destructor*, a parasitic mite of honey bees, has a detrimental impact on honey bee health, often leading to colony collapse. Korean beekeeping faces significant challenges due to high infestations of *Varroa* mite, and to address this, *tau*-fluvalinate and amitraz are commonly used for mite treatments. However, the effectiveness of these treatments and the extent of mite resistance to these miticides in South Korea remain poorly understood. Thus, this study aimed to evaluate the efficacy of mite treatment using *tau*-fluvalinate and amitraz while also assessing the status of miticide resistance in *Varroa destructor* collected from different apiaries in South Korea. To achieve this, sequencing analysis was performed to identify mutations in the voltage-gated sodium channel (VGSC) and the  $\beta$ -adrenergic-like octopamine receptor, which are the targets of *tau*-fluvalinate and amitraz, respectively. The results of the analysis conducted on 24 mite samples collected from various colonies in 17 apiaries showed that 83.3% (20/24) of the mite samples contained a mutation at position 925 of the VGSC gene, resulting in an amino acid change from leucine (L) to isoleucine (I). Additionally, one of the 24 samples (4.17%) exhibited a mutation at position 643 of the  $\beta$ -adrenergic-like octopamine receptor gene, leading to an amino acid substitution Y215H (Histidine replacing Tyrosine). The same mutation was reported in mites resistant to *tau*-fluvalinate and amitraz in the USA. Furthermore, a new mutation position in the  $\beta$ -adrenergic-like octopamine receptor gene was found to be prevalent in the mite samples collected in South Korea. This mutation involved the substitution of two nucleotides (AT) for CA at position 344 and 345 compared to the wild type in susceptible mites. Consequently, this mutation resulted in a change of Threonine (T) to Asparagine (N) at position 115 and was designated as T115N. Notably, 87.5% (21/24) of the collected samples exhibited this mutation. When mites with the new mutation were subjected to amitraz treatment, their survival rate ranged from 85% to 96.5%, whereas samples without the mutation only had a 41.7% survival rate. These results strongly suggest that *Varroa* mite populations in South Korea have developed resistance to both *tau*-fluvalinate and amitraz miticides. Consequently, the use of these chemicals might have a reduced effect in apiaries.

**Key words:** *Varroa destructor*, amitraz, *tau*-fluvalinate, miticide resistance

## P-13

## Poster presentation : Bee Health

**Comparative analysis of the complete genome of Sacbrood virus between *Apis mellifera* and *Apis cerana* in South Korea**

**Keun-ho Kim, Mi-Sun Yoo, So Youn Youn, Thu Thi Nguyen, Su-Kyeong Seo, Se-ji Lee, Jaemyung Kim, and Yun Sang Cho**

Parasitic and Honeybee Disease Laboratory, Bacterial Disease Division,  
Animal and Plant Quarantine Agency, Korea

The Sacbrood virus (SBV) is a prevalent viral pathogen in Korean apiculture, receiving significant attention from researchers and beekeepers in the country. While the full genome sequence of kSBV was reported in 2010, there has been a lack of updates on the pathogen's genome sequence since then. Consequently, this study aimed to investigate any changes in the genome sequences of kSBV by comparing published sequences with new ones obtained from samples collected between 2020 and 2023. A total of 20 full genome sequences of SBV were identified from infected *A. mellifera* (n=8) and *A. cerana* (n=12) samples using NGS or Sanger sequencing methods. Sequence alignment revealed *A. mellifera* exhibiting higher mutation rates compared to those in *A. cerana*. Phylogenetic analysis identified three different mutation trends among the 8 SBV isolates from *A. mellifera* in South Korea, with one of these trends showing high similarity to the sequences found in *A. cerana*. Furthermore, a phylogenetic analysis using whole genomes reported from different countries revealed four different genotypes, and all kSBV strains formed a separate cluster in the phylogenetic tree. The study's findings suggest that SBV has undergone adaptations to the honeybee population in South Korea, with a high mutation rate observed in *A. mellifera* hosts. Additionally, one of the mutation trends displayed high virulence and adaptability to *A. cerana* hosts.

**Key words:** *Apis mellifera*, *Apis cerana*, Sacbrood virus, genotype, genome analysis.

P-14

Poster presentation : Bee Health

## Molecular Detection of 14 Honeybee Diseases in *Apis mellifera* and *Apis cerana* in Korean Apiaries, in 2023

Su-Kyoung Seo, Mi-Sun Yoo, So Youn Youn, Keun-Ho Kim, Se-Ji Lee, Jaemyung Kim and Yun Sang Cho\*

Parasitic and Honeybee Disease Laboratory, Animal and Plant Quarantine Agency, Korea

Honeybee plays an essential role in pollination of crops and produces honey and other valuable by-products like pollen, propolis, royal jelly and so on. The main species present in Korea are *Apis mellifera* and *A. cerana*. A total of 136 samples (*Apis mellifera* 128, *A. cerana* 8) were collected from 96 apiaries located in 10 different regions from January 1<sup>st</sup> to December 31<sup>th</sup>. (Gangwon, Gyeonggi, Gyeongnam, Gyeongbuk, Jeonnam, Jeonbuk, Chungnam, Chungbuk, Gwangju and Jeju). Samples were collected, and stored at -20°C. Collected samples were homogenized in sterile PBS, and the supernatant was used for RNA and DNA extraction. Total RNA was eluted in 50µL of elution buffer and used directly for RT-PCR. The synthesized cDNA and the freshly-extracted DNA were used as templates for PCR amplification. PCR was performed using forward and reverse primers synthesized by Bioneer Co. The RT-PCR product was sequenced and analyzed by using BLAST (Basic Local Alignment Search Tool). DWV (Deformed wing virus, 71.3%) was the most prevalent in fourteen honeybee diseases, followed by AFB (American foulbrood, 36.8%), BQCV (Black queen cell virus, 35.3%), SBV (Sacbrood virus, 28.7%), NOSEMA (Nosema cerana, 23.5%) and IAPV (Israel acute paralysis virus 16.2%), ASCO (*Ascosphaera apis*, 15.4%), EFB (European foulbrood, 14.7%), ASP (*Aspergillus flavus*, 6.6%), CBPV (Chronic bee paralysis virus, 5.9%) and ABPV (Acute bee paralysis virus, 5.9%). And these diseases are main cause of honeybee decline in Korea. Therefore, it is needed to diagnose the diseases rapidly and accurately for implement optimal control measures. Also, molecular monitoring of honey bee disease pathogens should be continuously performed to investigate the precise relationship between hosts and pathogens and to prevent honeybee disease.



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## Poster presentation : Bee Health

### Nextractor<sup>®</sup> System: A rapid and sensitive point-of-care testing application in detecting and studying Honeybee Pathogens

Sooho Lim, Hyeonha Yoo, Joomin Aum, Youngji Kim, Heejong Shin, Chang Yoon Ji, Woojin Kim and Minlee Kim

R&D Center, Genolution Inc., Seoul 07793, Korea

To study the recent honeybee colony losses, the demands of sensitive, high-throughput, and capability of point-of-care testing (POCT) are required for diagnosis and surveillance of the honey bee pathogens. In this study, the performance of the Nextractor<sup>®</sup> system, an automated nucleic acid (NA) extraction device was compared to the conventional manual NA kits. To increase the usefulness of this system, loop-mediated isothermal amplification (LAMP) methods were designed to detect honeybee major pathogens (*Nosema* in *Apis mellifera* and *Korean sacbrood virus* in *A. ceranae*). UV spectrometer, conventional and real-time PCR results demonstrated the superior performance of Nextractor<sup>®</sup> system which showed higher NA extraction efficiency and purity than those of conventional method. The LAMP assay using automated extraction demonstrated to be more sensitive and three times faster in diagnosis than qPCR-based methods. Moreover, NA extraction and diagnostics with bee body parts without homogenization using Nextractor<sup>®</sup> system showed potential as a promising solution for field-deployable POCT application with the LAMP method. Therefore, the Nextractor<sup>®</sup> system is a useful alternative to existing methods, which could reduce workload and serve as a sensitive diagnostic and genetic research tool.

**Key words:** Automated nucleic acid extraction, loop-mediated isothermal amplification, LAMP, POCT, Nextractor<sup>®</sup>

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## Poster presentation : Bee Health

### Viral metagenomics investigation revealing honey bee virome in Taiwan

Fang-Min Chang<sup>1</sup>, Yi-Hsuan Li<sup>2</sup>, Yen-Hou Chen<sup>1</sup>, Ming-Cheng Wu<sup>1,2\*</sup>, Yu-Shin Nai<sup>1,2\*</sup>

<sup>1</sup>. Department of Entomology, National Chung Hsing University, Taichung, Taiwan.

<sup>2</sup>. Doctoral Program in Microbial Genomics, National Chung Hsing University and Academia Sinica, Taiwan

\*Corresponding authors

In this study, honey bees were collected from thirteen apiaries across Taiwan between March and November 2023 for viral detection. The results revealed the presence of five viral species, including Deformed Wing Virus (DWV), Lake Sinai Virus (LSV), Israeli Acute Paralysis Virus (AmSBV), Acute Bee Paralysis Virus (AcSBV), Black Queen Cell Virus (BQCV), and Kakugo virus (KV). Further RNA-seq analysis of four samples from Taichung City identified up to eight bee viral species in one sample. Our RNA-Seq data also uncovered newly recorded honey bee virus contigs in Taiwan, such as Darwin bee virus, Bundaberg bee virus, Varroa jacobsoni virus, and *Apis mellifera* filamentous virus. Future efforts will involve incorporating more viral metagenomics data to establish the honey bee virome in Taiwan, with rigorous phylogenetic analysis needed to confirm the status of newly discovered honey bee viruses as distinct species or not.

**Key words:** Honey bees; *mellifera*; metagenomics; Virome



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## Poster presentation : Bee Health

### Comparative genomics of *Vairimorpha ceranae* revealing the genome divergence between different isolates

Yi-Hsuan Li<sup>1,2</sup>, Fang-Min Chang<sup>1</sup>, Ming-Ceng Wu<sup>1,2</sup>, Yu-Shin Nai<sup>1,2\*</sup>

<sup>1</sup>Doctoral Program in Microbial Genomics, National Chung Hsing University and Academia Sinica, Taiwan.

<sup>2</sup>Department of Entomology, National Chung Hsing University

\*Corresponding author

Bees (*Apis mellifera*) play a crucial role as pollinators in agriculture but have long been adversely affected by various pathogens, impacting the health of bee colonies. *Vairimorpha cerana* is a primary pathogen causing nosemosis, a disease in bees. It is an obligate intracellular parasitic fungus that negatively affects bees' physiology and behavior, leading to mortality. Initially identified in western honeybee colonies in 2004, *V. cerana* infections seem to have transitioned to latent states in recent years. Our preliminary findings, using third-generation ONT sequencing and analysis, reveal genomic differences between *V. cerana* collected from bee colonies in Taichung, Taiwan, and the BRL strain from Jiangxi, China (Accession number: PRJNA514060). We aim to investigate *V. cerana* collected from regions with different temperature profiles to clarify whether temperature induces genomic variations among regional isolates and provide targeted and region-specific control strategies for *V. cerana* infections in different temperature regions in the future.

**Key words:** *Apis mellifera*, *Vairimorpha cerana*, comparative genomics, transcriptome, regional difference

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## Poster presentation : Bee product

### Optimization of sorting process for the drone pupae (*Apis mellifera* L.)

Hyo Young Kim, Seon Mi Kim, Hyo Jung Moon, Sik Ryu and Young Sin Lee

Department of Agricultural Biology, National Institute of Agricultural Science, Rural Development Administration

In this study, introduces a current method for drone pupae sorting with the aim of addressing its limitations by designing a specialized drone pupae frame. The sorting of drone pupae was categorized into three primary stages, further subdivided into nine steps. This division of sorting stages was necessitated by the limited time available for sorting at room temperature. The design of the dedicated drone pupae frame was developed to enhance the existing sorting method. Nevertheless, additional research is required for practical field implementation. Therefore, it is expected that the findings of this study will enable many beekeeping households to directly sort drone pupae. The refinement of sorting methods is deemed crucial and will necessitate further research.

**Key words:** Drone pupae, Sorting, Food materials.



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Poster presentation : Bee product

### Phytochemical Analysis of Honey Bee Brood: Initial Investigation in Chiang Mai, Thailand Employing LC-QToF/MS.

**Surat Hongsibsong<sup>1,\*</sup>, Phannika Tongjai<sup>1</sup>, Bajaree Chuttong<sup>2</sup>, PeerapongJeeno<sup>1</sup>, Jakkrawut Maitip<sup>3</sup>  
Khanchai Danmek<sup>4</sup>**

<sup>1</sup>School of Health Sciences Research, Research Institute for Health Sciences, Chiang Mai University, Chiang Mai 50200, Thailand

<sup>2</sup>Meliponini and Apini Research Laboratory, Department of Entomology and Plant Pathology, Faculty of Agriculture, Chiang Mai University, Chiang Mai 50200, Thailand

<sup>3</sup>Faculty of Science, Energy and Environment, King Mongkut's University of Technology North Bangkok, Rayong Campus, Bangkok, Rayong, 21120 Thailand

<sup>4</sup>School of Agriculture and Natural Resources, University of Phayao, Phayao 56000, Thailand

The honeybee brood, encompassing eggs, larvae, and pupae stages in the bee's life cycle, is renowned for its rich nutritional profile, comprising proteins, fats, carbohydrates, vitamins, and minerals. Its significance lies in fostering the robust development of adult bees. In this study, a thorough examination was conducted to assess the phytochemical composition of honeybee brood, employing LC-QTOF/MS analysis. Preliminary findings indicate the presence of bioactive compounds such as terodiline hydrochloride, N-(2,5-Dihydroxyphenyl) pyridinium, anandamide, inosine, tymazoline, senkyunolide M, 2-benzofurancarboxaldehyde, docosanamide, and pipecolic acid—substances utilized in pharmaceuticals. Additionally, LysoPE (18:1(11Z)/0:0) LPEs, sanctioned for accelerating ripening and enhancing the quality of fresh fruits and vegetables, were identified. These findings suggest potential medicinal applications, warranting further exploration of their therapeutic benefits.

**Key words:** Honey bee brood, Phytochemicals, LC-QToF/MS

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Poster presentation : Bee product

## Comparison of the physicochemical properties of Longan honey derived from stingless bees (Apidae: Meliponini) and honey bees (Apidae: Apini) from Thailand

**Kanokwan Klaithin<sup>1,2</sup>, Jer-An Lin<sup>3</sup>, Bajaree Chutthong<sup>2</sup>, Khanchai Danmek<sup>4</sup>, Surat Hongsibsong<sup>5</sup>, Jakkrawut Maithip<sup>6</sup>, Fuangfah Punthi<sup>7</sup>, and Ming-Cheng Wu<sup>1</sup>**

<sup>1</sup>Department of Entomology, College of Agriculture and Natural Resources, National Chung Hsing University, Taichung 40227, Taiwan

<sup>2</sup>Department of Entomology and Plant Pathology, Faculty of Agriculture, Chiang Mai University, Chiang Mai 50200, Thailand

<sup>3</sup>Graduate Institute of Food Safety, College of Agriculture and Natural Resources, National Chung Hsing University, Taichung 40227, Taiwan

<sup>4</sup>School of Agriculture and Natural Resource, University of Phayao, Thailand

<sup>5</sup>School of Health Sciences Research, Research Institute for Health Sciences, Chiang Mai University, Chiang Mai 50200, Thailand

<sup>6</sup>Faculty of Science, Energy and Environment, King Mongkut's University of Technology North Bangkok (Rayong campus), Rayong 21120, Thailand

<sup>7</sup>Department of Food Science and Biotechnology, College of Agriculture and Natural Resources, National Chung Hsing University, Taichung 40227, Taiwan

Honey has a complex chemical composition and health-promoting effects. Global honey production mostly relies on the bee species *Apis mellifera*. There is a distinct group of bees known as stingless bees (meliponine), which also contributes to honey production and has become popular. The principal objective of this study was to investigate the physicochemical properties of longan honey collected from the northern part of Thailand and produced by various bee species, specifically *Tetragonula laeviceps*, *Tetragonula pagdeni*, *Heterotrigona itama*, *Apis mellifera*, and *Apis cerana*. The differentiation data obtained from this study between honey from stingless bees and honey bees showed the average pH values were  $3.82 \pm 0.39$  and  $3.93 \pm 0.08$ , respectively. *H. itama* honey had the lowest pH at 3.29. The average total acidity of stingless bee honey was higher than that of *Apis* species honey,  $8.49 \pm 2.02$  and  $3.74 \pm 0.80$  meq/kg, respectively. The average protein content of stingless bees and honey bees was  $0.96 \pm 0.04$  and  $0.97 \pm 0.06$  g/100g, respectively. Honey from *A. cerana* showed the highest (1.08 g/100g) and honey from *H. itama* was the lowest (0.84 g/100g). The sugar composition in honey includes fructose, glucose, and trehalulose. Honey derived from honey bees exhibited the highest values of glucose and fructose ( $3.00 \pm 0.17$  and  $406.30 \pm 18.30$  mg/ml), whereas honey produced by stingless bees demonstrated the highest levels of trehalulose ( $444.88 \pm 107.64$  mg/ml). The diverse physicochemical properties observed in longan honey from various bee species contribute to our understanding of the complex process of honey production.



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Poster presentation : Bee product

### Comparative study on the anti-proliferative activity of breast cancer cells by apigenin from *Apis mellifera* bee pollen and apigenin-based synthesized silver nanoparticles

Bongkotchanok Danrungcharoen<sup>1</sup>, Stephan Thierry Dubas<sup>2</sup>, and Chanpen Chanchao<sup>1\*</sup>

<sup>1</sup> Department of Biology, Faculty of Science, Chulalongkorn University, 254 Phayathai Road, Bangkok 10330, Thailand

<sup>2</sup> The petroleum and petrochemical college, Chulalongkorn University, 254 Phayathai Road, Bangkok 10330, Thailand

\* Email: chanpen.c@chula.ac.th

Breast cancer has been the major cause of death for women worldwide. For decades, many single and/or combination therapy (surgery, chemotherapy, radiation therapy) have been applied to those patients. However, severe side effects like tissue injury, elimination of normal cells and intolerable adverse effects like fatigue, hair loss have been noticed. Hence, alternative agents from natural products or treatments are still required. Thus, apigenin isolated from corn (*Zea mays* L.) bee pollen was our target. Moreover, silver nanoparticles (AgNPs) have become to be beneficial materials which can enhance the potential of bioactivities. Here, AP synthesized with AgNPs (AgNPs-AP) was focused on the anti-proliferative activity of BT-474 breast cancer cells. The AgNPs were synthesized with humic acid as capping reagent. After that, UV-vis spectrophotometry was used to characterize and determine the optimum ratio of AgNPs-AP. Different concentrations (1:8-25 - 1:400-0.5 micrograms/mL) of AgNPs-AP and AP were treated on BT-474 cancer cells for 24, 48, and 72 h. Normal WI-38 fibroblast cells and free AgNPs were used as control. It was found that AgNPs-AP affected both BT-474 cancer cells and WI-38 normal cells (IC<sub>50</sub> of 1:12.405-16.278 and 1:12.214-16.375 microgram/mL, respectively). However, AgNPs-AP was more significantly cytotoxic on BT-474 cancer cells than WI-38 cells. In addition, AgNPs-AP is more potentially cytotoxic to BT-474 cancer cells than AP. The AgNPs-AP was potential at 24 and 72 h of incubation. Due to the above data, AgNPs-AP is promising for further experiments in order to apply them for alternative breast cancer therapeutic agents in the future.

**Keywords:** apigenin, bee pollen, breast cancer, cytotoxicity, silver nanoparticles

**Acknowledgement or funding:** Travelling grant from Faculty of Science, Chulalongkorn U.

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Poster presentation : Bee product

### Antimicrobial activity of crude alcoholic extract of propolis from stingless bee *Geniotrigona thoracica* in Thailand

Kawisa Konsila<sup>1</sup>, Kanthida Pamornpol<sup>1</sup>, Wanchai Assavalapsakul<sup>2</sup>, and Chanpen Chanchao<sup>1\*</sup>

<sup>1</sup>Department of Biology, Faculty of Science, Chulalongkorn University, 254 Phayathai Road, Bangkok 10330, Thailand

<sup>2</sup>Department of Microbiology, Faculty of Science, Chulalongkorn University, 254 Phayathai Road, Bangkok 10330, Thailand

\*E-mail: chanpen.c@chula.ac.th

*Malassezia globosa* is lipophilic yeast causing many severe chronic skin diseases like psoriasis, dandruff while *Propionibacterium acnes* and *Staphylococcus aureus* are bacteria causing inflammatory acne vulgaris. Since available antimicrobial agents still have various side effects, the new curative agents are required. *G. thoracica* propolis was harvested in Samut Songkhram province. Crude ethanol or methanol extract (CEE or CME) was prepared and its potential was determined by diameter ( $\varnothing$ ) of clear zone using agar well diffusion assay. To inhibit the growth of *M. globosa*, the CEE at 120 mg/mL was initially potential ( $\varnothing$  of clear zone,  $19.00 \pm 1.00$  mm). In addition, critical concentration ( $C_{cr}$ ) of CEE was calculated by two models. For linear diffusion model,  $C_{cr}$  from Bonev et al. (2008), 30.36 mg/mL, was lower than  $C_{cr}$  Cooper and Woodman formula and coefficient of determination ( $R^2$ ) was 0.917. The  $C_{cr}$  from radial diffusion model by Vesterdal was determined as 44.72 mg/mL and  $R^2$  was 0.910. The efficiency of CEE (200mg/mL) on lipase inhibition was 68.31%. Furthermore, for *P. acnes* and *S. aureus* growth inhibition, the minimal working concentration of CME was 62.5 mg/mL ( $\varnothing$  of clear zone at 14-15 mm). The antibacterial activity of CME was obviously dose-dependent. Moreover, the total phenolic compound content by Folin- Ciocalteu method was 20.67 mg gallic acid equivalents (GAE)/g and the flavonoid content by aluminium chloride method was 480.26 mg quercetin equivalents (QE)/g. Thus, *G. thoracica* propolis in Thailand can be used as an alternative agent on the antimicrobial activity in the future.

**Keywords:** alternative agent, crude extract, pathogenic microbe, propolis, stingless bee

**Acknowledgement or funding :** Traveling grant of Faculty of Science, Chulalongkorn University

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Poster presentation : Bee product

### 필터링 방법에 따른 꿀 혼합 프로폴리스 내 성분 변화

김성국, 문시원, 김효영, 최홍민, 김선미, 이문선, and 우순욱

국립농업과학원 양봉생태과

다양한 식물의 삼출물에서 유래되어 꿀벌이 생산하는 프로폴리스는 약 300가지 이상의 성분들이 포함되어 있다. 기존 연구들에서 프로폴리스의 수많은 생물학적 기능성이 밝혀졌으며, 현재도 기능성 식품, 의약 소재 등으로 프로폴리스를 활용하기 위한 연구가 수행되고 있다. 특히, 프로폴리스는 천연 성분을 다량으로 포함하고 있어 다른 물질과의 상호 혼합에 의한 기능성 상승 효과가 크며, 현재 건강기능성 식품 연구는 이런 산물 간의 혼합으로 생물학적 기능성을 높이는데 주력하고 있다. 본 연구에서는 꿀과 혼합한 프로폴리스를 세포에 적용하기 위해 필터링을 하여 산물에 포함된 미생물과 불순물 등을 제거하였는데, 이 과정에서 필터링과 혼합 순서에 따라 산물의 성분에서 변화가 나타남을 확인하였다. 10:1의 비율로 섞인 꿀 혼합 프로폴리스의 LC 분석을 위해 두 가지 방법으로 시료를 준비하였다. 먼저 동량의 80% 에탄올을 넣고, rotator에서 1시간 동안 섞어주었다. 이후, 동량의 D.W.를 첨가하여 완전히 혼합하고 0.45  $\mu$ m의 syringe filter로 필터링하였다. 또 다른 혼합 방법은 꿀만을 위의 혼합비로 섞어주고 0.45  $\mu$ m의 syringe filter로 필터링한 다음, 위에 섞인 조건대로 프로폴리스를 첨가한 것이다. 이 두 조건을 통해 제작된 제형을 LC 분석 장치에 주입하여 분석한 결과 혼합 후 필터링한 시료에서 20분 내에 나타난 성분이 제거된 것을 확인하였다. 이는 필터링 조건에 따라 프로폴리스 내 성분 변화가 나타남을 의미하며, 실험에 따라 혼합 시료의 필터링 조건을 다르게 사용해야 한다는 것이다. 또한 실험 조건에 따라 나타나는 프로폴리스 성분 변화를 통해 각 성분의 기능성 효과를 손쉽게 파악할 수 있는 단초가 될 것이다.

**Key words:** Honey, Propolis, Filtering

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Poster presentation : Bee product

### 천연 아까시꿀과 사양꿀로 혼합한 프로폴리스의 암세포 사멸 기능성 차이 분석

김성국, 문시원, 김효영, 최홍민, 김선미, 이문선, and 우순옥

국립농업과학원 양봉생태과

프로폴리스는 독특한 맛과 향으로 인해 섭취에 어려움이 있어 일반적으로 부형제를 활용하여 프로폴리스의 맛과 향을 경감시키는데, 프로폴리스 섭취를 위해 활용되는 부형제는 일반적으로 꿀을 사용한다. 꿀의 경우 밀원에 따라 구분되며, 국내에서 주로 채밀되는 꿀은 아까시나무에서 유래된다. 천연 조미료로 활용되는 꿀은 각종 식물에서 유래된 성분이 미세하게 포함되어 있어, 생물학적 기능성에서도 효과를 나타낸다. 하지만 사양꿀의 경우 설탕만을 이용하기 때문에 천연꿀에 포함되는 여러 기능성 성분들이 포함되지 않는다. 본 연구에서는 천연 아까시꿀과 사양꿀의 생물학적 기능성을 알아보기 위해 또 다른 양봉산물인 프로폴리스와 혼합하여 섭취에 용이하면서도 기능성 효과를 함께 가질 수 있는지를 확인하였고, 사양꿀과 천연꿀 간의 차이를 확인하고자 하였다. PANC-1 췌장암세포에 아까시꿀과 사양꿀에 각각 프로폴리스를 혼합한 제형을 처리하여 세포 사멸을 WST로 확인한 결과, 프로폴리스에서 나타나는 암세포 사멸 효과는 나타나지만 아까시꿀과 혼합했을 경우 암세포 사멸 효과가 증가되었으며, 사양꿀은 프로폴리스와 혼합해도 천연꿀에 비해 기능성 효과가 저하된 것으로 나타났다. 본 연구 결과를 통해 사양꿀의 경우 단맛은 추구할 수 있지만 천연꿀에 비해 기능성 효과가 떨어지며, 이는 결과적으로 생태계 식생 보호를 통해 뛰어난 기능성 효과를 가진 양봉산물을 생산해야 하는 것을 의미한다.

**Key words:** Acacia honey, Sugar honey, Propolis, Anti-cancer effect

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Poster presentation : Bee product

### 전기영동과 UPLC 분석을 통한 천연 아까시꿀과 사양꿀 비교

문시원, 김성국, 김효영, 최홍민, 김선미, 이문선, and 우순옥\*

국립농업과학원 양봉생태과

꿀은 대표적인 양봉산물로서 꿀벌이 자연에 존재하는 다양한 밀원으로부터 수집하여 생산된다. 그중 우리나라에서는 아까시나무를 밀원으로 생산된 아까시꿀이 집중적인 소비가 이루어지고 있다. 그러나 이와 같은 천연꿀은 밀원이 조성되어야만 생산이 가능하다. 그에 비해 사양꿀은 천연꿀 채취 후 꿀벌사육과정에서 대체 당으로 공급되는 설탕물을 모아 생산하기 때문에 연중 생산이 가능하다. 본 연구에서는 사양꿀과 아까시꿀의 분자 차이를 구명하여 판별하고자 하였으며, 이를 위해 전기영동(SDS-PAGE)과 초고성능크로마토그래피(UPLC)로 분석 및 비교하였다. 꿀 단백질 분석은 시료를 투석하여 꿀 안에 존재하는 다량의 당을 제거한 후 SDS-PAGE로 분석하였고, UPLC는 80% 에탄올과 물을 혼합하여 사용하였다. SDS-PAGE에서 뚜렷하게 구분된 밴드의 유무로 각 꿀을 구성하는 단백질에 차이가 있음을 알 수 있었고, 대부분의 페놀성 화합물이 감응하는 254 nm에서 UPLC 분석 결과, 피크의 차이를 확인하였다. 본 결과를 바탕으로, 사양꿀과 천연 아까시꿀을 판별하는데 유용한 기초자료로 활용할 수 있을 것이다.

**Key words:** Sugar-fed honey, Natural honey, *Robinia pseudoacacia*, SDS-PAGE, UPLC

**사사 :** 본 연구는 농촌진흥청 연구지원(과제번호:PJ01745701)으로 수행되었습니다.

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Poster presentation : Bee product

### 국산 아까시꿀과 베트남산 아카시아꿀의 비교분석

이문선, 김성국, 김효영, 최흥민, 김선미, 문시원, and 우순옥\*

국립농업과학원 양봉생태과

꿀은 전세계적으로 소비되는 중요한 식품 중 하나로 그 특성은 밀원에 따라 결정되며, 주변 식생, 환경 등에 의해 차이가 발생한다. 아까시꿀은 국내에서 가장 많이 소비가 되는 꿀 중 하나다. 그리고 국내 아까시꿀은 학명이 *Robinia pseudoacacia*인 아까시나무가 밀원이고, 베트남산 아카시아꿀은 학명이 *Acacia pycnantha*인 아카시아나무가 밀원이다. 2029년에 베트남산 꿀의 관세가 완전히 철폐됨에 따라 국내에 유입되었을 경우 국산 아까시꿀과의 원산지 혼동이 발생할 수 있기 때문에 두 꿀 간의 명확한 판별 기준 설정이 필요하다. 본 연구는 국산 아까시꿀과 베트남산 아카시아꿀을 분석하여 성분적으로 두 꿀이 구별될 수 있는 차이를 확인 하고자 했다. 연구 방법으로는 국산 아까시꿀과 베트남산 아카시아꿀을 각각 투석하고, 농축 후 재현탁 하여 SDS-PAGE를 실시했다. 또한 고성능액체크로마토그래피(HPLC)를 이용하여 꿀의 성분을 분석했다. 분석 결과 SDS-PAGE를 통해 두 꿀 사이에 단백질 차이를 확인하였고, HPLC분석을 통해서도 성분 차이가 있는 것을 확인 할 수 있었다. 따라서 본 연구의 결과를 통해 두 꿀 간의 명확한 차이를 밝혀 분자적으로 판별 근거를 제시함으로써 수입산 꿀로부터 국산 아까시꿀을 보호하는데 과학적 근거를 마련할 수 있다.

**Key words:** 국산 아까시꿀, 베트남산 아카시아꿀, SDS-PAGE, HPLC, 성분분석

**사사:** 본 연구는 농촌진흥청 연구지원(과제번호:PJ01745701)으로 수행되었습니다.

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Poster presentation : Bee product

### Bee Pollination Decreases Gray Mold Disease and Postharvest Deterioration in Strawberry Fruits

Yong Tae Kim<sup>1</sup>, Ji Yeong Ham<sup>1</sup>, Suong Tuyet Thi Ha<sup>1</sup>, Jong hwa Shin<sup>1</sup>, and Byung-Chun In<sup>\*1</sup>

<sup>1</sup>Department of Smart Horticultural Science, Andong National University

Pollination plays a crucial role in the fruiting process of strawberries (*Fragaria × ananassa*) and affects qualities such as firmness, color, weight, and yield. Strawberry fruits are perishable after harvest and prone to quality deterioration and gray mold disease (GMD) caused by *Botrytis cinerea* (B.C). This study was conducted to evaluate the effect of bee pollination (BPOL) on postharvest quality and GMD infection in strawberry fruits. After harvest, both BPOL and non-bee pollination (CON) fruits were inoculated or not with the B.C suspension ( $10^5$  conidia mL<sup>-1</sup>) to induce GMD development. The results showed that BPOL effectively suppressed skin color change, flesh firmness, and weight loss of strawberry fruits during postharvest storage. Higher firmness resulted in the longer shelf life of BPOL strawberry fruits by 2 days compared with CON and by more than 4 days compared with CON+B.C. GMD development occurred 4 days earlier in CON fruits than in BPOL fruits. These results affirm that bee pollination effectively enhances the postharvest quality of strawberries by retarding fruit ripening and reducing GMD infection.

**Key words:** Bee Pollination, Gray Mold Disease, Strawberry, Shelf life, Post harvest

**Funding Source:** This work was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by Ministry of Education (NRF-2018R1A6A1A03024862).



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Poster presentation : Bee product

### A Rapid Detection of Water status and Internal Sucrose Level of Rose Flowers using Hyperspectral Imaging

Ji Yeong Ham, Yong-Tae Kim, Suong Tuyet Thi Ha, and Byung-Chun In\*

Department of Smart Horticultural Science, Andong National University

Cut roses are often sensitive to water stress during storage and transportation, leading to premature wilting and a reduction in vase life. Hyperspectral imaging is widely used for non-destructive analysis of plant physiology and chemical properties. In this study, we used hyperspectral imaging to measure water content and evaluate postharvest quality in cut roses. Cut roses underwent either wet transport (WT), dry transport (DT), or treatment with dry and glucose to identify reflectance wavelengths closely associated with water content of cut roses. The results revealed that WT resulted in a longer vase life and better flower quality compared to DT. Glucoses treatment improved both the vase life and quality of the cut flowers compared to control flowers. Conversely, in the case of dry treatment, the vase life of cut flowers decreased with an increase in the degree of dryness. Our results also showed that the hyperspectral reflectance of the petals of cut roses in the wavelength range 680-720 nm was different among treatments. These results demonstrate that it is possible to evaluate and screen the postharvest quality of cut rose flowers based on the water status of cut flowers using hyperspectral data.

**Key words:** Cut Rose, Hyperspectral Imaging, Postharvest Quality, Vase Life, Water Content

**Funding Source:** This work was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by Ministry of Education (NRF-2018R1A6A1A03024862).

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Poster presentation : Bee product

### Nutritional composition analysis of honey in Wanju county by season

최홍민, 우순옥, 김효영, 김성국, 김선미, 문시원 and 한상미

국립농업과학원 양봉생태과

시기별 생산되는 벌꿀은 밀원의 종류 및 주변 환경에 따라 성분의 조성이 다르며 이러한 성분의 차이는 꿀벌의 영양 및 성장에 영향을 미친다. 본 연구에서는 전북 완주군에 위치한 국립농업과학원 양봉장 주변에서 아까시 꿀이 생산될때쯤부터 시기별(5월, 6월, 7월, 9월)로 생산되는 꿀의 일반영양성분, 당의 조성 및 정량분석, 무기질 함량 등 영양학적 조성의 차이를 분석하였다. 최대한 동일하게 사양조건을 유지하며, 채밀 당시에는 사양없이 공소비를 통하여 벌꿀을 수집하여 분석에 이용하였다. 일반성분은 전체적으로 탄수화물의 함량이 가장 높았으며, 5~7월 생산되는 꿀의 경우 수분함량이 비슷했지만 9월 생산꿀은 수분함량이 15.42%로 낮게 측정되었다. 당함량의 경우 5월 생산꿀이 62.58g으로 가장 높게 측정되었으며, 7월과 9월 생산꿀은 특이적으로 맥아당이 소량 검출되었다. 5월, 7월, 9월 생산되는 꿀의 과당:포도당의 비율은 1.3정도로 유사하였지만, 6월에 생산되는 꿀의 경우 2.1로 포도당의 비율이 매우 적고 과당의 비율이 매우 높게 측정 되었다. 시기별로 생산되는 모든 꿀에는 칼륨의 함량이 가장 높게 측정되었으며, 상대적으로 6월과 7월에 생산되는 꿀이 무구질 함량이 높게 측정되었다. 본 연구를 통해 시기별 생산되는 꿀의 영양성분 분석을 통해 추후 영양성분과 꿀벌의 강건성과의 상관성을 구명하기 위한 기초자료로서 활용할 수 있을 것으로 기대된다.

**검색어:** 영양성분 분석, 시기별 생산꿀, 무기질, 당조성



P-30

Poster presentation : Pollination & Honey Plant

**Propagation and Flowering Physiology of *Minuartia laricina* (L.) Mattf.,  
a new ornamental crop for pollinator gardens**

**Dong Gyu Lee<sup>1</sup>, Chae Won Kim<sup>1</sup>, and Seung Youn Lee<sup>1,2</sup>**

<sup>1</sup>Department of Horticulture and Breeding, Graduate School of Andong National University, Andong 36729, Korea, <sup>2</sup>Department of Smart Horticultural Science, Andong National University, Andong 36729, Korea

This study investigated germination characteristics and rooting of stem cuttings for development of a propagation protocol for *Minuartia laricina* (L.) Mattf. In addition, flowering requirements with cold treatment and photoperiod were studied. Fresh seeds did not germinate at 4°C, 10°C, 15°C, 20°C, 25°C, and 30°C for four weeks of incubation. However, the seeds germinated to 0%, 12.5%, 52.7%, 76%, 72%, and 60.4% at 4°C, 10°C, 15°C, 20°C, 25°C, and 30°C, respectively, following four weeks of dry after-ripening at room temperatures ( $\approx$  22°C). Cuttings of *M. laricina* rooted well without plant growth regulators treated, suggesting that stem cuttings propagation could be practical. Plants exposed to 5°C for  $\geq$ 8 weeks exhibited 100% flowering under long-day conditions (16h, 24h, or [9h+4h Night interruption]). Plants without cold treatment did not flower. Even with the same duration of cold treatment, an increased photoperiod resulted in a higher flowering percentage and a higher number of flowers. These findings highlight the obligate vernalization and obligate long-day flowering responses of *M. laricina*. (This research was supported by the National Research Foundation of Korea (NRF), Ministry of Education under Grant NRF-2018R1A6 A1A03024862.)

**Key words:** Caryophyllaceae, obligate vernalization, photoperiods, seed germination, vegetative propagation

**Funding Source:** The research was supported by the BSRP through the National Research Foundation of Korea (NRF), Ministry of Education under Grant NRF-2018R1A6A1A03024862.

P-31

Poster presentation : Pollination & Honey Plant

**Bioassay-Guided isolation of anti-diabetic Flavonoid derivatives from *Hypericum monogynum* and the  
mechanism study in HepG2 cells**

**Samuel Park<sup>1</sup>, Keono Kim<sup>1</sup>, Seungjoo Baik<sup>2</sup>, Junsoo Lee<sup>2</sup>, and Jeehye Sung<sup>1</sup>**

<sup>1</sup>Department of Food Science and Biotechnology, Andong National University

<sup>2</sup>Department of Food Science and Biotechnology, Chungbuk National University

In this study, two high-content flavonoid derivatives [3-8" bisapigenin (HM 104) and quercetin-3-O- $\beta$ -D-galactopyranoside (HM 111)] were obtained through the bioactivity-guided isolation of anti-diabetic compounds from *Hypericum monogynum* flowers. HM 104 and HM 111 exhibited good glucose consumption in fatty acid-induced insulin-resistant HepG2 cells. Moreover, both two active compounds improved glucose uptake by reversing the altered expression of important factors involved in glucose metabolism, including insulin receptor substrate 1 (IRS-1), phosphoinositide 3-kinase (PI3K), protein kinase B (Akt), and glucose transporter type 4 (GLUT4), and by mitigating the expression of forkhead box O1 (FOXO1), and the factors involved in gluconeogenesis. They upregulate the phosphorylation of GSK3 $\beta$  and glycogen synthase (GS), important factors in glycogen synthesis. Furthermore, the production of reactive oxygen species (ROS) was decreased by two compounds. These findings provide a novel mechanistic understanding of the beneficial effects of the flavonoid derivatives isolated from *H. monogynum* flowers on the prevention and treatment of insulin resistance and related metabolic disorders.

**Key words:** *Hypericum monogynum*, Flavonoid, Bioassay-guided isolation, Anti-diabetic activity, Insulin resistance, HepG2



P-32

## Poster presentation : Pollination &amp; Honey Plant

**Control Effect against Apple Fire Blight Using Bee Vectoring Dispenser for Pollinating Bees****Soon-Il Kim, In Bok Lee, and Seong Ryul Park**

Center for Research and Development of KLSBio

This study was carried out to determine control effect in screened cages against apple fire blight using developed dispensers. The temperature in honey bee hives equipped with dispensers and in dispensers was 30.8 and 29.3°C, and relative humidity was 66.1 and 72.9%, respectively. The number of *Bombus terrestris*, *Apis mellifera* and *Apis cerana* entering the hives per 10 minutes through the dispenser installed at the entrance was 7, 89, and 207, respectively, and *A. mellifera* delivered transport substances to the farthest distance (70 m) within the tested apple green house. The amount of microbial agent per *A. mellifera* and *A. cerana* was 3.6 ( $\pm 0.59$ ) and 1.2 ( $\pm 0.32$ ) mg, showing a significant difference (t-test,  $P=0.0008$ ). *A. mellifera* delivered about 3 times more than *A. cerana*. The mortality of *B. terrestris* exposed to the microbial products (*B. subtilis* QST713 and *B. amyloliquefaciens* MBI600) applied in cages in the apple house was 13.3 and 5.0% and the number of bee entrances in 30 minutes and the number of active bees in the cages were statistically insignificant. In addition, the incidence of fire blight in Hongro flowers was 35.8% in the *B. subtilis* QST713 and 84.2% in the *B. amyloliquefaciens* MBI600 treatments, and the corresponding control effect was 61% and 6.9%, respectively. Therefore, it was found that *B. subtilis* QST713 is useful as a bee-vectoring microbial agent for controlling fire blight. Based on these results, we will further study to apply the developed dispensers for control various crop diseases in green houses and fields.

**Key words:** Bee hive, Bee-vectoring, Dispenser, Fire blight, Microbial product.

This study was supported by “Development of control techniques against fire blight using pollinating bees (RS-2021-RD009549)” Rural Development Administration, Republic of Korea.

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## Poster presentation : Pollination &amp; Honey Plant

**Ecological characteristics and geographic distribution of Osmia Species across four province in South Korea****Kyu-Won Kwak, Dong Hee Lee, Kyeong Yong Lee, Young Bo Lee, Su Jin Lee, Hee Ji Kim**Division of Apiculture, Department of Agricultural Biology,  
National Institute of Agricultural Sciences, Korea

Solitary bees, such as *Osmia cornifrons*, *O. pedicornis*, *O. satoi*, and *O. taurus* belonging to the Hymenoptera order within the Megachilidae family, present opportunities for cost-effective and sustainable pollination. A comprehensive understanding of their ecological traits is essential for the effective implementation of fertilization strategies across a wide range of crops. This study investigated the nesting behavior of *Osmia* spp. in diverse regions and altitudes, utilizing various trap types in 2023. The results indicated that nesting rates were highest at altitudes exceeding 600 meters above sea level, and there was a preference for bamboo-type traps. The Jeongsun region in Gangwon demonstrated the highest overall nesting rate, highlighting the influence of altitude, habitat area, and trap type on the density of *Osmia* spp. nests. The distribution and diversity of the four *Osmia* spp. exhibited variations in occurrence across different regions and altitudes, with *O. pedicornis* displaying the broadest distribution, particularly at altitudes above 300 meters. Noteworthy differences in cocoon masses were identified among *O. cornifrons*, *O. pedicornis*, and *O. taurus*, with both region and altitude exerting influence on the masses of each species.

**Key words:** *Osmia* spp., distribution, characteristics, altitude

P-34

Poster presentation : Bee Biology

**The Effects of Sowing times on Predicting Honey Production of Korean Buckwheat (*Fagopyrum esculentum* M.) Cultivars.**

**Ji-Min Park, Young-Im Choi, and Sung-Joon Na\***

Forest Bioresources Department, National Institute of Forest Science

This study compares the potential honey production of three common buckwheat cultivars (Goun, GU; Haetsal, HS; Yangjeul, YJ) in Korea as nectar sources during scarce flowering periods. This research assessed the number of flowers, nectar volume, and free sugar content in nectar based on sowing times. From mid-April to mid-August 2023, 25 seeds of each cultivar were sown in nine sequences at a greenhouse in Suwon, Korea. Flowers were analyzed on the first day of blooming. All three cultivars showed the highest number of flowers when sown in May, with a sharp decline in both metrics from June. 'GU' and 'YJ' showed a decreasing trend in free sugar content per flower post-mid-April sowing, while 'HS' increased until early May, then decreased from mid-May. The nectar sugar content per ranged from 0.01 to 0.19 mg for 'GW', 0.02 to 0.25 mg for 'HS', and 0.03 to 0.39 mg for 'YJ'. The potential honey production per plant based on the sowing time for these cultivars ranged from 2.30 to 86.76 mg for 'GW', 3.42 to 181.25 mg for 'HS', and 4.52 to 120.29 mg for 'YJ'. Specifically, 'HS' was predicted to yield the most honey per plant when sown in early May, and 'GU' in mid-July. Overall, 'YJ' was considered the most superior cultivar for honey production per plant. Nonetheless, this study suggests the need for further research on the cumulative flowering duration of buckwheat.

**Key words:** *Fagopyrum esculentum* M., nectar sources, nectar volume, free sugar content, predicting honey production

This study was carried out with the support of 'R&D Program (Project No. FG403-2023-01-2023)' provided by NIFoS



## P-35

## Poster presentation : Bee Biology

### Effect of Capturing Honeybee Predatory Wasps Using the Composition for Attracting the Yellow-legged Hornet, *Vespa velutina nigrithorax* (Hymenoptera: Vespidae)

Jong-Eun Lee, Hyo-Ryeo Cho, Sang-Kyu Park, Yu-Jin Kim, and Myeong-Hyeon Nam

Industrial Entomology Research, Agricultural Research & Extension Services, Chungcheongnam-do, Republic of Korea.

The Yellow-legged hornet (*V. velutina nigrithorax*), which was first discovered in Busan in 2003, rapidly spread across the country around 2017, and it was classified as a foreign pest of the ecological disturbance species in 2019. Due to global warming, the damage of Yellow-legged hornet in Korean beekeepers is serious from several years ago, and there is no effective control technology. The wasp attractants are sold as commercial goods, but there is a problem in that the attraction effect against Yellow-legged hornet is low and the attraction lasting effect is short. This study was conducted to improve the attraction and persistence of attraction to Yellow-legged hornet to improve these problems. Wasps attraction composition capture experiments were investigated from April 1 to November 30, 2024. As a result of the capture experiment, the number of Yellow-legged hornet trapping populations of control attractant (two types of commercial products, A and B) and selected four types of composition selected for Yellow-legged hornet (P-A, P-G, T23-A, and T23-G compositions) was Cont.-A 193, Cont.-B 223, P-A 619, T23-A 877, P-G 719, and T23-G 1,253. In particular, in the peak season (October to November), the wasp reproduction period, the average number of total captive populations, including *V. vellutina nigritharax*, *V. mandarinia*, and *V. analis* etc., was  $16 \pm 0.5$  in controls A and B,  $46 \pm 6.3$  in P-A,  $78 \pm 8.7$  in T23-A,  $100 \pm 12.5$  in P-G, and  $294 \pm 7.4$  in T23-G. The capturing population index(CPI) compared to the control group (A&B) at the most number of wasps captured from October 16<sup>th</sup> to 22<sup>th</sup> were evaluated as P-A 2.9, T23-A 4.9, P-G 6.3, and T23-G 18.4. In addition, the average distribution ratio of the captured wasps was showed as *V. vellutina nigritharax* 83.3%, *V. crabro flavofasciata* 8.7%, *V. mandarinia* 4.8%, and *V. analis* 0.7%. It implies that the explosive increase and spread of the Yellow-legged hornet due to global warming is feared to cause serious damage to beekeepers.

Therefore, based on the excellent results of the composition for attracting the Yellow-legged hornet developed in this study, it is hoped that the joint control should be carried out as a policy project before the appearance of the queen wasps in spring.

**Kew words :** Yellow-legged hornet, Wasp, Queen wasp, Attractant, Capturing

## P-36

## Poster presentation : Bee Biology

### 사과꽃(*Malus pumila* Mill.)에서의 서양꿀벌(*Apis mellifera*), 동양꿀벌(*Apis cerana*), 서양뒤영벌(*Bombus terrestris*)의 방화활동 특성

김나현<sup>1</sup>, 최진혁<sup>1</sup>, 이명렬<sup>2</sup>, 권형욱<sup>2</sup>, 김길원<sup>1</sup>

<sup>1</sup>인천대학교 행동생태실험실, <sup>2</sup>인천대학교 매개곤충자원융복합연구센터

사과꽃(*Malus pumila*)의 결실을 위한 꽃가루 수분은 꿀벌 등 화분 매개 곤충에 의존하고 있다. 본 연구는 사과꽃 개화에 서양꿀벌(*Apis mellifera*), 동양꿀벌(*Apis cerana*), 서양뒤영벌(*Bombus terrestris*)의 방화 활동 패턴을 조사하고, 이를 토대로 계획적 화분 매개에 필요한 기초정보를 제공하고자 한다. 북충주에 위치한 방충망 하우스(전장 50m)에 10m 간격으로 카메라를 설치하여 시간별 사과꽃(*M. pumila*)에 방문하는 개체수와 벌통 입구의 출입 활동을 관찰하였다. 벌통 출입은 모두 14~16시에 최고치를 보였다. 각 시간대별 꽃에 방문하는 개체 수를 비교한 결과 서양꿀벌(*A. mellifera*)이 12시, 14시, 동양꿀벌(*A. cerana*)은 12시에 가장 많이 방문하는 것으로 나타났다. 반면, 서양뒤영벌(*B. terrestris*)은 모든 시간대에서 꿀벌보다 적은 수의 활동을 보였다. 꽃에 체류하는 시간은 동양꿀벌(*A. cerana*)이  $5.4 \pm 3.4$ 초로 가장 짧았으며, 서양꿀벌(*A. mellifera*)은  $7.5 \pm 4.5$ 초, 서양뒤영벌(*B. terrestris*)은  $10.2 \pm 5.3$ 초로 가장 길었다. 한편, 사과꽃(*M. pumila*)의 평균 꽃당 꽃꿀량은  $5.62 \pm 2.70 \mu\text{l}$ 로, 기존 연구(丁京聲, 1988)의 측정량인  $0.02 \pm 0.02 \mu\text{l}$ 보다 훨씬 많은 것으로 조사되었다.

**키워드:** 서양 꿀벌(*Apis mellifera*), 동양꿀벌(*Apis cerana*), 서양뒤영벌(*Bombus terrestris*), 사과꽃(*Malus pumila*), 방화활동, 꽃꿀량

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Poster presentation : Bee Biology

**Changes in honey bee colony development according to external environmental control of the colony in summer**

**Bo-Sun Park, Minwoong Son, Daegeun Oh, Akongte Peter Njukang, Dongwon Kim, Su-Bae Kim and Yong-Soo Choi**

<sup>1</sup>Department of Agricultural Biology, National Institute of Agricultural Science, RDA, Wanju 55365, Republic of Korea

Recently, loss of bee colonies has been occurring frequently throughout Korea. Various causes have been suggested, including pests, pesticides, and climate change. We conducted research focusing on the reasons for abnormal weather. We reared bee colonies during the summer in different external environments, and monitored changes in colony development during the experiment. The external environment was conducted in open fields, rain shelters, and outdoor chambers. In the case of the outdoor chamber, the temperature was set to be maintained consistently at  $15\pm 4^{\circ}\text{C}$ . As a result of the experiment, the growth of the flocks reared in an outdoor chamber at  $15^{\circ}\text{C}$  showed stable and good growth. However, from mid-July, when the hot and humid environment continued, the entire experimental group showed a common decrease. In the case of a  $15^{\circ}\text{C}$  chamber, the humidity rose rapidly, causing the entire group of bongs to disappear. Through this, it was concluded that not only temperature control but also humidity control is a very important factor, and that humidity monitoring is necessary periodically when using a  $15^{\circ}\text{C}$  chamber.

**Key words:** Honey bee, climate change, environmental control, chamber

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Poster presentation : Bee Biology

**Flight patterns honeybees (*Apis mellifera*) and bumblebees (*Bombus terrestris*) near their hives to use image deep learning**

**Kyeong Yong Lee, Jongho Park, Young Bo Lee, Su Jin Lee, Kyu-Won Kwak,**

Department of Agricultural Biology, The National Academy of Agricultural Science

Bee traffic at the hive entrance can be used as an important indicator of foraging activity. We investigated patterns of honeybees and bumblebees near their hives as a basis for calculating bee traffic using the image deep learning. The flight pattern near the hive differed significantly according to bee at entering and leaving the hive. Honeybees mainly showed flight that changed flight direction more than once (69.5%), whereas bumblebees mainly performed straight flight (48.7%) or had a single turn (36.5%) in flight. When bees entered the hive, honeybees primarily showed one-turn or two-turn flight patterns (88.5%), and bumblebees showed a one-turn flight pattern (48.0%). In contrast, when leaving the hive, honeybees primarily showed a straight flight pattern (63.0%), and bumblebees primarily showed a straight or one-turn pattern (90.5%). There was a significant difference in flight speed according to the flight pattern. The speed of straight flight ( $0.89\pm 0.47$  m/s) was 1.5 to 2.1 times faster than flight where direction changed. Therefore, our results can help determine the capturing and recognizing the flying image of bees when calculating bee traffic by image deep learning.

**Key words:** Flight speed, deep learning, *Apis mellifera*, *Bombus terrestris*

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## Poster presentation : Bee Biology

**Higher temperatures induce behavioral changes in bumblebee (*Bombus terrestris*) queens**Han Soo Kim<sup>1,3</sup>, Hyung Joo Yoon<sup>1,3</sup>, Bo Yeon Kim<sup>1</sup>, Kyeong Yong Lee<sup>2</sup>, Kwang Sik Lee<sup>1,\*</sup>, Byung Rae Jin<sup>1,\*</sup><sup>1</sup>College of Natural Resources and Life Science, Dong-A University, Busan 49315, Republic of Korea<sup>2</sup>Department of Agricultural Biology, National Academy of Agricultural Science, Wanju 55365, Republic of Korea

Due to the increasing frequency of heatwaves, climate change has the potential to greatly affect the population of bumblebees (*Bombus terrestris*), which are important pollinators in most temperate and boreal ecosystems. Bumblebee queens may be particularly vulnerable to elevated temperatures during their solitary period. In the present study, we investigated the behavior of overwintered spring queens and newly emerged fall queens and the resulting colony characteristics at three different temperatures: optimal (27 °C; C27), moderately high (32 °C; C32), and high (35 °C; C35). Spring queens exposed to higher temperatures exhibited distinct plastic responses in their oviposition behavior, with spring queens in the C35 group demonstrating a higher frequency of abnormal oviposition behavior, such as the cyclic digging of egg cells and oviduct, which ultimately led to colony failure. Compared to C27, spring queens in the C32 treatment were associated with a higher number of oviposition events, a higher colony formation rate, a higher number of offspring per colony, a shorter colony development period, and a lower body size for the adult offspring. These results indicate that elevated temperatures lead to behavioral changes in spring queens and affect the characteristics of the resulting colonies. Fall queens exhibited mating avoidance behavior at higher temperatures, particularly C35, resulting in a lower mating rate. Our results demonstrate that bumblebee queens exhibit a plastic behavioral response to thermal variation, with colony failure occurring due to abnormal behavior when thermal limits are exceeded. This suggests that climate change may have a deleterious effect on the population of bumblebees.

**Key words:** Bumblebee, *Bombus terrestris*, Climate change, Mating, Oviposition, Plastic response, Pollinator

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## Poster presentation : Bee Biology

**Amwaprin is a honeybee sperm-binding protein that inhibits sperm motility and enhances sperm viability**Yun Hui Kim<sup>1,3</sup>, Bo Yeon Kim<sup>1,3</sup>, Hyung Joo Yoon<sup>1</sup>, Yong Soo Choi<sup>2</sup>, Kwang Sik Lee<sup>1,\*</sup>, Byung Rae Jin<sup>1,\*</sup><sup>1</sup>College of Natural Resources and Life Science, Dong-A University, Busan 49315, Korea<sup>2</sup>Department of Agricultural Biology, National Academy of Agricultural Science, Wanju 55365, Korea

Mated queen honeybees store viable sperm in their spermathecae for egg fertilization throughout their lifetimes, which can span several years. However, the mechanism by which queen honeybees store sperm for extended periods has remained a longstanding question. The molecular basis for the long-term survival of stored sperm in queen honeybees is linked to minimized energy metabolism and reduced production of reactive oxygen species (ROS), but the specific factor responsible for such changes remains unknown. In this study, we present the first evidence of the presence of Amwaprin, a sperm-binding protein, in the seminal and spermathecal fluids of honeybees. We observed that Amwaprin acted as a sperm-binding protein primarily expressed in the testes and spermatheca of honeybees. A lack of binding between Amwaprin and the sperm surface resulted in altered sperm morphology, increased sperm motility, elevated H<sub>2</sub>O<sub>2</sub> production, and decreased sperm viability. Our data demonstrate that Amwaprin inhibits sperm motility and enhances sperm viability. These findings suggest that the reduced sperm motility caused by Amwaprin binding in queen bees' spermathecae contributes to the long-term survival of stored sperm by minimizing energy metabolism and ROS production.

**Key words:** Honeybee, Sperm-binding protein, Sperm motility, Sperm viability, Waprin

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## Poster presentation : Bee Keeping

### 경남지역 신품종 토종벌의 형질특성 및 생산력 검토

김종원<sup>1</sup>, 박지혜<sup>1</sup>, 장다현<sup>1</sup>, 배성문<sup>1</sup>, 윤진욱<sup>1</sup>, 심현영<sup>1</sup>, 이영한<sup>1</sup>, 김영광<sup>1</sup> and 최용수<sup>2</sup>

<sup>1</sup>경상남도농업기술원, <sup>2</sup>국립농업과학원

농촌진흥청에서 육성한 RX 계통은 낭충봉아부패병 저항성을 가지고 있으며 토종꿀 생산성이 우수한 토종벌이다. 이 RX 계통에 대하여 경남지역에서 형질특성과 생산력을 검토하였다. 조사결과 청소력(pin killed test)에 의한 사충제거능력은 8시간 경과 후 RX 계통 26%, 대조구인 한라벌은 52%였으며, 24시간 경과 후 RX 계통 90%, 한라벌 97%로 두처리구가 사충제거능력이 우수하였다. 수밀력은 유밀기에 벌통으로 들어오는 일벌과 나가는 일벌의 무게를 비교하여 조사하였는데 RX 계통의 한마리당 들어오는 일벌의 무게는 84.4mg, 나가는 일벌의 무게는 70.0mg으로 무게차가 14.4mg이었고, 대조구인 한라벌의 들어오는 일벌의 무게는 82.1mg, 나가는 일벌의 무게는 69.6mg으로 무게차가 12.2mg이었다. RX 계통의 수밀력은 한라벌의 수밀력에 비해 약 18%정도 높게 나타났다. RX 계통과 한라벌의 5~6월 봉군 발육 상태는 일벌과 유충, 번데기 모두 안정적으로 증가하였다.

**검색어:** 경남지역, 토종벌, 수밀력, 낭충봉아부패병

**사사:** 본 연구는 농촌진흥청 연구과제 PJ015042022021의 연구비로 지원된 결과입니다.

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## Poster presentation : Bee Keeping

### Investigation of Pesticide Residues in Honeybee Samples Used in Apiculture

Se-Hyung Kim, Chung-Oui Hong, Seon-Young Lee, Sunjin Park, Inhae Jeon, Jihye Kim,  
Sung-Won Park, Hyun-Ok Ku, and Mi-Young Park\*

Veterinary Drugs & Biologics Division, Animal and Plant Quarantine Agency (APQA),  
Gimcheon-si, 39660, Republic of Korea

The necessity of using pesticides in apiculture to combat the negative impact of varroa mites on honeybee populations has raised concerns about chronic toxicity from prolonged pesticide exposure. This study utilized LC-MS/MS to conduct a comprehensive analysis of multiple pesticide residues in honeybee samples. The targeted pesticides included bromopropylate, coumaphos, cymiazole, flumethrin, and fluvalinate, along with two amitraz metabolites (DMF and DMPF), with the aim of determining their presence in honeybees.

A total of 101 honeybee samples, collected in 2022, underwent examination using QuEChERS method and LC-MS/MS. A total of 207 pesticides were found in the samples where pesticides were detected, with fluvalinate being the most frequently identified substance (79, 78.2%). Analysis of the substance detection pattern across all cases revealed that the most common pattern was fluvalinate-DMF-DMPF (26, 25.7%). This study highlights the practical implications of pesticide residues in honeybees, emphasizing the quantification of residues.

**Key words:** Honeybees, Pesticide residues, LC-MS/MS analysis, Varroa mites





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## Poster presentation : Bee Keeping

**Analyze the reusability of rockwool substrate considering changes in physicochemical properties****Jae Seong Lee and Jong Hwa Shin**

Department of Horticulture and Breeding, Andong National University, Andong 36729, Korea

암면배지(재사용, 미사용)의 재수화 과정에서 발생하는 물리화학적 특성 변화 분석을 통해 암면 배지의 재사용 가능성을 판단하고자 하였다. 배지 물리화학적 비교 실험은 2023년 3월부터 8월까지 토마토 재배에 사용된 암면배지와 미사용 암면배지를 이용하여 진행되었다. 배수시간 및 배수량은 관수모니터링 시스템 상단 및 하단에 설치된 로드셀을 통해 측정되었다. 암면배지의 물리적 특성 비교에서 무게와 밀도는 재사용 암면배지에서 높은 경향을 보였으며, 포수 후 평균 배수 시간은 재사용 암면이 미사용 암면에 비하여 1.5배 늦었다. 암면 배지의 부분별 염류 농도는 재사용 암면배지가 미사용 암면배지에 비해 낮았다. 관수 시간에 따른 배액의 전기전도도 변화는 배수가 시작되는 시점에서 가장 컸으며, 배액의 양이 증가할수록 급속하게 작아지는 경향을 보였다. 관수 시간에 따른 배액 전기전도도 변화는 지수 감소 곡선의 형태를 보였다. 위 실험을 통해 배지의 물리화학적 특성비교로 암면 배지의 재사용 가능성을 판단할 수 있었다.

**Key words:** Drainage, Electrical conductivity (EC), Load-cell, Rockwool slab, substrate

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## Poster presentation : Bee Keeping

**Integrating Environmental-Condition Recording Sensors in One Board for Beehive Monitoring****Woogon Kim<sup>1</sup>, Jinha Kim,<sup>1</sup> Seonguk Kim<sup>1</sup>, Sanga Kim<sup>1</sup>, Sejin Lee<sup>1</sup>, Hyung-Wook Kwon<sup>1</sup> and Sungtek Kahng<sup>1</sup>**<sup>1</sup>Incheon National University

According to scientific reports, an increasing number of bees have gone away being affected by rapid climate changes and insect diseases. Densities of CO<sub>2</sub> in the air of apiary locations and temperatures from place to place and from season to season as indicators on phenomena of global warming and pollutions become more and more worth watching and being treated as rudimentary information in the course of coping up with deterring from loss of bees. In order to take effective measures in the aforementioned problem, the base of gaining information and making knowledges should be scientifically built by monitoring and environmental conditions of the insects' habitat. This motivated us to bring CO<sub>2</sub> and temperature sensors with their own functions and lay them at a single printed circuit board, traffic of multiple data along the time-line and suitability of the data. The chipset placed at the center of the board collects, stores and processes the data from the sensors and sends them wirelessly to the data gatherer, which leads to the display of the environmental conditions of the beehive. The user as a beekeeper can turn on the handset and access the data miles away from the farm and can do manage a system to keep the beehive away from harsh conditions.

**Key words:** Environmental conditions, Sensors, Data, Scientific beekeeping.

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## Poster presentation : Bee Keeping

### Installation of a Weight Sensor to Check Shock and Balance of a Beehive

Woogon Kim<sup>1</sup>, Jinha Kim,<sup>1</sup> Seonguk Kim<sup>1</sup>, Sanga Kim<sup>1</sup>, Sejin Lee<sup>1</sup>, Hyung-Wook Kwon<sup>1</sup> and Sungtek Kahng<sup>1</sup>

<sup>1</sup>Incheon National University

There are people who run apiaries as a hobby. However, for most cases, beekeeping is a business which enables farmers to make a fortune by selling honey in the market. It is undeniably true that honey is accepted as something precious to food industries and pharmaceutical production. As the bee population is drastically decreasing, the values of honey and beehive maintenance become higher and higher. Framers' beehives are placed outdoors, which is exposed to burglary. Wild animals recognize beehives and steal honey after dismantling the beehives. On the other hand, global boiling has caused turbulent weathers resulting in floods or landslides that do damage to beekeeping areas. Along with them, earth-shakes come as intruders into the most desirable structural stability. By installing a weight sensor under the base of the beehive, sensing shocks or imbalance of the horizontal base, we need to be prepared for actions to take to stop the damage from worsening even when we visit the town or are in the middle of other businesses.

**Key words:** Beehive maintenance, Weight sensors, Shock, Balance.

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