

台灣昆蟲學會第38屆年會

Taiwan Entomological Society
38th Annual Meeting



國立自然科學博物館，台中

National Museum of Natural Science, Taichung
Oct 20-21, 2017

昆言企業股份有限公司

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封面/Cover

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第三十八屆台灣昆蟲學會年會

The 38th Annual Meeting of Taiwan Entomological Society

本屆年會主題：

“當我們同在一起！”

昆蟲與共生微生物的交互關係

2017 年 10 月 20-21 日

台灣，台中，國立自然科學博物館

October 20-21, 2017

National Museum of Natural Science

Taichung, Taiwan

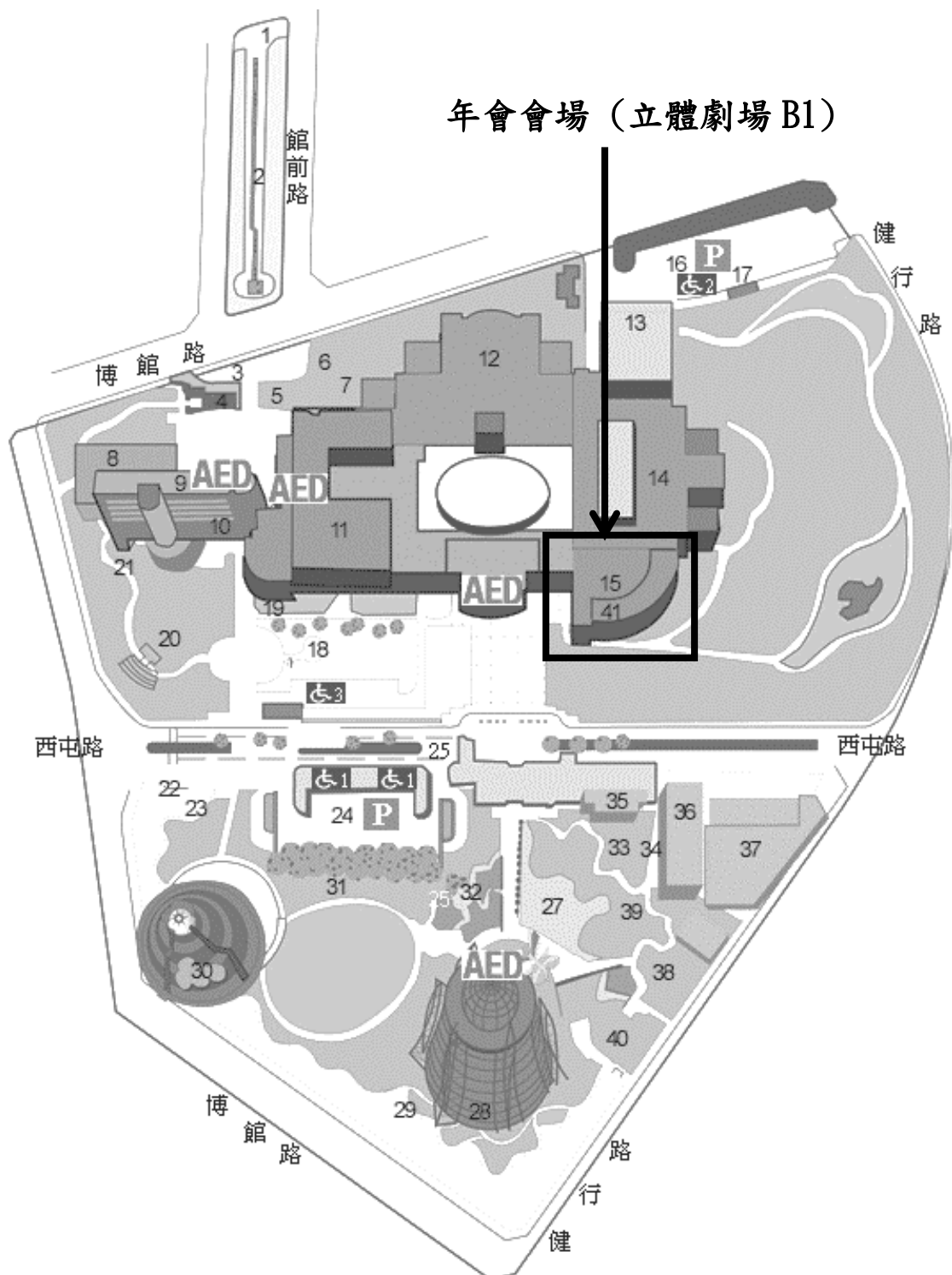
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會議地點 Meeting Venue

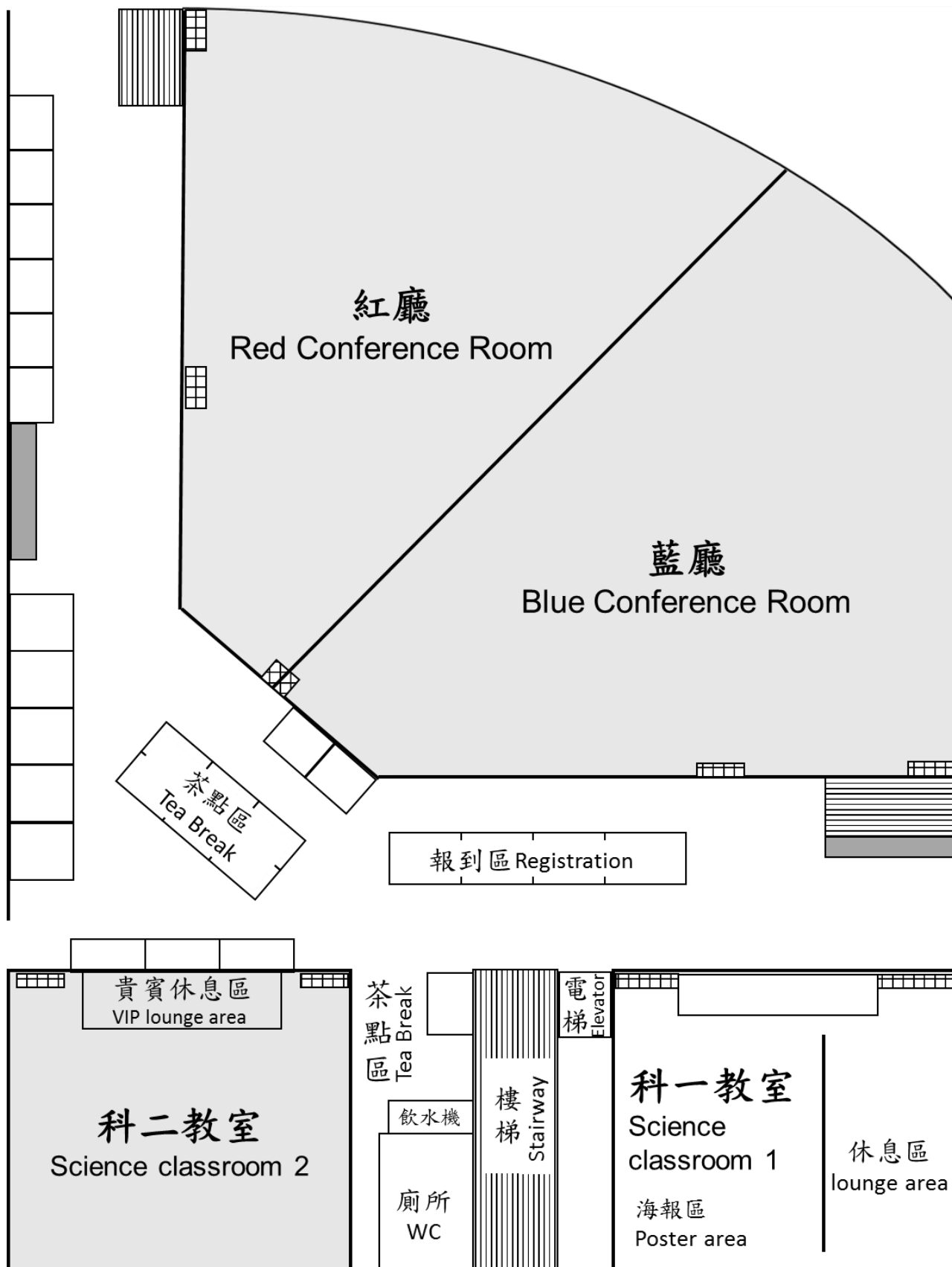
國立自然科學博物館立體劇場 B1

3D Theater (B1) of National Museum of Natural Science (NMNS)



會場平面圖 Floor Plan

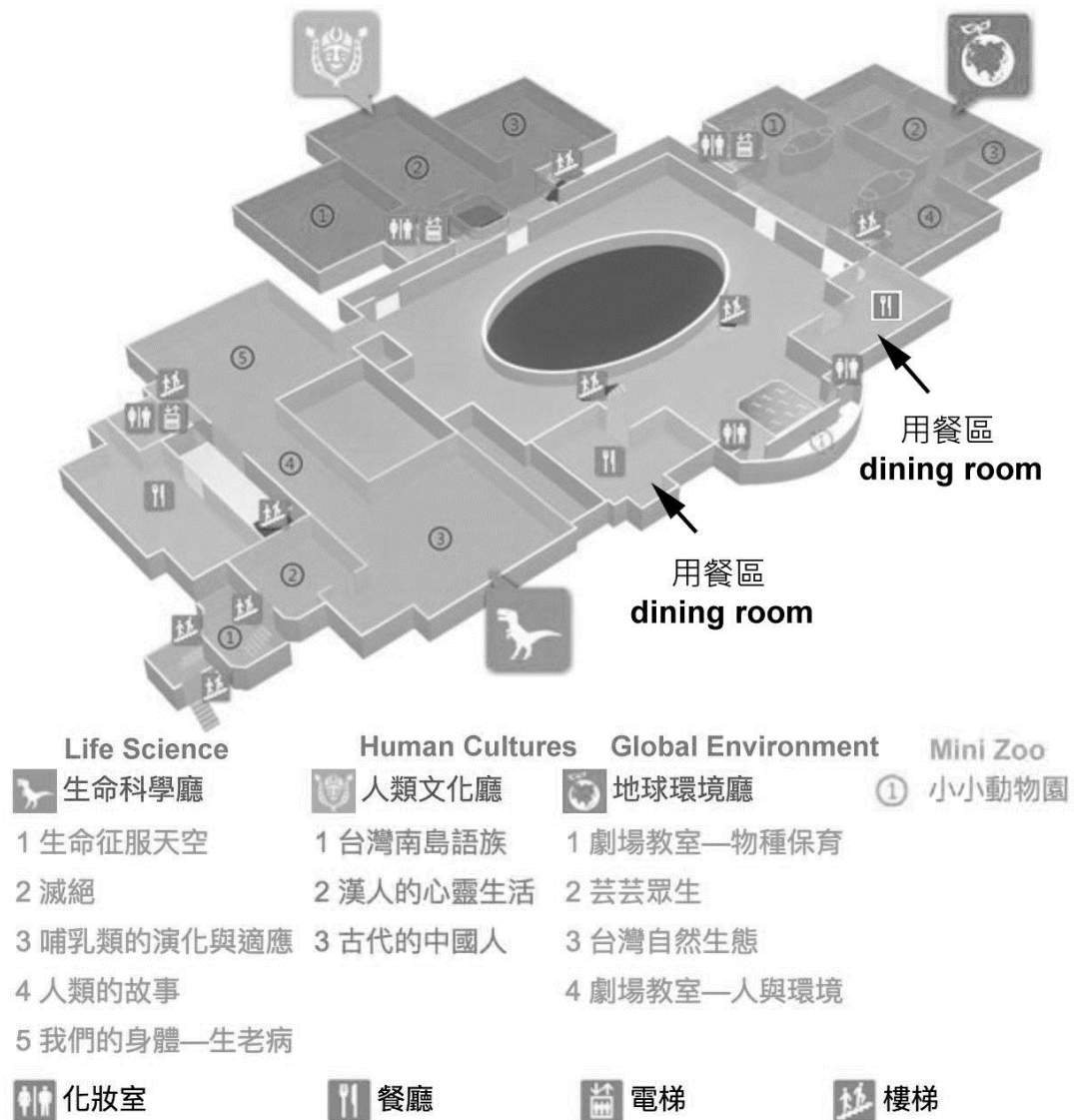
國立自然科學博物館立體劇場 B1 平面圖



用餐區位置 Location of dining room (2F)

國立自然科學博物館立體劇場 2F 平面圖

2 F 平面圖 (含服務設施)



大會資訊 Meeting Information

大會地點 Meeting Venue

本屆大會將於國立自然科學博物館(台中市北區館前路1號)立體劇場 B1 舉行。
主要場地包括紅廳、藍廳、科一及科二教室。

The conference will be held at the 3D Theater (B1) of National Museum of Natural Science, including Red conference room, Blue conference room, Science classroom 1 and 2.

論文宣讀者注意事項 Guidelines for Oral Presenters

所有場地皆備有筆記型電腦及投影機，所有講者務必於每一場次開始前將檔案上傳至會場電腦(建議使用 mac 的講者自備 adaptor)。每位講者有 15 分鐘，包括演講時間 12 分鐘與討論、換場時間 3 分鐘。

Laptops and projectors are provided for all meeting rooms. Presentation files should be uploaded to the laptops before the beginning of the sessions. Mac users have to bring your own adaptor. There are 15 minutes for each speaker; 12 minutes for oral presentation and 3 minutes for discussion.

海報宣讀者注意事項 Guidelines for Poster Presenters

海報請於 10 月 20 日上午 08:45-09:45 依所指定之編號張貼於『科一教室』。海報編號請見大會手冊，會場備有膠帶和剪刀。請宣讀者於當天下午 15:00-16:00 在海報旁介紹研究內容並回答問題。請務必於閉幕典禮前將海報下架。

The posters can be mounted at 08:45am-09:45am on Oct. 20th in the “Science classroom 1”. The poster numbers are listed in the programme. Tape and scissors are provided. During poster sessions (15:00pm-16:00pm), authors should stand close to their boards to answer questions and facilitate discussions on their work. Posters will be displayed throughout the meeting and have to be removed before the closing ceremony.

議程大綱 Program at a Glance

10月20日				
時間	地點	紅廳	藍廳	科二教室
08:45~09:45		報到 / 壁報張貼(科一教室)		
09:45~10:00		開幕		
10:00~11:00		Keynote Talk I: Dr. Matan Shelomi		
11:00~12:00		Keynote Talk II: Dr. Jiri Hulcr		
12:00~13:00		午餐 (2F用餐區)		理監事會
13:00~15:00		Symposium I: 昆蟲、真菌與線蟲共生的 農業社會	系統分類、族群遺傳、演化 OS_01~08	病媒、生物防治、蟲害管理 OD_01~08
15:00~16:00		茶敘 海報賞析(科一教室) 名錄審查委員會議(藍廳)		
16:00~17:30		生物多樣性、族群與群聚生 態學 OB_01~06	全英文場次 OEng_01~05	病媒、生物防治、蟲害管理 OD_09~14
10月21日				
時間	地點	紅廳	藍廳	科二教室
08:30~09:00		報到 / 簽到		
09:00~10:00			行為、生理、個體生物學 OE_01~04	病媒、生物防治、蟲害管理 OD_15~18
10:00~10:15			休息	
10:15~11:30		Symposium II: 食用昆蟲與昆蟲文化學	行為、生理、個體生物學 OE_05~09	病媒、生物防治、蟲害管理 OD_19~23
11:30~12:15		午餐 (2F用餐區)		
12:15~13:00		會員大會		
13:00~14:30		生物多樣性、族群與群聚生 態學 OB_07~12	行為、生理、個體生物學 OE_10~15	病媒、生物防治、蟲害管理 OD_24~29
14:30~15:00		茶敘		
15:00~16:15		生物多樣性、族群與群聚生 態學 OB_13~17	行為、生理、個體生物學 OE_16~20	病媒、生物防治、蟲害管理 OD_30~33
16:15~16:30		休息		
16:30~17:30		閉幕		

Program at a Glance

October 20				
Time	Place	Red Conference Room	Blue Conference Room	Science Classroom 2
08:45~09:45		Check In / Poster Posted (Science Classroom 1)		
09:45~10:00		Opening Welcome		
10:00~11:00		Keynote Talk I: Dr. Matan Shelomi		
11:00~12:00		Keynote Talk II: Dr. Jiri Hulcr		
12:00~13:00		Lunch (2F)		Board Meeting
13:00~15:00		Symposium I : Agricultural System of Fungus Cultivation in Termites & Beetles	Systematics, Population Genetics & Evolution OS_01~08	Disease Vector, Biological Control & Pest Management OD_01~08
15:00~16:00		Tea Break Poster Presentation (Science Classroom 1) Committee Meeting: Taxonomy Working Group (Blue Conference Room)		
16:00~17:30		Biodiversity, Population & Community Ecology OB_01~06	Full English Section OEng_01~05	Disease Vector, Biological Control & Pest Management OD_09~14
October 21				
Time	Place	Red Conference Room	Blue Conference Room	Science Classroom 2
08:30~09:00		Check In		
09:00~10:00			Ethology, Physiology & Organismic Biology OE_01~04	Disease Vector, Biological Control & Pest Management OD_15~18
10:00~10:15			Break	
10:15~11:30		Symposium II : Entomophagy & Cultural Entomology	Ethology, Physiology & Organismic Biology OE_05~09	Disease Vector, Biological Control & Pest Management OD_19~23
11:30~12:15		Lunch (2F)		
12:15~13:00		Annual General Meeting		
13:00~14:30		Biodiversity, Population & Community Ecology OB_07~12	Ethology, Physiology & Organismic Biology OE_10~15	Disease Vector, Biological Control & Pest Management OD_24~29
14:30~15:00		Tea Break		
15:00~16:15		Biodiversity, Population & Community Ecology OB_13~17	Ethology, Physiology & Organismic Biology OE_16~20	Disease Vector, Biological Control & Pest Management OD_30~33
16:15~16:30		Break		
16:30~17:30		Closing Ceremony		

論文宣讀總表 Table of Oral Presenters

10月20日			
時間 \ 地點	紅廳	藍廳	科二教室
08:45-09:45	報到 / 壁報張貼(科一教室)		
09:45-10:00	開幕		
10:00-11:00	K_01 The Future of Entomophagy Dr. Matan Shelomi		
11:00-12:00	K_02 The Ambrosia Symbiosis in the 21st Century Dr. Jiri Hulcr		
12:00-13:00	午餐 (2F用餐區)		理監事會
13:00-13:15	SI_01 Towards a better understanding of fungi associated with ambrosia beetles based on Taiwan materials 陳啟予副教授	OS_01* <i>Medinodexia</i> 屬 (雙翅目:寄生蠅科) 的分類研究 黃悠然、館卓司	OD_01* Evaluation of intercrop plants for the cultural control of tomato yellow leaf curl disease Fang-Yu Hu, De-Fen Mou & Chi-Wei Tsai
13:15-13:30		SI_02 Constructing the entomopathogenic nematode biological control system against <i>Euwallacea fornicates</i> 楊爵因 助理教授	OS_02* 釐清台灣產散白蟻屬的分類問題 吳佳倩、蔡正隆、梁維仁、竹松葉子、李後鋒

13:30-13:45	SI_03 Diversity of entomophilic nematodes in relation to carrier/host insects' habitat – focusing on termite- and bark/ambrosia beetle-associates Dr. Natsumi Kanzaki	OS_03* 台灣蟻科各亞科幼蟲之形態學與分類學研究(膜翅目：蟻科) 呂艾珊、林宗岐	OD_03* 防護罩噴撒技術防治臺灣蜚蠊之成效評估 陳遠哲、黃基森、楊育年、林信安
13:45-14:00		OS_04 台灣蟻形蜂科 <i>Apenesia</i> 屬的分布與系統分類的進一步檢討 廖浩全	OD_04* 畸翅病毒對西洋蜂幼蟲壽命路徑的影響評估 許博雅、黃玉峰、陳子翰、邱國平、陳裕文、乃育昕
14:00-14:15	SI_04 Nematode transmission pathways in the agricultural system of fungus-growing termite 李後鋒 副教授	OS_05 Species delimitation in the psyllid genus <i>Stenopsylla</i> (Hemiptera: Trioziidae) based on vibrational signals and morphology Yi-Chang Liao & Man-Miao Yang	OD_05* 西瓜銀斑病毒的感染對南黃薊馬取食行為的影響 朱英迪、蔡志偉
14:15-14:30		OS_06 紹德擬腹竊蠹 (<i>Falsogastrallus sauteri</i>) 及其外寄生蜂頭甲蟻形蜂 (<i>Cephalonomia</i> sp.) 之微細形態特徵與發生記述 賀毓翔、詹美鈴、蕭昀	OD_06* 台灣南部地區登革熱病媒蚊之化學防治 侯佳慧、曾偉倫、羅怡珮
14:30-14:45		OS_07 Does the length of dorsal setae provide taxonomic value in phytoseiid mites: Intraspecific variation of <i>Neoseiulus barkeri</i> (Acari: Phytoseiidae) Hsiao-Chin Lee, Jih-Rong Liao, Chyi-Chen Ho & Chiun-Cheng Ko	OD_07* 珍貴老樹之白蟻危害調查與台灣家白蟻之專一性防治 賴佑宜、李後鋒
14:45-15:00		OS_08 修訂「昆蟲綱科以上學名中名對照表」 蕭旭峰、吳文哲	OD_08* A study on feeding preferences of monomorium (<i>Monomorium chinensis</i>) on boric and fipronil based gel baits. Samantha Rose Gangai, Wang Yu Ming & Leknath Kafle
15:00-16:00		茶敘 海報賞析(科一教室) 名錄審查委員會議(藍廳)	

16:00-16:15	OB_01* 三種石蠶蛾面對洪水之反應 謝宗澤、崔宇辰、丘明智、郭美華	OEng_01* The silverleaf whitefly (<i>Bemisia tabaci</i>): a potential pest of rice in eastern Taiwan Jintana Chaiwong & Kwok-Ching Wong	OD_09* The insecticide resistance of field and insecticide-selected brown planthopper (<i>Nilaparvata lugens</i>) in Taiwan Namsuwat Ladawan & Shu-Mei Dai
16:15-16:30	OB_02* Direct and indirect effects of elevated temperature and CO2 on herbivore performance across altitudes Chi-Ming Liu, Shao-Kuan Yan & Chuan-Kai Ho	OEng_02* Effects of starvation on food intake and detection by German cockroaches (<i>Blattella germanica</i> L.) (Dictyoptera: Blattellidae) under Laboratory conditions Anil Chandra Neupane, Phillip Cheng & Lekhnath Kafle	OD_10 煙草粉蝨B型生物小種傳播CCYV技術及其保毒時間初探 林蕙盈、黃莉欣
16:30-16:45	OB_03* 美國東南區域之 <i>Geosmithia</i> 類真菌調查 Yin-Tse Huang, Miroslav Kolarik, Matthew T. Kasson & Jiri Hulcr	OEng_03* Host range of a newly identified parasitoid, <i>Apanteles opacus</i> (Ashmead) (Hymenoptera: Braconidae) Mei-Ying Lin, Shih-Ying Huang & Ramasamy Srinivasan	OD_11 推薦藥劑對嘉義地區水稻褐飛蟲及白背飛蟲之室內藥效評估 黃守宏、陳柏宏、王泰權、梁鈺平
16:45-17:00	OB_04* Ecological and morphological divergences of a snail-feeding carabid beetle, <i>Carabus (Coptolabrus) nankotaizanus</i> Kano, 1932 (Coleoptera, Carabidae) Lan-Wei Yeh, Hsin-Ping Ko, Ping-Shu Yang & Chung-Ping Lin	OEng_04* Polydnavirus-encoded microRNA exerts different effects on the immune responses in <i>Spodoptera litura</i> and <i>Snellenius manilae</i> Cheng-Kang Tang & Yueh-Lung Wu	OD_12 臺灣蚋蟻之危害現況與生活痛苦指數問卷調查 黃基森、楊育年、林信安
17:00-17:15	OB_05* 白蟻的建構物成分及建築策略初探 陳柏暉、張芳志、邱俊禕、李後鋒	OEng_05 A rapid method to survey pyrethroid resistance of <i>Aedes aegypti</i> I-Cheng Cheng, Yen-Chi Chen & Hwa-Jen Teng	OD_13 薤菜小金花蟲有機及化學防治之初步研究 梁鈺平、林郁欣、陳柏宏、王泰權、黃守宏
17:15-17:30	OB_06* 台灣家白蟻的重新描述與中國產之家白蟻屬同物異名問題 陳冠豫、吳佳倩、梁維仁、李後鋒		OD_14 柑橘銹蟎於三種柑橘上的族群消長、分布及化學防治之研究 陳柏宏、黃守宏、王泰權

10月21日

時間 \ 地點	紅廳	藍廳	科二教室
08:30-09:00	報到 / 簽到		
09:00-09:15		OE_01* 菌圃發酵產物為台灣土白蟻主要的營養來源 邱俊禕、歐玠縞、陳啟予、李後鋒	OD_15 探討台灣埃及斑蚊抗藥性品系鈉離子通道內含子多型性之現象 陳彥圻、陳易呈、鄧華真
09:15-09:30		OE_02* 米爾頓絨小蜂(膜翅目：絨小蜂科)對於不同品種的蓮霧及蒲桃花朵氣味之產卵偏好性 林鈺淳、林裕哲、廖一璋、楊曼妙	OD_16 埃及斑蚊對除蟲菊精類殺蟲劑抗藥性快速檢測方法之建立 陳易呈、陳彥圻、鄧華真
09:30-09:45		OE_03* 赤星瓢蟲對竹葉扁蚜之捕食效能評估 羅權彧、宋一鑫、黃啟鐘	OD_17 評估百利普芬、克凡派、賜諾殺及益達胺對於荔枝細蛾防治效果 王泰權、程子軒、陳柏宏、梁鈺平、黃守宏
09:45-10:00		OE_04* Examination of the histamine hypothesis for a mechanism underlying photoreceptor spectral opponency in the <i>Papilio</i> butterfly Pei-Ju Chen, Hiroshi Akashi, Atsuko Matsushita & Kentaro Arikawa	OD_18 草莓田二點葉蟎 (<i>Tetranychus urticae</i>) 族群動態與蔗糖酸酯及礦物油的室內防治效果評估 薛道原、莊益源
10:00-10:15	休息		
10:15-10:30		OE_05* Germline development in the aposymbiotic pea aphid: nutrition vs. reproduction Yi-min Hsiao, Shuji Shigenobu & Chun-Che Chang,	OD_19 以次世代定序資訊探討解毒酵素與東方果實蠅對有機磷殺蟲劑抗藥性之關聯 余俊瑩、吳昌昱、許博凱、陳倩瑜、許如君

10:30-10:45	SII_01 Entomophagy as a Traditional Food Culture Dr. Yuka Utsunomiya	OE_06* Parasitic wasps induces immunosuppression in <i>Spodoptera litura</i> via regulating the level of extra-cellular adenosine Chia-Chi Tai & Yueh-Lung Wu	OD_20 二點葉蟎在密滅汀的亞致死效應下之族群表現 洪乙庭、林明瑩
10:45-11:00	SII_02 昔日的驕傲，今日的懺悔——談我的蝴蝶產業 林耀堂 老師	OE_07* 巨卵現象在蟻客生活史演化中的趨同及生理適應 梁維仁、林明德、李後鋒	OD_21 Demographic characteristics of <i>Tetranychus ludeni</i> on eggplant leaves and the effects of prey's density and stage on predation rate of <i>Orius strigicollis</i> Wei-Han Lai & Shu-Jen Tuan
11:00-11:15	SII_03 請別叫我昆蟲男孩 劉耕名	OE_08* 先驅型白蟻物種的生殖彈性 邱奕寧、邱俊禕、林明德、李後鋒	OD_22 臺南市登革熱清潔隊員之知識態度行為之研究 黃基森、張少典
11:15-11:30		OE_09 益達胺抗藥性對於紅胸隱翅蟲生命表特徵的影響 馮文斌、梁國汶	OD_23 南台灣埃及斑蚊之抗藥性調查研究 林欣樺、戴淑美
11:30-12:15	午餐 (2F用餐區)		
12:15-13:00	會員大會		
13:00-13:15	OB_07 Ontogenetic antagonism–mutualism coupling: perspectives on resilience of stage-structured communities Po-Ju Ke & Takefumi Nakazawa	OE_10 季節性變動對於紅胸隱翅蟲水分生理的影響 王家子、梁國汶	OD_24 運用酵素連結免疫吸附法檢測殺蟲劑可尼丁之殘留 吳許斌、蔡佳馨、蕭順榮、沈振峯、何明勳、許如君
13:15-13:30	OB_08 胡麻斑天牛族群動態生物多樣性1：羽化期及體形 馬堪津、彭武康、何鎧光、徐爾烈	OE_11 Characterization of imidacloprid-affected cytochrome P450 gene, CYP450 305A1, in the honey bee, <i>Apis mellifera</i> 陳宥廷、吳明城、路光暉	OD_25 稈稻及私稻在貯藏期害蟲發生及為害比較 姚美吉、李啟陽、呂家榮

13:30-13:45	OB_09 胡麻斑天牛族群動態生物多樣性2：翅鞘斑及性比率 馬堪津、徐爾烈、何鎧光、彭武康	OE_12 Queen control on the worker reproduction in the invasive yellow crazy ant <i>Anoplolepis gracilipes</i> (Hymenoptera: Formicidae) Ching-Chen Lee, Chung-Chi Lin & Chin-Cheng Scotty Yang	OD_26 智能糧倉防蟲系統之規劃與測試 姚美吉、李啟陽、邱相文、賴明信
13:45-14:00	OB_10 Diversity pattern of phytophagous insects associated with the forests of Taiwan Beech Yu-Feng Hsu	OE_13 賜諾殺感抗性穀蠹之基因表現差異 王顥鈞、陳美娥	OD_27 不同柑橘類嫩葉影響柑橘木蝨之寄主選擇偏好性 花譽展、黃榮南、蕭旭峰
14:00-14:15	OB_11 有機耕作及農地地景對臺灣苗栗地區水稻田節肢動物多樣性之影響 黃寄綸、陳泓如、黃千育、羅英元、蔡志偉	OE_14 南方小黑花椿象捕食蘆氏葉蟪後若蟪之功能性反應 鍾伊庭、段淑人	OD_28 油茶彫木蛾(鱗翅目：織蛾科)發生生態及藥劑防治 陳巧燕
14:15-14:30	OB_12 東沙島之昆蟲相調查及島上訪花昆蟲行為之初探 廖一璋、江東權、劉哲元、董景生、楊曼妙	OE_15 蘆氏葉蟪之親代性比率對其子代之影響 潘光琦、段淑人	OD_29 以新型硼酸溶液產卵桶防治登革熱病媒蚊之田間評估 巫國志、賴羿廷、蔡坤憲
14:30-15:00	茶敘		
15:00-15:15	OB_13 白斑蛾蚋幼蟲飼育密度對其族群增長表現效果探討 鍾閔旭、段淑人	OE_16 臺灣設施栽培作物蜜蜂授粉效益 徐培修、盧美君	OD_30 化學藥劑搭配矽藻土防治十字花科小葉菜類黃條葉蚤之初探 戴從伊、陳麗芳、黃莉欣
15:15-15:30	OB_14 陽明山國家公園不同棲地之螞蟻群聚結構研究 許峰銓、林宗岐	OE_17 熱帶火蟻體型對種子搬運效率的影響 王奕傑、陳璋臨、邱名鍾、賴麗娟	OD_31 Serological evidence of scrub typhus in the Democratic Republic of Sao Tome and Principe Tsai-Ying Yen, Lien-Fen Tseng & Kun-Hsien Tsai
15:30-15:45	OB_15 台灣瘿蚋蟲瘿之豐度及組成 林聖豐、楊曼妙	OE_18 熱帶火蟻工蟻的體型二型性 陳璋臨、王奕傑、邱名鍾、賴麗娟	OD_32 台南地區登革熱病媒蚊室內外產卵監測 蕭翔宇、楊佳樺、鄭惠菁、黃旌集、杜武俊

15:45-16:00	OB_16 溫度對粉斑螟蛾發育繁殖之影響 林亞穎、段淑人	OE_19 The pro-ovigenic reproduction strategy and the ovarian development of gall-inducing wasp <i>Anselmella miltoni</i> Girault (Hymenoptera: Eulophidae) Ming-Der Lin,, Yu-Chun Lin, Chia-Ying Liu & Man-Miao Yang	OD_33 斑蚊產卵高度偏好性探討 吳逸鈞、楊曉峰、林怡瑩、郭又瑄、李宜勳、李侖遠、黃旌集、杜武俊
16:00-16:15	OB_17 台灣直翅目昆蟲海拔分布特性 詹明澍、楊正澤	OE_20 東方果實蠅抗菌蛋白基因之選殖與表現 李彥儒、李雅倩、路光暉	
16:15-16:30	休息		
16:30-17:30	閉幕		

Table of Oral Presenters

October 20				
Time	Place	Red Conference Room	Blue Conference Room	Science classroom 2
08:45-09:45		Check in / Poster Posted (Science classroom 1)		
09:45-10:00		Opening welcome		
10:00-11:00		K_01 The Future of Entomophagy Dr. Matan Shelomi		
11:00-12:00		K_02 The Ambrosia Symbiosis in the 21st Century Dr. Jiri Hulcr		
12:00-13:00		Lunch (2F)		Board meeting
13:00-13:15			OS_01* Taxonomic study of <i>Medinodexia</i> Townsend, 1927 (Diptera: Tachinidae) Yu-Zen Huang & Takuji Tachi	OD_01* Evaluation of intercrop plants for the cultural control of tomato yellow leaf curl disease Fang-Yu Hu, De-Fen Mou & Chi-Wei Tsai
13:15-13:30			OS_02* Revision of a subterranean termite genus, <i>Reticulitermes</i> (Isoptera: Rhinotermitidae), in Taiwan Chia-Chien Wu, Cheng-Lung Tsai, Wei-Ren Liang, Yoko Takematsu & Hou-Feng Li	OD_02* The population distribution and vector control strategies of autogenous <i>Culex pipiens molestus</i> Kai-Di Yu, Tsai-Ying Yen, Chin-Seng Chen & Kun-Hsien Tsai
13:30-13:45		SI_01 Towards a better understanding of fungi associated with ambrosia beetles based on Taiwan materials Dr. Chi-Yu Chen	OS_03* Morphological and Taxonomic Studies on Ant Larvae in Taiwan (Hymenoptera: Formicidae) Ai-Shan Lu & Chung-Chi Lin	OD_03* Effectiveness Evaluation of Control for <i>Forcipomyia (Lasiohelea) taiwana</i> : Diptera by Using Barrier Spray Yuan-Che Chen, Ji-Sen Hwang, Yu-Nien Yang & Hsin-An Lin

13:45-14:00	SI_02 Constructing the entomopathogenic nematode biological control system against Euwallacea fornicates Dr. Jiue-In Yang	OS_04 The research about distribution and taxonomy of <i>Apenesia</i> in Taiwan (Hymenoptera : Bethyridae) Hau-Chuan Liao	OD_04* Evaluation of the influence on the longevity mechanism of deformed wing virus-infected honey bee (<i>Apis mellifera</i>) larvae Po-Ya Hsu, Yu-Feng Huang, Zu-Han Chen, Kuo-Ping Chiu, Yue-Wen Chen & Yu-Shin Nai
14:00-14:15	SI_03 Diversity of entomophilic nematodes in relation to carrier/host insects' habitat – focusing on termite- and bark/ambrosia beetle-associates Dr. Natsumi Kanzaki	OS_05 Species delimitation in the psyllid genus <i>Stenopsylla</i> (Hemiptera: Triozidae) based on vibrational signals and morphology Yi-Chang Liao & Man-Miao Yang	OD_05* Effect of <i>Watermelon silver mottle virus</i> infection on the feeding behavior of <i>Thrips palmi</i> Ying-Di Chu & Chi-Wei Tsai
14:15-14:30	SI_04 Nematode transmission pathways in the agricultural system of fungus-growing termite Dr. Hou-Feng Li	OS_06 Ultramorphological characteristics of <i>Falsogastrallus sauteri</i> and its parasitic wasps, <i>Cephalonomia</i> sp., with note on their occurrences Yu-Hsiang Ho, Mei-Ling Chan & Yun Hsiao	OD_06* The chemical control efficacy of the dengue vectors from Southern Taiwan Jia-Hui Hou, Wei-Lun Tsen & Yi-Pey Luo
14:30-14:45		OS_07 Does the length of dorsal setae provide taxonomic value in phytoseiid mites: Intraspecific variation of <i>Neoseiulus barkeri</i> (Acari: Phytoseiidae) Hsiao-Chin Lee, Jhih-Rong Liao, Chyi-Chen Ho & Chiun-Cheng Ko	OD_07* Termite infestation survey of protected old trees and species-specific control of <i>Coptotermes formosanus</i> (Isoptera: Rhinotermitidae) Yu-Yi Lai & Hou-Feng Li
14:45-15:00		OS_08 Revision of “The name-list of Insecta (above family level) with Chinese common name” Shiuh-Feng Shiao & Wen-Jer Wu	OD_08* A study on feeding preferences of monomorium (<i>Monomorium chinensis</i>) on boric and fipronil based gel baits. Samantha Rose Gangai, Wang Yu Ming & Leknath Kafle
15:00-16:00	<p>Tea Break</p> <p>Poster Presentation (Science classroom 1)</p> <p>Committee Meeting: Taxonomy Working Group (Blue Conference Room)</p>		

16:00-16:15	OB_01* Response of three species of caddisfly larvae (Trichoptera) faced to flood Tsung-Tse Hsieh, Yu-Chen Tsui, Ming -Chih Chiu & Mei-Hwa Kuo	OEng_01* The silverleaf whitefly (<i>Bemisia tabaci</i>): a potential pest of rice in eastern Taiwan Jintana Chaiwong & Kwok-Ching Wong	OD_09* The insecticide resistance of field and insecticide-selected brown planthopper (<i>Nilaparvata lugens</i>) in Taiwan Namsuwat Ladawan & Shu-Mei Dai
16:15-16:30	OB_02* Direct and indirect effects of elevated temperature and CO2 on herbivore performance across altitudes Chi-Ming Liu, Shao-Kuan Yan & Chuan-Kai Ho	OEng_02* Effects of starvation on food intake and detection by German cockroaches (<i>Blattella germanica</i> L.) (Dictyoptera: Blattellidae) under Laboratory conditions Anil Chandra Neupane, Phillip Cheng & Lekhnath Kafle	OD_10 A technique of <i>Bemisia tabaci</i> B biotype transmitted- <i>Cucurbit chlorotic yellows virus</i> and its persistent period Hui-Ying Lin & L.H. Huang
16:30-16:45	OB_03* Survey of <i>Geosmithia</i> species in the southeast United States Yin-Tse Huang, Miroslav Kolarik, Matthew T. Kasson & Jiri Hulcr	OEng_03* Host range of a newly identified parasitoid, <i>Apanteles opacus</i> (Ashmead) (Hymenoptera: Braconidae) Mei-Ying Lin, Shih-Ying Huang & Ramasamy Srinivasan	OD_11 Evaluating the effect of recommended insecticides for controlling the brown planthopper and whitebacked planthopper in Chiayi district under laboratory condition Shou-Horng Huang, Po-Hung Chen, Tai-Chuan Wang & Yu-Ping Liang
16:45-17:00	OB_04* Ecological and morphological divergences of a snail-feeding carabid beetle, <i>Carabus</i> (<i>Coptolabrus</i>) <i>nankotaizanus</i> Kano, 1932 (Coleoptera, Carabidae) Lan-Wei Yeh, Hsin-Ping Ko, Ping-Shu Yang & Chung-Ping Lin	OEng_04* Polydnavirus-encoded microRNA exerts different effects on the immune responses in <i>Spodoptera litura</i> and <i>Snellenius manilae</i> Cheng-Kang Tang & Yueh-Lung Wu	OD_12 Questionnaire Survey of Nuisance Situation and Life Misery Index on the <i>Forcipomyia</i> (<i>Lasiohelea</i>) <i>taiwana</i> : Diptera Ji-Sen Hwang, Yu-Nine, Yang & Hsin-An Lin
17:00-17:15	OB_05* The material of termite-built structure and strategy of termite. (Blattodea: Isoptera) Bo-Ye Chen, Fang-Zhi Chang, Chi-Yu Chen & Hou-Feng Li	OEng_05 A rapid method to survey pyrethroid resistance of <i>Aedes aegypti</i> I-Cheng Cheng, Yen-Chi Chen & Hwa-Jen Teng	OD_13 Preliminary study of organic and chemical control of <i>Chaetocnema confinis</i> (Coleoptera: Chrysomelidae) Yu-Ping Liang, Yu-Sin Lin, Po-Hung Chen, Tai-Chuan Wang & Shou-Horng Huang

17:15-17:30	OB_06* Redescription of <i>Coptotermes formosanus</i> (Isoptera: Rhinotermitidae) and its synonyms in China Guan-Yu Chen, Chia-Chien Wu, Wei-Ren Liang & Hou-Feng Li		OD_14 Population Dynamic, Distribution, and Chemical Control of the Citrus Rust Mite, <i>Phyllocoptruta oleivora</i> (Ashmead) on Three Varieties of Citrus in Taiwan Po-Hung Chen, Shou-Hong Huang & Tai-Chuan Wang
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October 21

Time	Place	Red Conference Room	Blue Conference Room	Science classroom 2
08:30-09:00		Check in		
09:00-09:15			<p>OE_01*</p> <p>Fermented products of fungus garden is the major nutrition source of <i>Odontotermes formosanus</i> (Isoptera: Termitidae) Chun-I Chiu, Jie-Hao Ou, Chi-Yu Chen & Hou-Feng Li</p>	<p>OD_15</p> <p>Discovery of intron polymorphism in the voltage-gated sodium channel from pyrethroid resistance <i>Aedes aegypti</i> Yen-Chi Chen, I-Cheng Cheng & Hwa-Jen Teng</p>
09:15-09:30			<p>OE_02*</p> <p>The oviposition preference of <i>Anselmella miltoni</i> (Hymenoptera: Eulophidae) to the floral scent of different strains of <i>Syzygium samarandenes</i> and <i>S. jambos</i> Yu-Chun Lin, Yu-Che Lin, Yi-Chang Liao, & Man-Miao Yang</p>	<p>OD_16</p> <p>埃及斑蚊對除蟲菊精類殺蟲劑抗藥性快速檢測方法之建立 陳易呈、陳彥圻、鄧華真</p>
09:30-09:45			<p>OE_03*</p> <p>Predation efficacy of <i>Lemnia saucia</i> (Mulsant) (Coleoptera: Coccinellidae) on <i>Astegopteryx bambucifoliae</i> (Takahashi) (Hemiptera: Hormaphidae) Chuan-Yu Lo, I-Hsin Sung & Chi-Chuang Huang</p>	<p>OD_17</p> <p>The control efficacy of pyriproxyfen, chlorfenapyr, spinosad and imidacloprid to the litchi fruit borer (<i>Conopomorpha sinensis</i> Bradley) Tai-Chuan Wang, Zi-Xuan Cheng, Po-Hung Chen, Yu-Ping Liang & Shou-Hong Huang</p>
09:45-10:00			<p>OE_04*</p> <p>Examination of the histamine hypothesis for a mechanism underlying photoreceptor spectral opponency in the <i>Papilio</i> butterfly Pei-Ju Chen, Hiroshi Akashi, Atsuko Matsushita & Kentaro Arikawa</p>	<p>OD_18</p> <p>Population fluctuations of <i>Tetranychus urticae</i> in strawberry field and control evaluations of sucrose ester and mineral oil in laboratory Dao-Yuan Xue & Yi-Yuan Chuang</p>
10:00-10:15		Break		
10:15-10:30	SII_01	<p>Entomophagy as a Traditional Food Culture Dr. Yuka Utsunomiya</p>	<p>OE_05*</p> <p>Germline development in the aposymbiotic pea aphid: nutrition vs. reproduction Yi-min Hsiao,, Shuji Shigenobu & Chun-che Chang,</p>	<p>OD_19</p> <p>Understanding the relationship of detoxification enzymes in Organophosphate resistance of <i>Bactrocera dorsalis</i> through NGS data Chun-Ying Yu, Chang-Yu Wu, Po-Kai Hsu, Chien-Yu Chen & Ju-Chun Hsu</p>

10:30-10:45	SII_02 昔日的驕傲，今日的憾悔——談我的蝴蝶產業 Dr. Yao-Tang Lin	OE_06* Parasitic wasps induces immunosuppression in <i>Spodoptera litura</i> via regulating the level of extra-cellular adenosine Chia-Chi Tai & Yueh-Lung Wu	OD_20 The population performance of <i>Tetranychus urticae</i> (Acari: Tetranychidae) under the sublethal effects of milbemectin Yi-Ting Hong & Ming-Ying Lin
10:45-11:00	SII_03 請別叫我昆蟲男孩 Keng-Ming Liu	OE_07* Convergent life-history evolution and physiological adaptation of egg gigantism in myrmeco- and termitophiles Wei-Ren Liang, Ming-Der Lin & Hou-Feng Li	OD_21 Demographic characteristics of <i>Tetranychus ludeni</i> on eggplant leaves and the effects of prey's density and stage on predation rate of <i>Orius strigicollis</i> Wei-Han Lai & Shu-Jen Tuan
11:00-11:15		OE_08* Reproductive plasticity of pioneer termite species Yi-Ning Chiu, Chun-I Chiu, Ming-Der Lin & Hou-Feng Li	OD_22 Study on Knowledge, Attitudes and Practices of Dengue Fever Cleaner Team in Tainan City Ji-Sen Hwang & Shao-Dian Jhang
11:15-11:30		OE_09 The effect of imidacloprid resistance on life history traits of <i>Paederus fuscipes</i> (Coleoptera: Staphylinidae) Wen-Bin Feng & Kok-Boon Neoh	OD_23 Survey of insecticide resistance of <i>Aedes aegypti</i> (Diptera: Culicidae) in Southern Taiwan Hsin-Hua Lin & Shu-Mei Dai
11:30-12:15	Lunch (2F)		
12:15-13:00	Annual General Meeting		
13:00-13:15	OB_07 Ontogenetic antagonism–mutualism coupling: perspectives on resilience of stage-structured communities Po-Ju Ke & Takefumi Nakazawa	OE_10 Influence of seasonal variation on water relations of <i>Paederus fuscipes</i> (Coleoptera: Staphylinidae) Chia-Yu Wang & Kok-Boon Neoh	OD_24 Development of enzyme-linked immunosorbent assay for the insecticide clothianidin Hsu-Bin Wu, Chia-Hsin Tsai, Shuen-Rung Hsiao, Jenn-Feng Sheen, Ming-Hsun Ho & Ju-Chun Hsu
13:15-13:30	OB_08 Biodiversity of population dynamics of <i>Anoplophora macularia</i> (Thomson) 1: emergence stage and body size Can-Jen W. Maa, Wu-Kang Peng, Kai-Kuang Ho & Err-Lien Hsu	OE_11 Characterization of imidacloprid-affected cytochrome P450 gene, CYP450 305A1, in the honey bee, <i>Apis mellifera</i> Yu-Ting Chen, Ming-Cheng Wu & Kuang-Hui Lu	OD_25 Comparison of pest occurrence and damage in Japonica rice and Indica rice during storage period Me-Chi Yao, Chi-Yang Lee & Jia-Rong Lu
13:30-13:45	OB_09 Biodiversity of population dynamics of <i>Anoplophora macularia</i> (2) maculate pattern and sex ratio Can-Jen W. Maa, Kai-Kuang Ho, Err-Lien Hsu & Wu-Kang Peng	OE_12 Queen control on the worker reproduction in the invasive yellow crazy ant <i>Anoplolepis gracilipes</i> (Hymenoptera: Formicidae) Ching-Chen Lee, Chung-Chi Lin & Chin-Cheng Scotty Yang	OD_26 Programming and testing of intelligent insect-control management system in rice storehouse Me-Chi Yao, Chi-Yang Lee, Hsiang-Wen Chiu & Ming- Hsin Lai

13:45-14:00	OB_10 Diversity pattern of phytophagous insects associated with the forests of Taiwan Beech Yu-Feng Hsu	OE_13 Differential gene expression in spinosad-resistant and -susceptible <i>Rhyzopertha dominica</i> Yi-Chun Wang & Mei-Er Chen	OD_27 The effects of rutaceous plant flushes on the host preference of <i>Diaphorina citri</i> Kuwayama (Hemiptera: Liviidae) Yu-Chan Hua, Rong-Nan Huang & Shiuh-Feng Shiao
14:00-14:15	OB_11 The effect of organic practices and agricultural landscapes on arthropod diversity in rice fields in Miaoli, Taiwan Chi-Lun Huang, Hung-Ju Chen, Chien-Yu Huang, Ying-Yuan Lo & Chi-Wei Tsai	OE_14 The functional response of <i>Orius strigicollis</i> (Hemiptera: Anthocoridae) prey on deutonymph of <i>Tetranychus ludeni</i> (Acari: Tetranychidae) Yi-Ting Chung & Shu-Jen Tuan	OD_28 Study on the ecology and chemical control of Tea stem borer (<i>Casmara patrona</i> Meyrick) (Lepidoptera: Oecophoridae) Chiao-yen Chen
14:15-14:30	OB_12 The insect fauna of Dongsha Island and preliminary study of flower insect visitors Yi-Chang Liao, Tung-Chyuan Chiang, Che-Yuan Liu, Gene-Sheng Tung & Man-Miao Yang	OE_15 Effect of parent's sex ratio of <i>Tetranychus ludeni</i> (Acari: Tetranychidae) on its offspring Kuang-Chi Pan & Shu-Jen Tuan	OD_29 Field evaluation of a novel ovitrap with boric acid solution to control dengue mosquitoes Kuo-Chih Wu, Yi-Ting Lai & Kun-Hsien Tsai
14:30-15:00	Tea Break		
15:00-15:15	OB_13 Effect of larval rearing density on population increasing rate of <i>Clogmia albipunctata</i> (Diptera: Psychodidae) Ming-Hsu Chung & Shu-Jen Tuan	OE_16 Pollination effectiveness of greenhouse cultivation by honeybee in Taiwan Pei-Shou Hsu & Mei-Chun Lu	OD_30 化學藥劑搭配砂藻土防治十字花科小葉菜類黃條葉蚤之初探 戴從伊、陳麗芳、黃莉欣
15:15-15:30	OB_14 The research of the ant community structure in different habitats in Yangmingshan National Park Feng-Chuan Hsu & Chung-Chi Lin	OE_17 Effects of worker size on the harvesting efficiency of the tropical fire ants Yi-Chieh Wang, Zang-Lin Chen, Ming-Chung Chiu & Li-Chuan Lai	OD_31 Serological evidence of scrub typhus in the Democratic Republic of Sao Tome and Principe Tsai-Ying Yen, Lien-Fen Tseng & Kun-Hsien Tsai
15:30-15:45	OB_15 Richness and composition of midge galls in Taiwan Sheng-Feng Lin & Man-Miao Yang	OE_18 Size dimorphism in the tropical fire ant workers (<i>Solenopsis geminata</i>) Zhang-Lin Chen, Yi-Chieh Wang, Ming-Chung Chiu & Li-Chuan Lai	OD_32 Surveillance of oviposition of <i>Aedes</i> mosquitoes in peridomestic premises in Tainan area Hsiang-Yu Hsiao, Chia-Hua Yang, Hui-Ching Cheng, Chin-Gi Huang & Wu-Chun Tu1

15:45-16:00	<p>OB_16 Effect of temperature on the development and reproduction of <i>Cadra cautella</i> (Lepidoptera: Pyralidae) Ya-Ying Lin & Shu-Jen Tuan</p>	<p>OE_19 The pro-ovigenic reproduction strategy and the ovarian development of gall-inducing wasp <i>Anselmella miltoni</i> Girault (Hymenoptera: Eulophidae) Ming-Der Lin, Yu-Chun Lin, Chia-Ying Liu & Man-Miao Yang</p>	<p>OD_33 Oviposition of <i>Aedes</i> mosquitoes in different height Yi-Jun Wu, Shau-Fong Young, Yi-Ying Lin, You-Syuan Guo & Yi-Shiun Lee</p>
16:00-16:15	<p>OB_17 The elevational distribution of Orthopteran insects (Insecta: Orthoptera) in Taiwan Ming-Shu Chan & Jeng-Tze Yang</p>	<p>OE_20 Cloning and expression of the antimicrobial peptide gene in oriental fly, <i>Bactrocera dorsalis</i> (Hendel) Yen-Ju Lee, Ya-Chein Lee & Kuang-Hui Lu</p>	
16:15-16:30	Break		
16:30-17:30	Closing Ceremony		

壁報展示總表 Posters List

編碼	作者	論文標題(Title)
系統分類、族群遺傳、演化 Systematics, population genetics and evolution		
PS_01	吳士緯 Shipher Wu	豔苔蛾屬與美苔蛾屬屬級定義的重新評估（鱗翅目，裳蛾科，燈蛾亞科，苔蛾族） Evaluating the generic definitions of <i>Miltochrista</i> Hübner, [1819] and <i>Barsine</i> Walker, 1854 (Lepidoptera, Erebididae, Arctiinae, Lithosiini)
PS_02	Ming-Hsun Chou & Wen-Bin Yeh	Taxonomic revision of Genus <i>Cylindera</i> tiger beetles (Coleoptera: Carabidae: Cicindelinae) in Taiwan
PS_03	Watchalawalee Boonmee & Wen Bin Yeh	Multiplex PCR to Identify Quarantine Western Flower Thrips (Thysanoptera: Thripidae, <i>Frankliniella occidentalis</i>)
PS_04	楊心語、林聖豐、楊曼妙	台灣鞘翅目及鱗翅目蟲瘿 Coleopteran and Lepidopteran galls of Taiwan
PS_05	蔡正隆、郭美華、宋一鑫、林明瑩、葉文斌 Cheng-Lung Tsai, Mei-Hwa Kuo, I-Hsin Sung, Ming-Ying Lin & Wen-Bin Yeh	建立台灣地區重要農業害蟲 COI DNA 條碼 Establish COI DNA barcodes of important agricultural pests in Taiwan
PS_06	周瑜淵、蔡正隆、許家維、葉文斌、謝佳宏	外來入侵南洋肥角鍬形蟲形態變異研究 Morphological variations of the alien invasive <i>Aegus chelifer</i> in Taiwan

	Yu-Yuan Chou, Cheng-Lung Tsai, Chia-Wei Hsu, Wen-Bin Yeh & Chia-Hung Hsieh	
PS_07	郭宇廷、楊正澤 Yu-Ting Kuo & Jeng-Tze Yang	樹皮象鼻蟲亞科(鞘翅目:象鼻蟲科)單模屬大量出現的原因探討 Molytinae (Coleoptera, Curculionidae) comprised of high proportion of monotypic genus
行為、生理、個體生物學 Ethology, physiology and organismic biology		
PE_01*	周匡文、廖祥延、乃育昕 Kuang-Wen Chou, Hsiang-Yen Liao & Yu-Shin Nai	尼泊爾埋葬蟲與尾足蟎之攜遷關係 Phoresy by Uropodina in <i>Nicrophorus nepalensis</i>
PE_02*	魏嬪如、顏聖紘 Wei Shann-Ru & Yen Shen-Horn	低溫衝擊無法證實藍紋鋸眼蝶(<i>Elymnias hypermnestra hainana</i>) 具有翅色季節型 Cold-shock can not prove that <i>Elymnias hypermnestra hainana</i> has seasonal forms
PE_03*	張宸睿、徐堉峰 Chen-Jui Chang & Yu-Feng Hsu	四黃斑蛾之生物學初探 Preliminary ecological study on <i>Artona flavipuncta</i> (Lepidoptera: Zygaenidae)
PE_04	Hsiao-Ling Lu, Chun-Che Chang & Alex C. C. Wilson	Roles of duplicated amino acid transporter genes in the developmental integration of the pea aphid and its obligate intracellular symbiont <i>Buchnera</i>
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大會專題演講 Keynote Talk



紅廳(Red)

K_01 專題演講 1 Keynote Talk 1

講者：Dr. Matan Shelomi

國立台灣大學昆蟲學系

Department of Entomology, National Taiwan University

主題：The Future of Entomophagy



10/20

10:00-11:00

K_02 專題演講 2 Keynote Talk 2

講者：Dr. Jiri Hulcr

美國佛羅里達大學 森林資源與保育研究所

School of Forest Resources and Conservation, University of
Florida, USA

主題：The Ambrosia Symbiosis in the 21st Century



10/20

11:00-12:00

專題討論 Symposium

專題討論 I：昆蟲、真菌與線蟲共生的農業社會

Symposium I：Agricultural system of fungus cultivation in termites and beetles

主持人：



紅廳(Red)

1. 李後鋒 副教授/國立中興大學昆蟲學系

Dr. Hou-Feng Li / Department of Entomology,

National Chung Hsing University, Taiwan



10/20

13:00-15:00

2. Dr. Jiri Hulcr /美國佛羅里達大學 森林資源與保育研究所

School of Forest Resources and Conservation, University of Florida, USA

演講人與題目：

SI_01: Towards a better understanding of fungi associated with ambrosia beetles

based on Taiwan materials

陳啟予 副教授/國立中興大學植物病理學 Department of Plant Pathology,

National Chung Hsing University, Taiwan

SI_02: Constructing the entomopathogenic nematode biological control system

against *Euwallacea fornicates*

楊爵因 助理教授/國立台灣大學植物病理與微生物學系 Department of

Plant Pathology and Microbiology, National Taiwan University, Taiwan

SI_03: Diversity of entomophilic nematodes in relation to carrier/host insects'

habitat – focusing on termite- and bark/ambrosia beetle-associates

Dr. Natsumi Kanzaki/日本林業總合研究所 Forestry and Forest Products

Research Institute, Japan

SI_04: Nematode transmission pathways in the agricultural system of fungus-

growing termite

李後鋒 副教授/國立中興大學昆蟲學系 Department of Entomology,

National Chung Hsing University, Taiwan

專題討論 II：食用昆蟲與昆蟲文化學



紅廳



10/21

10:00-11:30

Symposium II：Entomophagy & cultural entomology

主持人：

3. 楊曼妙 教授/國立中興大學昆蟲學系

Dr. Man-Miao Yang/Department of Entomology, National Chung Hsing University, Taiwan

4. Dr. Matan Shelomi/國立台灣大學昆蟲學系 Department of Entomology, National Taiwan University, Taiwan

演講人與題目：

SII_01: Entomophagy as a Traditional Food Culture

Dr. Yuka Utsunomiya/日本青山學院女子短期大學 Aoyama Gakuin Women's Junior College, Japan

SII_02: 昔日的驕傲，今日的憾悔——談我的蝴蝶產業

林耀堂老師/輔仁大學應用美術系 Department of Applied Arts, Fu Jen Catholic University, Taiwan

SII_03: 請別叫我昆蟲男孩

劉耕名/Bito 甲蟲創意負責人兼導演 Director and founder of Bito Studio

第 38 屆台灣昆蟲學會年會

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OE	行為、生理、個體生物學論文宣讀 Oral Session: Ethology, physiology and organismic biology
OB	生物多樣性、族群與群聚生態學論文宣讀 Oral Session: Biodiversity, population and community Ecology
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OEng	全英文場次論文宣讀 Oral Session: Full English section
PS	系統分類、族群遺傳、演化壁報展示 Posters: Systematics, population genetics and evolution
PE	行為、生理、個體生物學壁報展示 Posters: Ethology, physiology and organismic biology
PB	生物多樣性、族群與群聚生態學壁報展示 Posters: Biodiversity, population and community Ecology
PD	病媒、生物防治、蟲害管理壁報展示 Posters: Disease vector, biological control and pest management

專題演講

Keynote Talk

The Future of Entomophagy

Matan Shelomi

Department of Entomology, National Taiwan University

More and more people around the world are thinking about entomophagy: eating insects as food. Although insects have been and still are eaten by many people around the world, it is primarily by rural, traditional people. The current trend tries to encourage people in wealthier societies to eat insects as an alternative to livestock meat, because insects have a smaller ecological footprint and are better for the environment. Does the hype around this popular topic match the science? Is raising awareness about edible insects enough? How do people choose the foods that they eat? Even if insects become socially acceptable to eat worldwide, will people still choose them over other meats, and will that be better for the environment? Answering these questions is important as edible insects become a bigger business and topic of study.

The Ambrosia Symbiosis in the 21st Century

Jiri Huler

School of Forest Resources and Conservation, University of Florida, Gainesville, FL,
USA

Background/Question/Methods

Some of the most charismatic biological entities include the insect-fungus farming systems, such as the fungus-farming ants, termites and ambrosia beetles. These associations evolved into efficient biomass-processing systems, often likened to human industrial agriculture. The association between the wood-boring ambrosia beetles and their nutritional fungal mutualists offers a unique opportunity for a comparative analysis because of its multiple origins. There are more than 3,000 species of ambrosia beetles, but they are not a monophyletic group. The University of Florida's Forest Entomology laboratory has set out to determine two questions about the ambrosia symbiosis: 1) What is the composition of the fungal symbiont communities in each of the independently evolved clades? We have used high-throughput DNA metabarcoding and quantitative culturing to document the fungi associated with previously unstudied beetles, including three newly discovered symbioses. 2) Several ambrosia beetle and fungi are highly invasive and damaging in the newly colonized regions. Which beetles and fungi are most likely to be the next invasive cases? We test-inoculated multiple tree commodities with fungi associate with exotic beetles.

Results/Conclusions

The ambrosia beetle–fungus farming symbiosis is more heterogeneous than previously thought. The symbiosis evolved at least 11 times among beetles, and at least 8 times among fungi. There is not one but many ambrosia symbioses, each with its own degree of beetle-fungus specificity, ranging from strict to promiscuous. Each new origin has also evolved a new mycangium – the fungus transport organ. The ambrosia lifestyle facilitated a radiation of social strategies, from fungus thieves to eusocial species. In terms of economic impact, over 95% of the symbiotic pairs are economically harmless. The pest species all share the capacity to colonize live tree tissues, and we propose to study this feature in order to determine which beetles are most likely to become invasive pests in the future.

Key words: Scolytinae, invasion ecology, mutualism, forest health

專題討論 I：

**昆蟲、真菌與線蟲共生的
農業社會**

Symposium I:

**Agricultural system of
fungus cultivation in termites
and beetles**

Towards a better understanding of fungi associated with ambrosia beetles based on Taiwan materials

Yu-Ting Lin¹, Chao-Hung Sung¹, Hsin-Hui Shih², Jiri Hulcr³, Ching-Shan Lin⁴,
Sheng-Shan Lu², Fwu-Ling Lee⁵, Li-Na Huang⁵, Chi-Yu Chen¹

¹Department of Plant Pathology, National Chung Hsing University, Taichung, Taiwan.

²Taiwan Forestry Research Institute, Taipei, Taiwan

³School of Forest Resources and Conservation, University of Florida, USA

⁴Tsau-Hou Elementary school, Taichung, Taiwan

⁵Bioresource Collection and Research Center, Food Industry Research and Development Institute, Hsinchu, Taiwan

Ambrosia beetles comprise some members of Scolytinae and all members of Platypodinae. These beetles possess common habits by tunneling in wood where they secrete the ophiostomatoid fungi, carried in the beetle's specialized structure, mycangium, to grow in the ambient wood and the fungi on the tunnel wall serve as their food. *Ambrosiella* and *Raffaelea* are two genera of ophiostomatoid fungi obligately associated with ambrosia beetles. Members of these two genera are highly adapted to living with ambrosia beetles. Several species of these fungi have been reported in Taiwan. *Ambrosiella* species in the latest definition are tightly associated with ambrosia beetles in genera *Anisandrus*, *Cnestus*, and *Xylosandrus* within the tribe Xyleborini characterized by a mesothoracic mycangium. *Eccoptopterus* and *Hadrodemius* are another two xyleborine genera possessing mesothoracic mycangium, but their symbiotic fungi are unknown. A survey of *Ambrosiella* species in Taiwan indicated that members of *Eccoptopterus* and *Hadrodemius* are also associated with fungi of *Ambrosiella*. It corroborates the hypothesis that *Ambrosiella* species are exclusively associated with ambrosia beetles having mesothoracic mycangium. The association appears asymmetrical: a single *Ambrosiella* species can be carried by multiple species of beetles, while each beetle species associates with only one *Ambrosiella* species. In addition to ophiostomatoid fungi, ambrosia beetles may have yeast associates. In a survey of yeasts associated with ambrosia beetles in Taiwan, members of certain yeast genera are found associated with ambrosia beetles. However, ambrosia beetles usually are not the exclusive hosts for these yeast species. New findings have been obtained. The correlation between yeasts and ambrosia beetles merits further investigation, which can be supported by the unlimited resources in Taiwan.

Constructing the entomopathogenic nematode biological control system
against *Euwallacea fornicatus*

Chi-shuen Chang¹ Jian Ren Lai² and Jiue-in Yang¹

¹ Department of Plant Pathology and Microbiology, National Taiwan University,
Taipei, Taiwan 106

² Master Program of Plant Medicine, National Taiwan University, Taipei, Taiwan 106

Abstract

Background/Question/Methods

Several Asia-originated *Euwallacea* sp. ambrosia beetles have caused serious damages to the avocado industry in California, United States after successful invasion, while carrying the symbiont plant pathogenic fungus *Fusarium ambrosium* within the specialized mycangia structure. On the surfaces of the infected tree trunks, usually tens to hundreds of invasion holes could be observed. Occasionally, the sugar volcano symptom could be seen on certain host plants. Beetles excavate tunnels inside the trunk while they invade the trees, where they cultivate symbiotic fungi as their food. Entomopathogenic nematodes are considered good biological control agents, as they possess symbiont bacteria and release them after invading into their insect host. We investigate the ambrosia beetle associating nematode populations in their origins, screen for potential nematodes by gene-association analysis and morphological characteristics, and evaluate their pathogenic ability.

Results/Conclusions

Beetles and host wood samples were collected from multiple locations in Taiwan and nematode samples were isolated and identified morphologically and molecularly. In addition to the white trap method and direct dissection method for nematode isolation, laboratory reared *E. fornicatus* were used in the modified artificial medium baiting method. Thus far, nematodes from *Rhabditis* sp., *Oscheius* sp. and etc. were evaluated with laboratory reared *E. fornicatus* for entomopathogenicity. The outcome of the study will provide new insights into field management of *Euwallacea fornicatus*.

Key word: Biological control, *Euwallacea fornicatus*, Nematode

Diversity of entomophilic nematodes in relation to carrier/host insects' habitat – focusing on termite- and bark/ambrosia beetle-associates

Natsumi Kanzaki

Kansai Research Center, Forestry and Forest Products Research Institute, 68
Nagaikyutaro, Momoyama, Fushimi, Kyoto, Kyoto, 612-0855 Japan.

Background/Question/Methods

Phylum Nematoda (nematode) is one of the most divergent groups of the animals. The nematodes inhabit almost everywhere in the world including deep sea, high mountain and even Antarctica. Although the worms are regarded as the agricultural / forest pests (plant parasites) and human and animal parasites (round worms and pinworms), the most species are microbe feeders which inhabit oceanic environment, soil, fresh water, leaf litter and dead logs.

The nematodes generally have small and soft body without legs or wings, i.e., they are vulnerable to desiccation and have quite low movability. Thus, the nematodes utilize other animals, especially the insects (and other arthropods), as their shelter from desiccation and transportation carrier. The insect-nematode association is quite divergent, e.g., parasites, parasitoids, phoretic associates and pathogens. Those all groups of insect-associated nematodes are generally regarded as “entomophilic nematodes”.

Results/Conclusions

Because of their close relationship with insects, biological characters of those nematodes, e.g., body structure, life history, behavior, physiology, distribution and evolutionary history, are strongly affected by those of carrier/host insects. For example, the insects inhabiting nitrogen-rich habitat, e.g., carcass, dung and humus, are often associated with bacteria feeders, and those inhabiting carbon-rich habitat, e.g., dead wood, tends to associated with various groups of fungal feeders. Further, even among fungal feeders, some phylogenetic groups are associated with bark beetles inhabiting shallow wood, and others are associated with deep wood-inhabiting ambrosia beetles. Those patterns are introduced focusing on the termite- and ambrosia/bark beetle-associated nematodes.

Key words: nematode, phorecy, parasitism, habitat

Nematode transmission pathways in the agricultural system of fungus-growing termite

Natsumi Kanzaki¹, Wei-Ren Liang², Chun-I Chiu², Yen-Ping Hsueh³, and Hou-Feng Li²

¹ Kansai Research Center, Forestry and Forest Products Research Institute, 68 Nagaikyutaro, Momoyama, Fushimi, Kyoto, Kyoto, 612-0855 Japan

² Department of Entomology, National Chung Hsing University, 145 Xingda Rd., Taichung, 40227, Taiwan.

³ Institute of Molecular Biology, Academia Sinica, Taipei, Taiwan.

Background/Question/Methods

Pest management is a common task for agriculture animals including humans, leaf-cutting ants, fungus-growing termites, and ambrosia beetles. The agriculture pests, such as insects and microbes, decrease the yield of crop and may affect the survival of farmers. Controlling pest transmission is one of the most efficient approach in human's agriculture, but coordinated control practices are rarely studied in other agriculture systems. Nematode is a potential pest of the fungus cultivation system. To understand their diversity, pest status, introduction pathway, multiple subterranean nests of the fungus-growing termite, *Odontotermes formosanus* (Shiraki), were excavated. Occurrence of nematodes on fungus garden, multiple termite castes, and various termite associated arthropods were examined.

Results/Conclusions

In the termite nests, nematode was rarely found on fungus garden, termite egg, larva, alates and nursery workers. However, more than half of major workers who forage outside and carry in plant material for culturing fungus were highly infested by nematodes. Among associated arthropods in termite nest, nematodes were only found under the elytra of beetle adults, but not wingless beetle larvae, flies, silverfishes, and millipedes. Two nematode taxa were separately carried by termite foraging workers and termitophile beetle indicating two independent nematode transmission pathways. Further lab experiment proved all nematodes, including fungus-feeder and bacteria-feeder, were not deterred by the cultured fungus, *Termitomyces* spp. We speculated that nematode control practice in termite nest based on continuous feeding and excretion of plant material of fungus garden, and termites grooming each other and associated arthropods. The ingested nematodes are not likely survived through termite's gut.

Key words: *Odontotermes formosanus*, *Termitomyces*, fungus garden, transmission pathway, pest management

專題討論 II：
食用昆蟲與昆蟲文化學
Symposium II：
Entomophagy & cultural
entomology

Entomophagy as a Traditional Food Culture

Yuka Utsunomiya

Aoyama Gakuin Women's Junior College, Department of Liberal Arts

The history of Entomophagy Culture can be traced back to very old times. In pre-historical era, ancestors of the human beings ate insects very well as an important nutritious food. In China, about 3000 years ago, in Yin-Chou Eras, entomophagy culture were recorded by inspections on animal bones and tortoise carapaces. The Old Bible, about 2,500 years ago, mentioned that locusts were edible. The Ancient Greek, about 2,350 years ago, Aristotle described that the Cicada was tasty. In Japan, about 1,300 years ago, entomophagy habit was referred in the old historical book, Nihon-shoki (the oldest chronicles of Japan).

The entomophagy Culture is still popular in such areas as Southeast Asia, Africa, Central and South America and Oceania. Of those, in Southeast Asia, it is the most popular, and local people utilize edible insects as a nutritious food, and sometimes as seasoning. I will talk about- **What kinds of insects have been eaten? Reasons why people eat insects. How to cook edible insects? Entomophagy culture in Asia and Big issue to be resolved.** By 2030, the population in the world will be more than 9 billion and increase the global demand for food, especially animal-based protein sources. FAO (国際連合食糧農業機関=Food and Agriculture Organization of the United Nations) considers that Entomophagy has many environmental, health and social/ livelihood benefits, especially the feed-to-meat conversion rates extremely high in insects. In areas and countries there have Entomophagy Culture nowadays, people need to maintain and succeed to the next generation as a valuable heritage. I also prepare traditional insect dishes for you all. Please try to eat and enjoy them.

昔日的驕傲，今日的憾悔——談我的蝴蝶產業

林耀堂

輔仁大學應用美術系、台灣科技大學工商設計系

台灣的經濟發展在二十世紀的五〇年代逐步起飛，一直到六〇年代末期全世界發生石油危機才消退下來。在這段期間有一項產業是跟台灣昆蟲有關的，那就是蝴蝶產業。

捕捉蝴蝶製作成標本或是取下蝶翅製成裝飾商品，在當年是台灣商人的一條致富的管道，五〇、六〇年代每年台灣蝴蝶的消耗量在一百五十萬隻到五億隻之間。蝶類外銷的金額高達三千萬美元，是當時台灣十分重要的外匯收入來源。

台灣蝴蝶被大量捕殺，在今日普世都注重環境保護的觀念看來，真是不可思議。而當年二十多歲年紀的我，也曾經在兩三年之間，以蝴蝶做為我的主要經濟來源。當年曾自豪地告訴人家：「全世界只有兩個國家能將蝴蝶當作商品，一個是巴西，另一個國家就是台灣。」當年的洋洋自得，如今卻是羞愧無比，這段蝴蝶伴我成長的歲月，是我刻意要遺忘的生命歷史。

但是，在民智已開的此時，我願將它與各位分享。

請別叫我昆蟲男孩

劉耕名

劉耕名，現為 BITO 負責人兼導演，旅居紐約九年，作品橫跨電影、電視台形象，電視廣告、音樂錄影帶、插畫等領域。2006 年初試啼聲，以首支動畫短片 Travel Dairy 拿下 Adobe 設計成就獎首獎，其後多支作品獲逾 50 個世界影展及獎項肯，並在紐約 TED 公開播映。服務客戶包括 Facebook、Nike、MTV、Pepsi 等國際企業。

劉耕名成長於台北萬華，幼時愛畫畫也愛自然生態，立志當昆蟲學家，推甄就讀台灣大學昆蟲學系，大學時期為採集研究，足跡踏遍台灣山林。大學畢業後，美感天賦驅使下，赴紐約藝術學院(School Visual Art)攻讀電腦藝術創作碩士，畢業後曾為 Brand New School 等多家紐約工作室創作動畫，後任職 Suspect 工作室資深美術指導 4 年，活躍紐約廣告設計圈至今。

2012 年起回到台灣，成立 Bito 甲蟲創意，五年內成為亞洲最知名的設計動畫公司。相信動態圖像會成為下一代的平面設計。從 TEDXTaipei 教育 2.0 開始，和新世代創作者分享理念。擔任台北世大運 Taipei in Motion 的導演，金曲獎視覺總監，IF 設計獎評審。讓台灣的设计被世界看見

在截然不同的背景激盪之下，他的視覺語言獨特，善於融合看似對立的不同元素及媒材，山林／都會、類比／數位、童趣／性感、復古／新潮 兼備。擅長賦予靜態圖像生命，剪輯緊湊新穎的轉場說故事，融合紐約下城的活力以及大自然規律的美感，結合字體設計、插畫、手繪動畫、逐格動畫、motion graphics 等不同媒材，呈現色彩鮮明，活潑復古的趣味影像。

本次講座將帶大家進入他奇幻的轉場人生

系統分類、族群遺傳、演化

論文宣讀摘要集

Oral Session:

**Systematics, population genetics
and evolution**

Medinodexia 屬（雙翅目：寄生蠅科）的分類研究

Taxonomic study of *Medinodexia* Townsend, 1927 (Diptera: Tachinidae)

黃悠然¹、館卓司²

Yu-Zen Huang¹, Takuji Tachi²

Graduate School of ISGS, Kyushu University¹, Biosystematics Lab, Kyushu University²

背景/研究問題/材料方法

Medinodexia Townsend 共四種，其模式種為 *M. fulviventris* Townsend，分布於印尼；*M. morgani* (Hardy) 則分布在澳洲和斯里蘭卡，並曾在澳洲被應用於防治守瓜 (*A. foveicollis* (Lucas))；其後，*M. orientalis* Shima, 1979 和 *M. exigua* Shima, 1979 在東方區被發現(前者分布於馬來西亞和泰國，後者於印尼和台灣)；近期，*Medinodexia* 屬首次於日本被發現，一未知種 (*M. sp. 1*) 在日本九州大學伊都校區被發現寄生於黑腳黑守瓜 (*Aulacophora nigripennis* Motschulsky) 中；去年則有一近似 *M. orientalis* 的未知種 (*M. sp. 2*) 在台灣被發現。本研究解剖比較 *Medinodexia* 屬成員與兩個新發現未知種的雌雄生殖器構造，探討 *Medinodexia* 屬及屬內各物種之系統分類地位。

結果/結論/應用啟示

在觀察雌雄生殖器後發現，日本的 *M. sp. 1* 之雌雄生殖器與模式種非常相似，可確認為 *Medinodexia* 屬。台灣的 *M. sp. 2* 與 *M. orientalis* 及 *M. exigua* 之生殖器構造相像，但卻與模式種完全不同；此三個物種的雌蟲雖具有 *Medinodexia* 屬的針刺狀產卵管，但形成針刺形狀的腹部第七節背板與腹版分離。相對的，模式種 *M. fulviventris* 具有背腹板完全癒合的腹部第七節，此特徵與 *Medina* 屬的產卵管構造相似，因此推測 *Medinodexia* 屬與 *Medina* 屬親緣關係接近。而 *M. orientalis*、*M. exigua* 和台灣的 *M. sp. 2* 則應不屬於 *Medinodexia* 屬，需要後續研究以確認其分類位置。

關鍵詞 (Key words) : *Medinodexia*、Taxonomy、Postabdomen、*Aulacophora*

釐清台灣產散白蟻屬的分類問題

Revision of a subterranean termite genus, *Reticulitermes* (Isoptera: Rhinotermitidae), in Taiwan.

吳佳倩¹、蔡正隆¹、梁維仁¹、竹松葉子²、李後鋒¹

Chia-Chien Wu¹, Cheng-Lung Tsai¹, Wei-Ren Liang¹, Yoko Takematsu², and Hou-Feng Li¹

¹中興大學昆蟲學系

Department of Entomology, National Chung Hsing University

²日本山口大學農學部

Faculty of Agriculture, Yamaguchi University

背景/研究問題/材料方法

散白蟻屬 (*Reticulitermes*) 主要危害木造建築，在日本、韓國、中國及美國皆為重要木材害蟲。台灣的散白蟻已知紀錄 2 種，分別為黑胸散白蟻 *R. leptomandibularis* Hsia and Fan, 1965 及黃肢散白蟻 *R. flaviceps* (Oshima, 1911)，主要分布於山區。由於本屬物種間診斷形態特徵不明確，物種鑑定有其困難度，因此台灣產散白蟻屬之多樣性有待重新檢視。為了解散白蟻屬的物種界定，本研究採集台灣各地共 62 個樣點的散白蟻屬樣本，結合形態及分子特徵 (COII、ITS) 探討台灣散白蟻屬之多樣性。

結果/結論

據 COII 分析結果顯示，台灣的散白蟻屬可分為三群，分別為 *R. leptomandibularis*、*R. flaviceps* Group A 與 Group B。其中，Group A 與 GenBank 資料庫內序列比對後結果為 *R. flaviceps*，Group B 則為 *R. kanmonensis* Takematsu, 1999，三者的模式地分別為中國、台灣與日本。同時，我們取得日本模式產地的 *R. kanmonensis* 族群進行分析，結果顯示日本產 *R. kanmonensis* 皆歸群於 Group B，然而兩群間之形態特徵並無明顯差異，且 ITS 序列也支持台灣的散白蟻屬應分為 *R. leptomandibularis* 及 *R. flaviceps* 兩種。基於形態特徵無法區辨及遺傳混雜程度下，我們推測 *R. kanmonensis* 及 *R. flaviceps* 應視為同一種，考慮命名優先權，因此 *R. kanmonensis* 應視為 *R. flaviceps* 的同物異名。

關鍵字 (Key words)：散白蟻屬 (*Reticulitermes*)、同物異名 (Synonymization)、COII、ITS、台灣 (Taiwan)

台灣蟻科各亞科幼蟲之形態學與分類學研究(膜翅目：蟻科)
Morphological and Taxonomic Studies on Ant Larvae in Taiwan
(Hymenoptera: Formicidae)

呂艾珊、林宗岐

Ai-Shan Lu, Chung-Chi Lin

國立彰化師範大學生物學系 Department of Biology, National Changhua
University of Education

背景/研究問題/材料方法

螞蟻屬於真社會性昆蟲，蟻巢成員包括蟻后、雄蟻、工蟻及幼期個體。在物種辨識上，工蟻具有最完整的形態描述及鑑定流程，而部分地區或分類群的雄蟻及蟻后也已建立檢索表，但對於幼期個體的研究多著重在結構與功能間的關聯，鮮少牽涉到物種辨識的議題；在台灣，螞蟻幼蟲的相關研究尚有許多空白；本研究以末齡幼蟲之外形投影、體表附屬結構等特徵，初步探討台灣螞蟻幼蟲之形態。

結果/結論/應用啟示

目前已收集 10 亞科、56 屬、128 種之螞蟻幼蟲標本，經過比對後顯示，不同亞科的末齡幼蟲在外形與體表附屬結構上有明顯差異；大致上，琉璃蟻亞科(Dolichoderinae)外形粗短，體表接近光滑；擬家蟻亞科(Pseudomyrmecinae)及軍蟻亞科(Dorylinae)呈長圓柱狀，差異在體節是否明顯及體毛多寡；鈍針蟻亞科(Amblyoponinae)、泛蟻亞科(Ectatomminae)、細蟻亞科(Leptanillinae)，針蟻亞科(Ponerinae)及盾角針蟻亞科(Proceratiinae)外形為腹部中間粗，往兩端變細，各亞科差異在體節寬度變化及體表附屬結構；而家蟻亞科(Myrmicinae)和山蟻亞科(Formicinae)之各屬變化極大，難以歸納出共同特性；未來將進一步以其他特徵為參考，作為屬級間的辨識依據。

關鍵詞 (Key words)：蟻科 (Formicidae)、幼蟲 (larva)、形態學 (morphology)

台灣蟻形蜂科 *Apenesia* 屬的分布與系統分類的進一步檢討

The research about distribution and taxonomy of *Apenesia* in Taiwan

(Hymenoptera : Bethylidae)

廖浩全

Hau-Chuan Liao

首都大學東京 生命科學專攻

Department of Biological Sciences, Tokyo Metropolitan University

背景/研究問題/材料方法

蟻形蜂科在生物防治應用上，是能有效降低鱗翅目與鞘翅目幼蟲對於農作物危害的寄生蜂。近年來，咖啡樹在台灣的中南部地區開始成為新興經濟作物。然而害蟲也對其收穫產生影響。在缺乏可利用的天敵昆蟲下，僅能利用農藥及物理防治來降低損失。在國外先前研究當中，已經有觀察到本科 *Apenesia* 屬對 *Xylotrechus* 屬天牛的幼蟲會有寄生行為。因此同樣地利用台灣本地的 *Apenesia* 屬是可行的選擇。故本研究將對台灣常見的 *Apenesia* 屬及相近各屬進行系統分類及分布調查。

結果/結論/應用啟示

本研究當中，調查地區包含台灣中、南部山區、以及生物相相近的琉球群島。目前利用形態分類共發現新種 4 種、新紀錄種 4 種。此外利用 28srRNA 系統樹中發現兩點：從台灣本島南部到琉球群島的奄美大島，其中 3 種依地區分布呈現小部分基因差異(<1%)。對於台灣到琉球的島鏈生物相研究可以作為一個有用的模型；另外從前的 *Apenesia* 屬是歸類於 *Pristocerinae* 亞科下的單一系統樹，但同樣利用分子分析結果後，推測該屬為多系統的可能性較高，而且近期也同樣有其他研究者對該屬提出相近的見解。因此在之後 *Apenesia* 屬與相近各屬，包含 *Pristocerinae* 亞科的分類系統還有進一步檢討的需求。

關鍵詞 (Key words)：蟻形蜂科(*Bethylidae*)、生物防治(Biocontrol)、咖啡樹(coffee tree)、分類學(taxonomy)

Species delimitation in the psyllid genus *Stenopsylla* (Hemiptera: Triozidae) based on vibrational signals and morphology

Yi-Chang Liao, Man-Miao Yang

Department of Entomology, National Chung Hsing University

Background/Question/Methods

The psyllid genus *Stenopsylla* Kuwayama comprises 12 species worldwide and three species distributed in Taiwan. Members of this genus are recognized by long Rs vein of forewing and thickened antennal flagellum with conspicuous bristles. We have collected other unrecorded species of *Stenopsylla* from Taiwan in recent years and further review of the group showing some known species are questionable based on the morphological comparison and host plant information. Therefore, applying other biosystematic characters may assist species classification. Psyllids emit vibrational signals and both genders perform duets in the mating context. As these signals are species-specific, our previous studies on some other psyllids suggest that characteristics of vibrational signals are valuable tools in clarifying species boundaries in Psylloidea. In this study, a combination of morphology and vibrational signals is attempted to delimitate species status of *Stenopsylla* psyllids.

Results/Conclusions

We measured the characteristics of vibrational signals of 32 males and 28 females of five *Stenopsylla* species collected from Taiwan. The quantitative characteristics include the signal duration, the pulse rate, the latency period, and the dominant frequency, while binary characteristics are the symmetry and the frequency modulation of signals. Signals of males showed that the signal duration, the pulse rate, and the dominant frequency had significant differences among species based on nonparametric Kruskal-Wallis test. As well, characteristics of females also presented significant differences among species in the signal duration, the pulse rate, the latency period, and dominant frequency. Moreover, the principal coordinate analysis (PCoA) based on all characteristics of vibrational signals of males and females, respectively, showed that signals of different species are grouped separately from each other. Adult morphology further displays differences among five species, including genitalia, genal cone, body color, and forewing. These results provide evidences that these five species of *Stenopsylla* should be distinct species.

Key words: Psylloidea, systematics, duets, host plant, *Symplocos*

紹德擬腹竊蠹(*Falsogastrallus sauteri*) 及其外寄生蜂頭甲蟻形蜂
(*Cephalonomia* sp.) 之微細形態特徵與發生記述
Ultramorphological characteristics of *Falsogastrallus sauteri* and its
parasitic wasps, *Cephalonomia* sp., with note on their occurrences

賀毓翔¹、詹美鈴²、蕭昀³

Yu-Hsiang Ho¹, Mei-Ling Chan², Yun Hsiao³

1 國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing
University

2 國立自然科學博物館生物學組 Division of Biology, National Museum of Natural
Science

3 臺灣昆蟲同好會 Taiwanese Society of Insect Natural History

背景/研究問題/材料方法

鞘翅目蛛甲科(Ptinidae) 中有許多種類為重要的博物館與圖書館害蟲，如菸甲蟲(*Lasioderma serricorne*)、藥材甲(*Stegobium paniceum*)、紹德擬腹竊蠹(檔案竊蠹)(*Falsogastrallus sauteri*) 等，對標本文物與書籍常造成嚴重損害，對文物保存的影響甚鉅。2017年，我們從遭蟲蛀之老舊書籍中採集到鞘翅目及膜翅目成蟲標本，透過外部形態及生殖器比對，確認為紹德擬腹竊蠹與蟻形蜂科(Bethylidae) 頭甲蟻形蜂屬(*Cephalonomia* sp.) 種類。紹德擬腹竊蠹為重要的檔案及圖書害蟲，過往臺灣相關研究報告中，雖偶有提及紹德擬腹竊蠹會危害圖書，但對幼蟲和成蟲之細微形態並無更進一步之描述，更無任何其外寄生蜂之資訊，因此我們再利用掃描電子顯微鏡(scanning electron microscope, SEM) 檢視兩物種之細微形態特徵。

結果/結論/應用啟示

紹德擬腹竊蠹為重要檔案及圖書害蟲，約2 mm，幼蟲蛀食書籍造成坑洞，甚至導致書籍支離破碎，成蟲則不取食；而同時發現之頭甲蟻形蜂為首次記錄會寄生於紹德擬腹竊蠹的外寄生蜂，雄蟲長翅型，約1.3 mm，雌蟲具短翅型及長翅型兩種型態，約1.7 mm，但其寄生方式仍不明瞭。已記錄之頭甲蟻形蜂屬主要寄生於鞘翅目幼蟲或蛹，某些發生於居家環境種類，有時會螫人引起疼痛不適，甚至引發過敏反應。本研究結果除提供紹德擬腹竊蠹幼蟲、成蟲與頭甲蟻形蜂成蟲細微形態特徵資訊，也將助於後人之鑑定與防治工作進行。

關鍵詞 (key words): 檔案害蟲 (archival pests)、紹德擬腹竊蠹 (*Falsogastrallus sauteri*)、頭甲蟻形蜂 (*Cephalonomia* sp.)、掃描電子顯微鏡 (scanning electron microscope)、寄生蜂 (parasitic wasps)

Does the length of dorsal setae provide taxonomic value in phytoseiid mites: Intraspecific variation of *Neoseiulus barkeri* (Acari: Phytoseiidae)

Hsiao-Chin Lee¹, Jhih-Rong Liao¹, Chyi-Chen Ho², Chiun-Cheng Ko^{1*}

¹Department of Entomology, National Taiwan University, Taipei, Taiwan

²Taiwan Acari Research Laboratory, Taichung City, Taiwan

Background/Question/Methods

Phytoseiid mites have diverse feeding habits, some species are considered as natural predators for phytophagous pests involving spider mites, whiteflies, thrips and nematodes. They have received considerable attention because of their biological control potential for phytophagous mites and other small arthropods. More than 2,700 species of Phytoseiidae have been reported in the world, whereas 58 species in Taiwan. Current classification of phytoseiids is based on morphological characteristics (e.g. dorsal setae length). The aim of present study is confirming the stability of morphological characteristics by approaching intraspecific variations of *Neoseiulus barkeri* (Hughes). Principal component analysis (PCA) and non-metric multidimensional scaling (NMDS) analysis were used to determine how the differences in the morphological characteristics can be associated with species delimitation.

Results/Conclusions

The setal variations can be further divided into the following categories: additional, absent, deviated and lengthened setae. The numerical analyses of PCA and NMDS both divided specimens into four groups. The results showed currently used morphological characters should be reconsidered because of intraspecific variations, especially dorsal setae length. We hope this study will approach intraspecific variation and species delimitation of phytoseiids on morphological and molecular aspects, and also re-examine the morphometric method for closely phytoseiid species.

Key words: intraspecific variation, *Neoseiulus barkeri*, Phytoseiidae

修訂「昆蟲綱科以上學名中名對照表」

Revision of “The name-list of Insecta (above family level) with Chinese common name”

蕭旭峰、吳文哲

Shiuh-Feng Shiao, Wen-Jer Wu

國立臺灣大學昆蟲學系 Department of Entomology, National Taiwan University

背景/研究問題/材料方法

昆蟲分類學是研究昆蟲學的基礎，昆蟲中文名稱的統一在研究發展上極為重要；而科名是決定中文種名的重要基礎，因此台灣昆蟲學會的前身中華昆蟲學會於1994年委託台灣昆蟲名錄審查委員會，編印「昆蟲綱科以上學名中名對照表」以供同好採用，並規定發表在中華昆蟲之報告沿用委員會所決定的中文名。然此對照表迄今已逾20年未曾修訂過，期間因研究之進展及分類地位之更迭，原中名與拉丁學名之合理性與適切性已有大幅修訂的必要。本學會第十九屆第二次理監事聯席會決議改組「台灣昆蟲名錄審查委員會」，首要工作為邀請各分類群專家分工協助修訂新版本。

結果/結論/應用啟示

目前已成立工作小組，規劃由各分類群專家負責整合整理各類群之最新系統（包括目級、亞目、總科、科及部分類群的亞科）及其中名。採用中文名稱之最大原則，為盡量由已有之中文名中，選擇一個較適當者，沒有適當的中文名時再給予一個新創名；選擇名稱時之原則為兼顧普遍性、字數及易念。工作小組完成的新版本初稿及綱級（如：昆蟲綱或六足總綱）和目級系統將由名錄審查委員會討論及審訂通過。

關鍵詞 (Key words)：昆蟲綱 (Insecta)、名錄 (name list)、科級 (family level)、中名 (Chinese name)

行為、生理、個體生物學
論文宣讀摘要集

Oral Session:
Ethology, physiology and
organismic biology

菌圃發酵產物為台灣土白蟻主要的營養來源

Fermented products of fungus garden is the major nutrition source of *Odontotermes formosanus* (Isoptera: Termitidae)邱俊禕¹、歐玠皓²、陳啟予²、李後鋒¹Chun-I Chiu¹, Jie-Hao Ou², Chi-Yu Chen², Hou-Feng Li¹¹ 國立中興大學昆蟲學系

Department of Entomology, National Chung Hsing University

² 國立中興大學植病學系

Department of Plant Pathology, National Chung Hsing University

背景/研究問題/材料方法

養菌白蟻 (fungus-growing termites) 具有建造菌圃培養真菌 *Termitomyces* spp. 的行為，其工蟻會在取食植物組織後，將植物組織排泄建造新菌圃，並在菌圃發酵後再度吃下菌圃。目前菌圃的功能並不清楚，有兩個主要的假說，一、白蟻利用菌圃提供的酵素協助其分解、利用植物組織中的營養 (acquiring enzyme hypothesis)，二、由菌圃分解植物組織，而白蟻利用菌圃中的發酵產物 (主要為真菌組織) 作為主要的營養來源 (ruminant hypothesis)。為了解菌圃發酵過程中的營養變化及其產物是否為養菌白蟻的營養來源，本研究採集台灣土白蟻 (*Odontotermes formosanus* Shiraki) 及其蟻巢並分析新鮮菌圃、發酵菌圃及白蟻組織中的 18 種 α -胺基酸及 56 種脂肪酸的組成，嘗試以營養組成的相似性判斷白蟻的營養來源。

結果/結論/應用啟示

根據 3 個不同地點的蟻巢及白蟻的營養組成分析，白蟻體內的 α -胺基酸組成與發酵菌圃相似 (Partial linear correlation: $r = 0.91, p < 0.0001$)，而與新鮮菌圃並不相似 ($r = -0.17, p = 0.50$)。白蟻體內的脂肪酸亦與發酵菌圃相似 ($r = 0.75, p < 0.0001$)，但與新鮮菌圃有較大的差異 ($r = -0.51, p < 0.0001$)。 α -胺基酸及脂肪酸的分析結果皆支持台灣土白蟻的營養來源以菌圃的產物為主。另外，發酵菌圃的胺基酸變異度較低 ($t = 2.2, p < 0.05$)，顯示菌圃發酵可使營養均質化。根據以上結果，建造菌圃是養菌白蟻的食物前處理過程，白蟻利用菌圃發酵生產均質且均衡的營養。

關鍵詞 (Key words)：台灣土白蟻 (*Odontotermes formosanus*)、酵素獲得假說 (Acquiring enzyme hypothesis)、反芻假說 (Ruminant hypothesis)、固態發酵 (Solid-state fermentation)

米爾頓絨小蜂(膜翅目：絨小蜂科)對於不同品種的蓮霧及蒲桃花朵氣味之產卵偏好性

The oviposition preference of *Anselmella miltoni* (Hymenoptera: Eulophidae) to the floral scent of different strains of *Syzygium samarandenes* and *S. jambos*

林鈺淳、林裕哲、廖一璋、楊曼妙

Yu-Chun Lin, Yu-Che Lin, Yi-Chang Liao, Man-Miao Yang

國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

米爾頓絨小蜂屬膜翅目絨小蜂科，於桃金娘科的蓮霧與蒲桃種子部位造癭，導致種子膨大，雖不損害果實風味，但為近年台灣蓮霧出口中國的檢疫害蟲，造成嚴重外銷損失。依據防檢局出口檢疫資料，顯示台灣出口的三品種蓮霧(南洋種、印尼種、泰國種)之米爾頓絨小蜂感染率有所差異，因而進一步探討造成米爾頓絨小蜂於不同品種蓮霧與野外寄主蒲桃感染率差異的因素。本研究針對米爾頓絨小蜂是否對不同寄主植物有氣味偏好進行測試，探討嗅覺對米爾頓絨小蜂搜尋寄主的影響。由於米爾頓絨小蜂於開花時期開始前來產卵，此研究以盛花期三品種蓮霧與蒲桃為材料，利用 Y 型管進行氣味測試，觀察米爾頓絨小蜂對寄主植物氣味是否有選擇偏好。

結果/結論/應用啟示

就單一花源與空氣組(控制組)測試的結果顯示，雌蜂選擇南洋種的比例最高，其次為蒲桃、印尼種，而泰國種最低；在兩種花源測試中，蒲桃和其他三品種蓮霧相比，雌蜂有比較高的比例前往產卵；三品種蓮霧花源相比，南洋種相較印尼種和泰國種有較高的比例吸引雌蜂前往產卵。由此，我們推論花朵氣味為雌蜂選擇寄主的主要因子之一，後續將再以 GC-MS 進行氣味分析，比較各氣味的組成，找出何種成分為吸引雌蜂產卵的主因，進一步發展為誘引或忌避劑並應用於田間防治。

關鍵詞 (Key words)：Y 型管 (Y-tube olfactometer)、寄主搜尋 (host searching)、蟲癭 (gall)、植物揮發物 (plant volatile)

赤星瓢蟲對竹葉扁蚜之捕食效能評估

Predation efficacy of *Lemnia saucia* (Mulsant) (Coleoptera: Coccinellidae) on *Astegopteryx bambucifoliae* (Takahashi) (Hemiptera: Hormaphidae)

羅權彧¹、宋一鑫²、黃啟鐘¹

Chuan-Yu Lo¹, I-Hsin Sung², Chi-Chuang Huang¹

¹ 國立嘉義大學生物資源學系 Department of Biology Resource,

National Chiayi University

² 國立嘉義大學植物醫學系 Department of Plant Medicine,

National Chiayi University

背景/研究問題/材料方法

竹葉扁蚜為臺灣低海拔竹林之常見害蟲，於每年9月至翌年3月為族群密度高峰期。竹葉扁蚜吸食葉片汁液，且會分泌蜜露引發煤煙病，阻礙葉片光合作用，影響竹子的生長勢與竹筍產量。赤星瓢蟲為竹葉扁蚜常見的捕食性天敵之一。本研究利用赤星瓢蟲之幼蟲與成蟲，分別進行竹葉扁蚜之捕食效率與捕食功能反應試驗，並採用 Holling II 和 Rogers II 模型分析攻擊係數及捕捉時間，以評估赤星瓢蟲之捕食能力。

結果/結論/應用啟示

本研究結果顯示，赤星瓢蟲幼蟲之日平均捕食量隨齡期的增長而增加，其中以三、四齡幼蟲之日平均捕食量為最高，分別為 62.2 和 68.9 隻，且與一、二齡幼蟲的捕食量達顯著差異。赤星瓢蟲雌、雄成蟲皆屬於第 II 型捕食功能反應，又雌成蟲之捕食量較雄成蟲高。雖然雌、雄成蟲在竹葉扁蚜密度試驗組的捕食量沒有差異，但攻擊係數 (a) 和捕捉時間 (T_h) 的分析結果，顯示雌成蟲之捕食效率顯著高於雄成蟲。從 AIC (Akaike information criterion) 分析結果，顯示 Rogers II 模型之適合性較高，推論赤星瓢蟲雌、雄成蟲，以隨機性捕食竹葉扁蚜。綜合上述結果，赤星瓢蟲對竹葉扁蚜之捕食能力，可供為未來生物防治的參考。

關鍵詞 (Key words)：赤星瓢蟲 (*Lemnia saucia*)、竹葉扁蚜 (*Astegopteryx bambucifoliae*)、功能性反應 (functional response)、捕食效能 (predation efficacy)

Examination of the histamine hypothesis for a mechanism underlying photoreceptor spectral opponency in the *Papilio* butterfly

Pei-Ju Chen, Hiroshi Akashi, Atsuko Matsushita, Kentaro Arikawa

Department of Evolutionary Studies of Biosystems, Sokendai, Japan

Background/Question/Methods

Spectral opponent responses, i.e. positive at some wavelengths and negative at others, have been observed at the level of photoreceptors in butterflies. To explain its mechanism, we have proposed a “histamine hypothesis”. Histamine is the only neurotransmitter so far identified in insect photoreceptors and synapse-like structures have been found between *Papilio* photoreceptors. If histaminergic inhibitory synapses exist between different spectral receptors, the photoreceptor spectral opponency could be reasonably explained. To confirm the hypothesis, we have carried out immunolocalization of two candidates of histamine-gated chloride channels, PxHCIA and PxHCIB, in the eye of the butterfly *Papilio xuthus*. We also analyzed physiological properties of these channels by whole-cell patch-clamp using those expressed in HEK293 cells.

Results/Conclusions

The patch-clamp experiments confirmed that both PxHCIA and PxHCIB are indeed activated by histamine and permeate chloride ions. The double fluorescence labeling with anti-PxHCIA and anti-PxHCIB revealed that these channels do not overlap in their distribution. The PxHCIA immunoreactivity was detected at the second order neurons that are postsynaptic to photoreceptors, while the PxHCIB widely overlapped with photoreceptor axons indicating this channel is probably expressed at the inter-photoreceptor synapses. The unique PxHCIB distribution provides a support for the histamine hypothesis: this channel may be involved in the photoreceptor spectral opponency.

Key words: color vision, histamine-gated chloride channel, immunohistochemistry, optic lobe, voltage clamp

Germline development in the aposymbiotic pea aphid: nutrition vs. reproduction

Yi-Min Hsiao^{1,2,3}, Shuji Shigenobu³, Chun-che Chang^{1,2}

¹Institute of Biotechnology, College of Bioresources and Agriculture, National Taiwan University, Taipei, Taiwan

²Department of Entomology, College of Bioresources and Agriculture, National Taiwan University, Taipei, Taiwan

³National Institute for Basic Biology, National Institutes of Natural Science, Aichi, Japan

Background/Question/Methods

The obligate endosymbiont *Buchnera aphidicola* in the pea aphid *Acyrtosiphon pisum* supplies essential amino acids (EAAs) and vitamins (VITs). Previous reports show that embryonic development in the *Buchnera*-free (aposymbiotic) aphid is retarded and body size of the host aphids become reduced. In the past decades, the impact of symbiosis on amino acid metabolism has been intensively studied. Nevertheless, why aposymbiosis results in the sterilization of the host remain unclear on the molecular basis. Here, we hypothesized that symbiosis might regulate the germline development, which are the specialized cells involved in reproduction.

Results/Conclusions

We found that aposymbiosis did not disrupt the specification and migration path of primordial germ cells (PGCs). However, lacking *Buchnera* reduced the numbers of migrating germ cells before karyotaxis (embryo flip). Consequently, numbers of germaria were dramatically decreased in the aposymbiotic aphid. Moreover, the aphid/*Buchnera* symbiosis was necessary for expressions of germline genes in migrating PGCs. The results indicate that the function of *Buchnera* not only synthesized essential nutrients for host growth but also required for the survival of migrating PGCs and provide the first description on *Buchnera* regulated host germline development. It may shed light on obligate symbiont have a non-nutritional role on host embryo development in insects.

Key words: aphid, symbiosis, nutrient insufficiency, germline survival

Parasitic wasps induces immunosuppression in *Spodoptera litura* via regulating the level of extra-cellular adenosine

Chia-Chi Tai, Yueh-Lung Wu

Department of Entomology, National Chung Hsing University

Background/Question/Methods

Immune system is an energy required response and to resist the invasion of non-self objects effectively. In previous research in *Drosophila melanogaster*, which proved that when the parasitic wasp infects fruit flies, adenosine plays an important signal to regulate energy allocation in the host. Moreover, increased circulating trehalose confirm energy flows from development tissues to immune cells, and promote immune response to prevent the growth of wasp offsprings. Adenosine is an endogenous purine nucleoside can be found in organism. The formation of adenosine is metabolized from adenosine triphosphates (ATP) in stress or damage cells by several enzymes. Then, adenosine back into cells to induce the following physiology response, such as glycolysis. After response, adenosine deaminase (ADA) break down adenosine into inosine, because the high level of adenosine will harmful to cell, and can even cause apoptosis. In general parasitic wasps, adenosine increases to enhance immune systems after infection. But in *Snellenius manilae*, the parasitic wasp in my research, has polydnavirus (PDV) encode in the genome. PDVs help wasps develop, and is injected into the host body along with the eggs of parasitic wasps. Currently, there have been a number of studies proving that PDVs inhibit immune genes. We assume that if energy flows and adenosine decrease during immunosuppression, it could be that miRNAs origin from PDV of wasp block the formation of adenosine and affect energy allocation in the host, *Spodoptera litura*.

Results/Conclusions

The gene expression shows gradually reducing adenosine and enzymes participate in the formation pathway of adenosine when hosts are infected. We analyze the gene fragment and compare the sequence with miRBase to predict miRNAs which can target on the adenosine formation enzymes. Through understanding PDV affected sites in adenosine pathways can help to clarify parasitic mechanisms in an physiological point of view.

Key words: adenosine deaminase, immune response, adenosine, PDV, miRNA

巨卵現象在蟻客生活史演化中的趨同及生理適應

Convergent life-history evolution and physiological adaptation of egg gigantism in myrmeco- and termitophiles

梁維仁¹、林明德²、李後鋒¹

Wei-Ren Liang¹, Ming-Der Lin², Hou-Feng Li¹

¹ 國立中興大學昆蟲學系

Department of Entomology, National Chung Hsing University

² 慈濟大學分子生物暨人類遺傳學系

Department of Molecular Biology and Human Genetics, Tzu Chi University

背景/研究問題/材料方法

昆蟲卵的數目與大小與其繁殖策略有關，大部份的昆蟲產下多且小的卵，但幼蟲期死亡率高，僅少數能成蟲；然而亦有昆蟲生產與成蟲體型大小相近的卵，稱為巨卵現象 (Egg gigantism)，這些物種通常幼蟲不取食或幼蟲期短。除了適應洞穴棲地或乾燥環境的昆蟲外，巨卵現象亦發現於依賴社會性昆蟲資源的蟻客。為了解巨卵現象的演化與生理機制，本研究首先確立卵與母代相對大小的量化方法，用以比較各物種的差異並定義巨卵物種。接著以蟻客為材料進行文獻收集、田野調查及生殖器解剖，藉由比較巨卵與非巨卵物種間在生物學及生殖器結構的異同，探討巨卵現象之選汰壓力與生理適應。

結果/結論/應用啟示

根據卵與雌成蟲的易測量性，以卵體積與母成體乾重之比值 (mm^3/mg) 最適合代表卵與母代的相對大小，一般昆蟲之比值介於 0.001~0.1，而巨卵昆蟲中，幼蟲期不取食之 *Zyras* 屬隱翅蟲為 0.53，棲息於白蟻巢中之白蟻蚤蠅亞科的數個物種則介於 0.3~0.9 之間。綜合現有資訊推測，不同蟻客類群的巨卵現象為趨同演化；蟻客中最極端的巨卵現象出現於以成蟲特化利用蟻巢資源的物種，而以幼蟲特化利用蟻巢資源的物種則未有紀錄。生理適應方面，大多數昆蟲有多條微卵管同步發育多個卵子，而有巨卵現象的 *Zyras* 屬隱翅蟲以及土蟻蚤蠅之卵子發育過程，每次僅有一顆卵子成熟，各微卵管內之卵子發育並不同步。

關鍵詞 (Key words): 喜蟻性生物 (Myrmecophile)、喜白蟻性生物 (Termitophile)、台灣土白蟻 (*Odontotermes formosanus*)、卵黃營養幼體 (Lecithotrophic larva)、無取食行為幼蟲 (Non-feeding larva)

先驅型白蟻物種的生殖彈性

Reproductive plasticity of pioneer termite species

邱奕寧¹、邱俊禕¹、林明德²、李後鋒¹Yi-Ning Chiu¹, Chun-I Chiu¹, Ming-Der Lin², Hou-Feng Li¹¹ 國立中興大學昆蟲學系

Department of Entomology, National Chung Hsing University

² 慈濟大學分子生物暨人類遺傳學系

Department of Molecular Biology and Human Genetics, Tzu Chi University

背景/研究問題/材料方法

原鼻白蟻 (*Prorhinotermes* spp.) 廣泛分佈在全球熱帶地區的島嶼及沿岸森林，是典型先驅型的拓殖物種，前人研究觀察到原鼻白蟻族群內有高比例的棕色個體 (2.0-12.9%)，並推測其為補充繁殖型。目前在其他白蟻物種發現的補充生殖型多為雌性，具有膨大腹部，其功能是在蟻后老化或死亡後接替其生殖功能。然而，原鼻白蟻的棕色個體腹部無明顯膨大，生殖能力尚未驗證，亦無記載性別辨識方法。本研究在實驗室內以小群體方式飼養原鼻白蟻，檢測其最小拓殖個體數，並解剖棕色個體觀察其生殖器官發育狀態以驗證其性別與生殖能力。

結果/結論/應用啟示

將 10-320 隻原鼻白蟻工蟻飼養於培養皿中，於 1 週內即觀察到部份工蟻轉變為棕色個體，4 週內產卵、6 週後可觀察到若蟲、24 週後族群平均成長一倍，顯示 10 隻原鼻白蟻便具有拓殖能力。另外，飼養 5-20 隻工蟻或棕色個體於培養皿中，7 週內兩階級的生存率無顯著差異，支持棕色個體無須工蟻照顧亦能獨立存活。此外，飼養 6 個具有 5 隻棕色個體的群體於容器中，10 天後，三分之二的群體有產卵，證明棕色個體具繁殖能力，同樣的試驗操作以工蟻進行，則無觀察到卵。解剖 14 隻棕色個體後發現 5 隻個體具有成熟的卵巢，而 9 隻個體具發育的精巢，對照其腹部板片及尾毛形態確定可用外部型態分辨雌雄。根據以上結果，原鼻白蟻能以極小的族群拓殖，而其棕色個體為補充生殖型，且保有工蟻的功能，亦無需工蟻照顧。

關鍵詞 (Key words)：原鼻白蟻 (*Prorhinotermes* spp.)、補充生殖型 (secondary reproductives)、拓殖 (colonization)、生殖器 (sex organs)

益達胺抗藥性對於紅胸隱翅蟲生命表特徵的影響

The effect of imidacloprid resistance on life history traits of *Paederus fuscipes* (Coleoptera: Staphylinidae)

馮文斌、梁國汶

Wen-Bin Feng and Kok-Boon Neoh

國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

紅胸隱翅蟲 (*Paederus fuscipes*) 在農業上是一種有益昆蟲，它可以取食多種農業害蟲，但是它對於人類居住地的侵擾以及其體液中隱翅蟲素 (pederin) 造成的隱翅蟲皮膚炎 (dermatitis linearis) 使得它在都市害蟲的地位不斷上升。殺蟲劑的使用在農業上防治害蟲是極為普遍，但是在農業系統非目標性昆蟲也會接觸到殺蟲劑並且發展抗藥性，抗藥性更進一步影響到生命表特徵。本研究從全台灣 12 個水稻田樣點採集紅胸隱翅蟲，製作生命表 (Life table) 及使用半致死時間 (Lethal time 50%) 作為益達胺抗藥性基準，並且利用混合線性回歸 (Linear mixed model) 分析兩者之間的關係。

結果/結論/應用啟示

根據抗藥性結果顯示相對於較感性品系，抗性紅胸隱翅蟲已經產生高達 20 倍益達胺抗藥性，生命表結果顯示各地區的紅胸隱翅蟲生命表特徵有顯著差異，例如：成蟲前發育時間 19.5~21.5 天、卵孵化率 76%~95.12%、成蟲前存活率 48.89%~97.44%。根據混合線性回歸分析兩者後結果顯示益達胺抗藥性對於卵期時間、下一世代卵品質有顯著差異，但是多數生命表特徵並沒有顯著差異，推測可能是因為生命表特徵是受到複數殺蟲劑抗藥性影響，未來將會針對其他在水稻中常使用的殺蟲劑進行相關研究。

關鍵詞 (Key words)：紅胸隱翅蟲 (*Paederus fuscipes*)、益達胺 (Imidacloprid)、殺蟲劑抗藥性 (Insecticide resistance)、生命表 (Life history)

季節性變動對於紅胸隱翅蟲水分生理的影響

Influence of seasonal variation on water relations of *Paederus fuscipes*
(Coleoptera: Staphylinidae)王家于、梁國汶Chia-Yu Wang and Kok-Boon Neoh國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing
University

背景/研究問題/材料方法

昆蟲須維持體內水分平衡的穩定適應多樣化的氣候條件，而環境中溫度及濕度為影響昆蟲水分生理的重要非生物因子。在溫熱帶地區，紅胸隱翅蟲(*Paederus fuscipes*)多次被記錄侵擾人類居住環境，其體液中的隱翅蟲素 (pederin) 為隱翅蟲皮膚炎 (dermatitis linearis)的致病因子。在本研究中，我們認為紅胸隱翅蟲的水分生理會因應季節溫濕度變化和水稻栽培週期而有所改變。為了探討紅胸隱翅蟲水分生理和野外水稻環境之間的關係，於台中市兩個水稻田樣點每月進行採集，再將當天採集到的紅胸隱翅蟲帶回實驗室，放置於乾燥環境下進行抗旱實驗。

結果/結論/應用啟示

根據研究結果，表皮滲透率(Cuticular permeability)、含水率(Total body water content)和失水率(Total body water loss)均受季節性的影響。雌性紅胸隱翅蟲的表皮滲透率至秋冬季節(10-12月)時顯著下降；雌雄蟲含水率至秋冬季節(11-1月)時有顯著上升之趨勢，且相較於高溫潮濕的季節，在低溫乾燥的環境下皆表現出較低的失水率。綜合以上結果，紅胸隱翅蟲能夠隨著環境變動調整自身生理能力，進而防止水分流失，經由降低表皮滲透率、限制水分流失，或透過攝取更多水分來增加含水量，當暴露於乾燥環境下時，較慢達到臨界致死水平。

關鍵詞 (Key words)：紅胸隱翅蟲 (*Paederus fuscipes*)、亢旱性(desiccation resistance)、水分生理 (Water relations)

Characterization of imidacloprid-affected cytochrome P450 gene,
CYP450 305A1, in the honey bee, *Apis mellifera*

陳宥廷、吳明城、路光暉

Yu-Ting Chen, Ming-Cheng Wu and Kuang-Hui Lu

國立中興大學昆蟲學系

Department of Entomology, National Chung Hsing University

Background/Question/Methods

Cytochrome P450s (CYP450s) in honey bee play a crucial role in detoxification to resist the adversity of pesticides and phytotoxins. Additionally, CYP450s are also related to the hormone biosynthesis, including juvenile hormone (JH) and ecdysteroid. In our study of imidacloprid-affected next generation sequencing gene library, the expression of CYP450s gene group in the newly emerged adult head was affected when honey bee larvae exposed to sublethal doses of imidacloprid. Especially the expression of the gene, *CYP450 305A1*, increased by 2^{16} -fold after treatment, was investigated. According to gene alignment result, it has been assumed that *CYP450 305A1* encoding methyl farnesoate epoxidase, probably involved in juvenile hormone synthesis. We have treated honey bee with juvenile hormone III (JH III) and fed sublethal doses of imidacloprid to 2- to 5-day-old larvae. We wonder how the gene expression of *CYP450 305A1* changed when the honey bee receives the JH III or imidacloprid.

Results/Conclusions

By using quantitative RT-PCR, it has found that the *CYP450 305A1* expression in the head was declined by the growing age and was repressed by JH III. Additionally, the *CYP450 305A1* gene expression was increased by imidacloprid treatment. Furthermore, we investigated the gene expression of tissue specificity in the honey bee head and found that mouth-parts have the highest gene expression. The future study will be conducted to reveal the physiological role of *CYP450 305A1* in the honey bee.

Key words: Cytochrome P450s, imidacloprid, juvenile hormone, *Apis mellifera*

Queen control on the worker reproduction in the invasive yellow crazy ant *Anoplolepis gracilipes* (Hymenoptera: Formicidae)

Ching-Chen Lee¹, Chung-Chi Lin¹, Chin-Cheng Scotty Yang²

¹ Department of Biology, National Changhua University of Education

² Research Institute for Sustainable Humanosphere, Kyoto University

Background/Question/Methods

Our previous studies showed that physogastric workers in yellow crazy ant *Anoplolepis gracilipes* produce trophic eggs that constitute a major dietary regime for larvae. To test if demand of trophic egg serves as a predominant factor triggering ovary development of workers, we compared level of ovary development and proportion of physogastric workers between queenright and queenless colony fragments. We then hypothesized both parameters are significantly higher in queenright colonies where demand of trophic eggs is higher due to the production of larvae.

Results/Conclusions

Our results contradict our hypothesis that the proportion of physogastric workers was significantly higher in queenless fragments than in queenright fragments, and workers in the queenless fragments tend to possess more well-developed ovaries (i.e., higher number of yolky oocytes per ovariole and total number of mature oocytes). These findings suggest that development of worker ovary appears to be under queen control (e.g., queen pheromone signaling) as seen in many other ant species. We also found that virtually all queenright colonies share similar proportion of physogastric workers, suggesting only a certain ratio of physogastric workers is allowed in a colony. We conclude that despite its critical nutritional role as a trophic egg producer, excess of physogastric workers likely jeopardize colony performance as workers of such kind invest much less in non-reproductive tasks (e.g., foraging). In other words, an optimum ratio of physogastric worker therefore is required and is a product of balance between nutrition supply and colony-level productivity that is most likely controlled by queen.

Key words: *Anoplolepis gracilipes*, invasive species, physogastric workers, parental manipulation

賜諾殺感抗性穀蠹之基因表現差異

Differential gene expression in spinosad-resistant and -susceptible
*Rhyzopertha dominica*王顛鈞、陳美娥Yi-Chun Wang, Mei-Er Chen國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing
University

背景/研究問題/材料方法

穀蠹為穀倉內的害蟲，主要以殺蟲劑進行防治，但長期施用相同藥劑容易使族群產生抗性，因此需輪替使用藥劑以減緩抗性產生速率。賜諾殺是一種新興的藥劑，其對環境的汙染較低且對哺乳動物較無毒性，因此有望成為防治穀蠹的藥劑。為了能在施用賜諾殺防治前先解決產生抗性的問題，本研究即為探討穀蠹對賜諾殺的抗性，將抗性倍率提升到百倍以上後，利用 cDNA 篩檢法篩選出抗性品系或感性品系中表現量較高的基因，從被篩選出的基因中研究穀蠹對賜諾殺抗性之機制。

結果/結論/應用啟示

目前從感性品系及抗性品系篩選出的基因中，麥芽糖酶 (maltase) 基因在抗性品系中佔了 26.9%；但在感性品系中並沒有發現此基因，顯示此糖解酵素基因的高表現量可能與穀蠹產生賜諾殺抗性有關。此外，40S 核糖體蛋白質基因在感性品系及抗性品系基因內皆被發現，感性品系中佔了 33.3%；而在抗性品系中佔了 15.4%，推論是因抗性品系所產生的適應代價致使核糖體蛋白質的表現量較低而造成轉譯效率較差。未來將持續篩選表現量具差異之基因，以進一步探討穀蠹對賜諾殺產生抗性的機制。另一方面進行抗性衰退實驗，以探討穀蠹對賜諾殺之感受性與篩選出之基因的相關性。

關鍵詞 (Key words)：穀蠹 (*Rhyzopertha dominica*)、賜諾殺 (Spinosad)、抗性 (Resistance)、cDNA 篩檢法 (cDNA subtraction)、麥芽糖酶 (maltase)

南方小黑花椿象捕食蘆氏葉蟎後若蟎之功能性反應

The functional response of *Orius strigicollis* (Hemiptera: Anthocoridae) prey on deutonymph of *Tetranychus ludeni* (Acari: Tetranychidae)

鍾伊庭、段淑人

Yi-Ting Chung、Shu-Jen Tuan

國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

南方小黑花椿象 (*Orius strigicollis* (Poppius)) 為台灣田間與溫室中常見之本土捕食性天敵，其可捕食多種小型害蟲，如：葉蟎、薊馬、粉蝨等，而其捕食能力常以功能性反應 (functional response) 的形式呈現，並以此與其他同屬 (*Orius*) 天敵進行捕食能力的探討，但南方小黑花椿象在此部分並沒有資料，為補足這部分研究數據的缺口，因此進行南方小黑花椿象對蘆氏葉蟎的功能性反應試驗。此研究於 $25\pm 1^{\circ}\text{C}$ 定溫環境、相對溼度為 $70\pm 10\%$ 及光週期 12:12 (L:D) h 之生長箱內，並以花豆 (*Phaseolus coccineus*) 葉飼養蘆氏葉蟎 (*Tetranychus ludeni* Zacher)，以定面積 (4.9 cm^2) 葉片上飼養不同密度之蘆氏葉蟎至後若蟎，再供予南方小黑花椿象雌、雄成蟲捕食，記錄其 24 小時捕食率。

結果/結論/應用啟示

南方小黑花椿象的雌性與雄性成蟲對蘆氏葉蟎後若蟎皆呈現第二型 (type II) 的功能性反應，即二者捕食率皆隨獵物密度上升而以減少的速率增加，雌成蟲與雄成蟲的攻擊速率 (attack rate, a) 分別為 1.794 h^{-1} 與 0.820 h^{-1} ，處理時間 (handling time, T_h) 則分別為 0.159 h 與 0.333 h，呈現南方小黑花椿象雌成蟲的攻擊速率與處理時間皆優於雄成蟲。上述資料提供南方小黑花椿象在 25°C 環境下的功能性反應，再結合其族群特性與捕食量，可為將來溫室或田間試驗時，提供生物防治措施執行之基礎資料。

關鍵詞 (Key words): 南花小黑花椿象 (*Orius strigicollis*)、蘆氏葉蟎 (*Tetranychus ludeni*)、功能性反應 (functional response)、捕食率 (predation rate)

盧氏葉蟎之親代性比率對其子代之影響

Effect of parent's sex ratio of *Tetranychus ludeni* (Acari: Tetranychidae)
on its offspring

潘光琦、段淑人

Kuang-Chi Pan, Shu-Jen Tuan國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing
University

背景/研究問題/材料方法

葉蟎科 (Tetranychidae) 物種具有孤雌產雄 (arrhenotokous parthenogenesis) 以及兩性生殖 (bisexual reproduction) 之繁殖模式，其受精卵發育為雌性個體，而未受精卵發育為雄性。而交尾情形、雌蟎生理狀態、以及環境因子皆會影響葉蟎子代之性比率。本實驗設計親代雌雄比不同之四個群體 (8:0、6:2、4:4 與 2:6)，以群體兩性生命表程式分析探討盧氏葉蟎成蟎性別比例不同時，對其繁殖能力、子代性比率是否造成影響。

結果/結論/應用啟示

藉由記錄雌雄比不同之群體兩性生命表，發現當族群中存在雌雄二性狀態下 (雌雄比 6:2、4:4、2:6)，盧氏葉蟎之子代性比受雌蟎日齡影響，年輕雌蟎所產之子代以雌蟎為主，隨日齡增加、老齡雌蟎之子代則以雄蟎為主，此性比之轉變約以 13-15 日齡為界線，各組間皆呈現相同趨勢。在本實驗中，群體之性別比對子代性別比並無顯著影響，認為 6:2 之雌雄比足以使所有雌蟎在羽化後短時間內即完成交尾。此外，在兩性生殖狀態下，盧氏葉蟎之性比對其壽命、產卵期並無顯著影響，但當族群由處女雌蟎組成，產卵期早期其產卵量為四組中最低，但其產卵期較各組為長。我們進一步進行重複交尾試驗，測試 3 日齡雄蟎與過去曾經交尾之 13 日齡雌蟎之間之交尾行為，發現即使雄蟎數量高達 40 隻，在 15 組重複數中皆未觀察到成功交尾行為發生。推斷由於雌蟎僅第一次成功之交尾之精子可有效使卵受精，雌雄蟎之間避免進行重複交尾行為。

關鍵詞 (Key words)：盧氏葉蟎 (*Tetranychus ludeni*)、性比率 (sex ratio)、性分配 (sex allocation)、兩性生命表 (two-sex life table)

臺灣設施栽培作物蜜蜂授粉效益

Pollination effectiveness of greenhouse cultivation by honeybee in
Taiwan

徐培修、盧美君

Pei-Shou Hsu, Mei-Chun Lu

行政院農業委員會苗栗區農業改良場 Miaoli District Agricultural Research and
Extension Station, Council of Agriculture, Executive Yuan

背景/研究問題/材料方法

設施栽培缺乏授粉媒介，為取代勞力及節省成本，本研究調查蜜蜂(*Apis mellifera*)授粉應用於設施栽培之效益，目標作物為高經濟價值的大果番茄、草莓及苦瓜。實驗植株定植於膠膜溫室內，蕾期時將授粉蜂群搬入，處理分為：(1)自然著果：花苞套袋至結果(2)人工授粉：花苞套袋，待花期時人工授粉，再套袋至結果(3)藥劑施用(僅大果番茄)：花苞套袋，待花期時使用著果劑噴施花朵，再套袋至結果(4)蜜蜂授粉：不作額外處理。調查著果率、畸果率、果實品質(果重、果長、果寬、長寬比及種子數)及風味(糖度、酸度及糖酸比)。

結果/結論/應用啟示

大果番茄應用蜜蜂授粉著果率92%與施用藥劑89%無顯著差異，顯著高於人工授粉43%及自然著果8%，而果實品質及風味均無顯著差異。草莓應用蜜蜂授粉著果率100%，顯著高於人工授粉75%及自然著果59%。蜜蜂授粉畸果率0%，顯著低於人工授粉40%及自然著果81%。果實品質具顯著差異，蜜蜂授粉高於人工授粉及自然著果，果實風味無顯著差異。苦瓜應用蜜蜂授粉著果率87%與人工授粉87%無顯著差異，顯著高於自然著果0%。果實品質具顯著差異，蜜蜂授粉高於人工授粉。總結蜜蜂授粉適合設施栽培，可提升果實產量及果實品質。

關鍵詞 (Key words)：蜜蜂(Honeybee)、授粉(Pollination)、設施栽培(Greenhouse cultivation)

熱帶火蟻體型對種子搬運效率的影響

Effects of worker size on the harvesting efficiency of the tropical fire ants

王奕傑¹、陳璋臨¹、邱名鍾^{1,2}、賴麗娟¹Yi-Chieh Wang¹, Zang-Lin Chen¹, Ming-Chung Chiu^{1,2}, Li-Chuan Lai¹¹ 靜宜大學生態人文學系 Department of Ecological Humanities, Providence University² 國立嘉義大學生物資源學系 Department of Biological Resources, National Chiayi University

背景/研究問題/材料方法

熱帶火蟻 (*Solenopsis geminata*) 工蟻的體型在過去被認為是連續多態型，我們取樣的結果卻發現熱帶火蟻工蟻存在兩個獨立的體型分布。獨立的體型分布暗示功能的分化，雖然最早的研究認為火蟻體型與功能間沒有顯著的關連，但遭到隨後研究報導的質疑，認為在面對不同大小的種子時，體型大的工蟻傾向搬運較大顆的種子。本實驗設計螞蟻覓食區與10 cm 通道，藉此比較不同體型工蟻搬運種子的速度差異，並進一步探討體型對種子搬運效率的影響。

結果/結論/應用啟示

在兩個獨立的體型分布中，體型大的工蟻搬運大型種子 (2.19 mg) 時具有較佳的速度，然而這個優勢隨著種子的重量降低而下降。當種子重量降至約 0.18 mg 時，體型大和小的工蟻在搬運速度上沒有統計的差異，而0.18 mg正是野外熱帶火蟻巢內儲存的許多種子中最普遍的重量。兩型工蟻的出現有利於處理更多樣的種子，然而野外可利用的種子偏小，體型大的工蟻對搬運效率的貢獻便相對較低，且可能無法彌補體型帶來的能量消耗。熱帶火蟻多棲息在高度干擾的環境，該棲地主要由草本植物組成，而草本植物的種子普遍偏小，我們測量蟻巢內工蟻體型，發現體型偏小的工蟻在巢內佔的比例較高，推測應能有效搬運環境中的小型種子，然而仍然必須釐清體型偏大的工蟻在蟻巢中是否還有其他的功能。

關鍵詞 (Key words)：熱帶火蟻 (*Solenopsis geminata*)、體型 (body size)、多態型 (polymorphism)、分工 (division of labor)

熱帶火蟻工蟻的體型二型性

Size dimorphism in the tropical fire ant workers (*Solenopsis geminata*)陳璋臨¹、王奕傑¹、邱名鍾^{1,2}、賴麗娟¹Zhang-Lin Chen¹; Yi-Chieh Wang¹; Ming-Chung Chiu^{1,2}; Li-Chuan Lai¹¹ 靜宜大學生態人文學系 Department of Ecological Humanities, Providence University² 國立嘉義大學生物資源學系 Department of Biological Resources, National Chiayi University

背景/研究問題/材料方法

生物形態的變異時常伴隨著功能的分化，這些形態變異也往往成為社會性昆蟲階級分化的指標。熱帶火蟻 (*Solenopsis geminata*) 工蟻因頭部形態的差異，被認為是多態型，亦有研究將其工蟻體型分成小型工蟻 (minor worker)、中型工蟻 (media worker) 和頭型顯著偏大的大型工蟻 (major worker)。行為研究證實中小型工蟻參與護幼、覓食等工作，大型工蟻幾乎不參與覓食，其主要工作在於打破與鉗碎種子。我們的野外調查發現，熱帶火蟻中小型工蟻族群存在體型的分化，並非以往認為的單一連續分布，也非過去研究方式的二分法。在本實驗中，我們先將頭型偏大、分工不同的大型工蟻排除，再藉由高斯混合模型 (Gaussian mixture model) 檢驗剩餘的工蟻頭寬分布，以模型的估計結果推測其中的亞族群數量，與亞族群之間的分佈界線。

結果/結論/應用啟示

在8個樣區內的28巢熱帶火蟻當中，模型的預測顯示頭寬分布均存在2個亞族群，界線落於0.924 mm。亞族群中體型較小的個體占總工蟻族群的74.36% (52.42-84.83%)，體型較大的則占25.64% (15.17-47.57%)。形態測量的結果顯示熱帶火蟻的工蟻有體型分化，然而目前的研究中並沒有明確的證據顯示工蟻有行為上的差異。未來的研究將探討體型不同的工蟻在行為上是否有差異。

關鍵詞 (Key words)：熱帶火蟻 (*Solenopsis geminata*)、多態型 (polymorphism)、體型二型性 (size dimorphism)、分工 (division of labor)、高斯混合模型 (Gaussian mixture model)

The pro-ovigenic reproduction strategy and the ovarian development of gall-inducing wasp *Anselmella miltoni* Girault (Hymenoptera: Eulophidae)

Ming-Der Lin^{1,3}, Yu-Chun Lin², Chia-Ying Liu³, Man-Miao Yang^{2,*}

¹ Department of Molecular Biology and Human Genetics, Tzu Chi University

² Department of Entomology, National Chung Hsing University

³ Institute of Medical Sciences, Tzu Chi University

Background/Question/Methods

Anselmella miltoni Girault is a newly emerged pest which infests wax apple *Syzygium samarangense* and rose apple *S. jamos*. During the flowering season, females of *A. miltoni* insert their ovipositors into the soft tissue of pistil and lay clusters of eggs onto the ovules. The surrounded tissue deformed during the fruit development which gradually covered each egg and hatched larva. The formation of galls provides food and shelter for these eulophid wasps. The adults emerge inside the gall and damage the fruit by tunneling it outside which cause economic loss. By contrast to the understanding of infestation mechanism, the cryptic life-cycle of *A. miltoni* and its reproduction strategy are poorly understood. In this report, we uncovered the ovarian structure of *A. miltoni* and explored the pro-ovigenic nature of its ovarian development. Moreover, the ovarian structure of another gall-inducing eulophid wasp *Quadrastichus erythrinae* Kim, a notorious invasive pest, was conducted as a comparison.

Results/Conclusions

The newly emerged female of *A. miltoni* has three pairs of ovaries within which only mature eggs could be found. The mature egg is dumbbell-shaped with a long peduncle in the middle. As no developing follicle with nurse cells could be identified in newly emerged females, the ovarian development of *A. miltoni* is categorized as pro-ovigenic type which the females have all their eggs mature at the onset of adult life. From the ovaries of white pupae, the polytrophic meroistic ovarioles containing developing follicles could be identified. The ovarian structure of *A. miltoni* is distinct from that of *Q. erythrinae* which possesses a pair of ovaries with both mature eggs and developing follicles. In the lab, *A. miltoni* do not feed and had a short life-span. In contrast, *Q. erythrinae* feeds on the nectar of coral trees in the wild and has longer life-span when reared with honey water than simply feeding water. Therefore, the pro-ovigenic reproduction strategy of *A. miltoni* in contrast to the synovigenic type of *Q. erythrinae* could be sufficiently explained in correspondence to their life cycle and environmental fluctuations.

Key words: pro-ovigeny, synovigeny, reproduction strategy, gall-inducing eulophid wasp

東方果實蠅抗菌蛋白基因之選殖與表現

Cloning and expression of the antimicrobial peptide gene in oriental fly,
Bactrocera dorsalis (Hendel)

李彥儒、李雅倩、路光暉

Yen-Ju Lee, Ya-Chein Lee, and Kuang-Hui Lu

國立中興大學昆蟲學系

Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

隨著抗生素被廣泛使用，對抗生素產生抗性的菌株也越來越多，因此目前急需代替抗生素的新藥。而抗微生物肽 (Antimicrobial peptides, AMPs) 於真核生物體內，扮演著第一道防線的角色，且微生物肽對微生物具有廣泛的抑菌性、免疫調節及無抗藥性的優點。先前觀察到東方果實蠅 (*Bactrocera dorsalis* (Hendel)) 所產卵的果肉不易受微生物感染，進而分析卵上是否帶有抑菌AMP進行探討。

結果/結論/應用啟示

將卵上的物質洗下後，已確認此收集液具抑菌效果；且藉由聚丙烯醯胺凝膠電泳法 (SDS-PAGE)，在3 kDa附近的位置確實可觀察到一明顯的蛋白質條帶，經質譜定序分析的結果顯示此抗菌肽可能源自於sarcocystatin-like protein的降解。以此蛋白質序列為基礎，自東方果實蠅的RNA樣本進行反轉錄聚合酶連鎖反應增幅得到450 bp的片段，再利用cDNA快速放大法向序列兩端延伸，選殖出全長571 bp的cDNA序列 (命名為*Bdcys-A*)，可轉譯出124個胺基酸。而在*Bdcys-A*序列內發現同時具有數個疑似可被胰蛋白酶切割的位點，推論可切割產生抗菌肽。*Bdcys-A*在東方果實蠅各發育時期皆持續表現；且無論雌、雄成蟲，在腹部的表現量皆較頭部及胸部為高。另外利用大腸桿菌 (*Escherichia coli*) 的蛋白質表現系統，構築表達*Bdcys-A*的載體用以生產並純化該抗菌蛋白，進而驗證胰蛋白酶切割之論點及進行抑菌活性分析。後續，將使用蛋白酶切割後產生的抗菌肽，以及合成的抗菌肽，對不同菌株進行抑菌效果測試，希望對於日後抗菌肽的發展有所幫助。

關鍵詞 (Key words)：東方果實蠅 (*Bactrocera dorsalis* (Hendel))，抗菌肽 (antimicrobial peptides)

生物多樣性、族群與群聚生態
學論文宣讀摘要集

Oral Session:
**Biodiversity, population and
community Ecology**

三種石蠶蛾面對洪水之反應

Response of three species of caddisfly larvae (Trichoptera) faced to flood

謝宗澤、崔宇辰、丘明智、郭美華

Tsung-Tse Hsieh, Yu-Chen Tsui, Ming -Chih Chiu, Mei-Hwa Kuo

國立中興大學昆蟲學系

Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

氣候變遷所造成之極端事件近年來持續增加中，本研究地位於大甲溪流域上游武陵地區，於 2005 年七月發生近 50 年來之最大極端流量衝擊。此地溪流為臺灣櫻花鉤吻鮭 (*Oncorhynchus masou formosanus*) 現存棲息地，溪流中石蠶蛾為其偏好食餌，為瞭解此極端事件對三種石蠶蛾(黑頭流石蛾 (*Rhyacophila nigrocephala*)、斑紋角石蛾 (*Stenopsyche marmorata*) 及臺灣黑管石蛾 (*Uenoa taiwanensis*))的影響，於桃山西溪、七家灣溪、高山溪及有勝溪共設 5 樣站，2003 至 2006 年 2、4、6、10 月至每站以舒伯式水網 (Surber sampler) 採樣，攜回實驗室鑑定並挑出目標物種，紀錄個體數及測量體長以計算次級生產量。

結果/結論/應用啟示

三種石蠶蛾每年年初為其高峰，洪水造成數量及年次級生產量下降，臺灣黑管石蛾於 2006 年沒有採得樣本。黑頭流石蛾及斑紋角石蛾，於數量及年次級生產量分別下降 84、87% 及 88、99%。斑紋角石蛾年次級生產量為最大者，流量對其族群數量有顯著的負影響($p=0.0419$)。不同物種面對洪水衝擊時，存活率及洪水後族群回彈速率不一。未來將擴大尺度進一步探討流量對溪流生態系的衝擊，供溪流管理及保育策略所需。

關鍵詞(Key words)：黑頭流石蛾 (*Rhyacophila nigrocephala*)、斑紋角石蛾 (*Stenopsyche marmorata*)、臺灣黑管石蛾(*Uenoa taiwanensis*)、次級生產量 (Secondary production)、洪水(Flood)

Direct and indirect effects of elevated temperature and CO₂ on herbivore performance across altitudes

Chi-Ming Liu, Shao-Kuan Yan and Chuan-Kai Ho

劉騏銘、顏韶寬、何傳愷

Institute of Ecology and Evolutionary Biology, National Taiwan University

Background/Question/Methods

Temperature and CO₂ concentration in atmosphere are predicted to keep rising during this century. Therefore, it becomes increasingly important to understand 1) whether the elevated temperature and CO₂ will influence species performance (e.g., herbivore growth and development) directly, or indirectly via their effects on interactive species (e.g., herbivores' host plants), and 2) whether these effects will vary spatially (e.g., populations across altitudes might react differently due to their acclimation history). To answer the aforementioned questions, we studied the performance of *Pieris canidia* (herbivore) on *Rorippa indica* (host plant) by conducting four experiments: (direct vs. indirect effects) x (low vs. medium altitudes). Each experiment had a 3x2 factorial design including daily fluctuating temperature treatment (21.8, 24.8, 27.8°C on average, representing ambient, +3°C, +6°C, respectively) and CO₂ (500, 1000 ppm) treatment, allowing us to examine the individual and collective effects of temperature and CO₂. In the direct effect experiment, *P. canidia* larvae were kept in one of six temperature-CO₂ treatments but fed with *Rorippa* plants from a common garden. In the indirect effect experiment, *P. canidia* larvae were kept in the ambient treatment (21.8°C on average, 500 ppm CO₂) but fed with *Rorippa* plants grown under each of six temperature-CO₂ treatments. In the low and medium altitude experiments, *P. canidia* and *Rorippa* plants were originally collected from three sites each at low (100m) and medium (1000m) altitudes, to avoid potential idiosyncrasies.

Results/Conclusions

The results showed that in direct or indirect experiments, temperature and altitude generally affected *P. canidia* performance, while CO₂ concentration alone was not. However CO₂ could interact with other factors in some cases. In conclusion, our work shows that 1) elevated temperature and CO₂ can affect species performance directly and indirectly, and 2) these effects will vary spatially (e.g., altitude).

Key words: Direct & Indirect effects, Elevated temperature, Elevated carbon dioxide concentration, Altitude, *Pieris canidia*

美國東南區域之 *Geosmithia* 類真菌調查

Survey of *Geosmithia* species in the southeast United States

Yin-Tse Huang¹, Miroslav Kolarik², Matthew T. Kasson³, Jiri Hulcr¹

¹ School of Forest Resources and Conservation, University of Florida, PO Box 110410, Gainesville, Florida, 326011

² Institute of Microbiology CAS, v.v.i, Vídeňská 1083, 142 20 Prague 4, Czech Republic

³ Division of Plant and Soil Sciences, West Virginia University, Morgantown, WV, 26506, USA

Background/Question/Methods

Geosmithia (Hypocreales) is a widespread and common but little-studied genus of fungi that are mostly associated with bark-dwelling insects. The genus includes a pathogenic species, *G. morbida*, which is a contributing agent in the thousand cankers disease (TCD) of *Juglans* spp. To contribute to the understanding of the origin of the disease, we are studying three questions: (1) what is the diversity of native *Geosmithia* species in the South Eastern USA? (2) what is the specificity between the fungus, the vector beetles and the tree hosts? and (3) is *G. morbida* is invasive in the South East, or native but overlooked? To survey the *Geosmithia* species in their environment, bark beetle specimens and tree branches infested by beetles are collected. Tree species related to *Juglans* spp. and tree species prevalent in the southeast are targeted. Based on our first surveys, neither *G. morbida* or the walnut twig beetle (WTB, *Pityophthorus juglandis*) were discovered in Florida.

Results/Conclusions

Nine different *Geosmithia* spp., including five new species and three new to the North America, were recovered from eight different tree hosts. The species of *G. pallida* complex are the most frequently encountered species, followed by *Geosmithia* sp12. The absence of *G. morbida* and *P. juglandis* in this region may be a result of the rarity of their primary host tree. This study reveals that *Geosmithia* species are diverse and ubiquitous in the Southeastern United States.

Key words: North America, ectosymbiont, Hypocreales, subcortical beetles, symbiosis

Ecological and morphological divergences of a snail-feeding carabid beetle, *Carabus (Coptolabrus) nankotaizanus* Kano, 1932 (Coleoptera, Carabidae)

Lan-Wei Yeh¹, Hsin-Ping Ko², Ping-Shu Yang³, and Chung-Ping Lin⁴

¹ Department of Life Science and Center for Tropical Ecology Biodiversity, Tunghai University, Taichung, Taiwan

² Taiwan Insect Hall, Taipei, Taiwan

³ Department of Entomology, National Taiwan University, Taipei, Taiwan

⁴ Department of Life Science, National Taiwan Normal University, Taipei, Taiwan

Background/Question/Methods

The geographic variation of ecological and morphological traits of an organism reflects the underlying evolutionary processes of inter- or intra-species interaction, niche differentiation and life history of the species. This study investigated the level of morphological and ecological variation between populations of a snail-feeding carabid beetle, *Carabus (Coptolabrus) nankotaizanus* Kano, 1932 in Taiwan. We tested three hypotheses: i) The ecological traits (seasonality and active temperature), ii) morphological traits (body sizes and shapes) have diverged between mountain and lowland populations, and iii) these divergences were related to environmental factors.

Results/Conclusions

The results revealed elevational discontinuity distinguishing mountain and lowland populations. The mountain (>1,000 Meters) and lowland (between 6 and 392 meters) populations showed significant differences in seasonality, active temperature, body sizes and shapes. Mountain populations were the most active in the summer (April to October), with a lower active temperature range (11~15°C) and larger body sizes and thin and elongated body shapes. By contrast, the lowland populations were active in the winter (September to May), with a higher active temperature range (15~25°C) and smaller body sizes and thick and broader shapes. Based on our findings, we hypothesized that ecological and morphological divergences of *C. nankotaizanus* between elevational populations were due to adaptation of differentiation of high temperature in the lowlands and low temperature in the mountains.

Key words: body shape, body size, elevation, geometric morphometrics, subtropical mountain, temperature, thermo-adaptation

白蟻的建構物成分及建築策略初探

The material of termite-built structure and strategy of termite. (Blattodea: Isoptera)

陳柏曄¹、張芳志²、邱俊禕¹、李後鋒¹

Bo-Ye Chen, Fang-Zhi Chang, Chi-Yu Chen, Hou-Feng Li

¹ 國立中興大學昆蟲學系

Department of Entomology, National Chung Hsing University

² 國立台灣大學生物資源暨農學院實驗林管理處

The Experimental Forest, College of Bio-Resources and Agriculture,

National Taiwan University

背景/研究問題/材料方法

白蟻的建構物依形態可分為多孔狀 (porous structure) 及通道型 (shelter tube structure) 兩種，其可能的功能為保護白蟻群體不受環境及天敵的干擾。不同種類的白蟻可能依其食物資源及棲息環境的差異，改變建構物的成分以適應棲地，而同種白蟻亦可能以不同的材料建構不同的結構。研究白蟻建構物的成分有助於瞭解白蟻如何改變建築策略以適應棲地環境。因此，本研究初步調查台灣土白蟻 (*Odontotermes formosanus* Shiraki, 1909)、高砂象白蟻 (*Nasutitermes takasagoensis* Shiraki, 1911) 和格斯特家白蟻 (*Coptotermes gestroi* Wasmann, 1896) 的建構物及建構物周邊的木材及土壤的有機和無機物比例，藉此推測建構物材料的來源。

結果/結論/應用啟示

台灣土白蟻多孔狀結構物有機物為無機物的 7.18 ± 2.24 ($n = 5$) 倍；高砂象白蟻多孔狀建構物有機物為無機物的 23.91 倍 ($n = 1$)；格斯特家白蟻多孔狀建構物有機物為無機物的 4.87 ± 3.49 倍 ($n = 7$)，統計結果顯示物種間沒有顯著差異 (Kruskal-Wallis test: Chi-square = 3.84, $p = 0.15$)。台灣土白蟻在土壤中建造巢狀建構物，但其有機物含量顯著高於周邊土壤 ($t = 6.94, p < 0.01$)，並非就地取材。格斯特家白蟻在木材中建造巢狀建構物，有機物含量與週邊的木材相似 ($t = -1.15, p = 0.22$)。由於三種白蟻巢狀建構物的有機物含量高，推測皆是以木材或其消化後的糞便為材料。比較台灣土白蟻多孔狀及通道型建構物的有機物含量，發現巢狀建構物有機物含量顯著高於管狀建構物 ($t = 6.96, p < 0.01$)，而管狀建構物的有機物含量與周邊土壤無差異 ($t = -0.54, p = 0.32$)，顯示台灣土白蟻以不同的材料建構不同的結構。

關鍵字(Key words): 台灣土白蟻(*Odontotermes formosanus*)、高砂象白蟻(*Nasutitermes takasagoensis*)、格斯特家白蟻(*Coptotermes gestroi*)、自我組織行為(Self-organization behavior)

台灣家白蟻的重新描述與中國產之家白蟻屬同物異名問題

Redescription of *Coptotermes formosanus* (Isoptera: Rhinotermitidae)
and its synonyms in China

陳冠豫、吳佳倩、梁維仁、李後鋒

Guan-Yu Chen, Chia-Chien Wu, Wei-Ren Liang, Hou-Feng Li

國立中興大學昆蟲學系

Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

家白蟻屬 (*Coptotermes* spp.) 為世界廣布，且多數物種為重要木材害蟲，但其眾多分類問題懸而未決，主因之一是中國在 1980 年代一共發表三十餘個家白蟻屬的新物種，大部分的種類形態描述不足、缺乏與近似種的比較，且與較早發表的台灣家白蟻 (*C. formosanus*) 和東南亞的格斯特家白蟻 (*C. gestroi*) 基因差異度低，被認為是上述兩種的同物異名。然而，台灣家白蟻的形態描述亦不明確。台灣家白蟻的模式產地在台灣。素木得一於 1909 年發表台灣家白蟻時所用的標本應混雜了格斯特家白蟻，且並未指定台灣家白蟻的模式標本。2010 年李後鋒選定台灣家白蟻的新模式標本，但未有形態描述。為解決家白蟻屬的分類問題，本研究採集台灣各地的台灣家白蟻樣本、量測其形態特徵並重新描述台灣家白蟻。本研究藉由比較台灣家白蟻與中國產家白蟻屬物種的形態差異，判斷台灣家白蟻的同物異名。

結果/結論/應用啟示

本研究檢視來自台灣不同地點的台灣家白蟻群體樣本，包含 36 個有翅繁殖型個體及 34 個兵蟻個體。分別對有翅繁殖型及兵蟻量測六個形態特徵，並與上海昆蟲研究所典藏之家白蟻屬模式標本比較，發現河口家白蟻 (*C. hekouensis* Xia et He, 1986)、蘇州家白蟻 (*C. suzhouensis* Xia et He, 1986)、長泰家白蟻 (*C. changtaiensis* Xia et He, 1986) 與台灣家白蟻沒有型態上的差異，判斷為同物異名。

關鍵詞 (Key words)：台灣家白蟻 (*Coptotermes formosanus*)、同物異名 (synonymization)、白蟻多樣性 (termite diversity)、中國 (China)、無章分類 (taxonomy anarchy)

Ontogenetic antagonism–mutualism coupling: perspectives on resilience of stage-structured communities

Po-Ju Ke¹ and Takefumi Nakazawa²

¹ Department of Biology, Stanford University, California, USA,

² Department of Life Sciences, National Cheng Kung University, Tainan, Taiwan

Background/Question/Methods

Organisms typically change their diets ontogenetically. Recent studies have shown that an ontogenetic diet shift undermines the resilience of stage-structured food webs. Here, we study the integration of stage-structured food-web theory into theory of hybrid community (i.e. mixture of different interaction types), considering that not only diet but also interaction type often changes because of ontogenetic niche shift (e.g. the metamorphosis of pollinating insects, in which juveniles and adults are herbivores and pollinators, respectively). We developed and mathematically analysed a one-consumer two-resource model in which juvenile and adult consumers utilise different resources as antagonists and mutualists, respectively.

Results/Conclusions

Model analyses illustrated that the consumer either goes extinct or coexists with the resources depending on the initial condition when the resources have low carrying capacities while their community dynamics always converge to a single steady state when the resources have high carrying capacities. These dynamic features are different from those of the corresponding purely antagonistic module in previous studies, in which the consumer always goes extinct for low resource carrying capacities while the dynamics converge to either juvenile-dominated or adult-dominated state depending on the initial conditions for high resource carrying capacities. Taken together, we can suggest that ontogenetic antagonism–mutualism coupling is stabilising in that it increases the potential for species coexistence in unproductive environments while improving community resilience in productive environments. Further, these effects are generally robust to interaction nonlinearity. Beyond the previous concern of the instability in stage-structured food-webs, our results suggest that antagonism–mutualism coupling can play a crucial role in stabilising stage-structured hybrid (e.g. plant–animal) communities under environmental changes. The present study represents an important first step in understanding how interaction type diversity can mediate the dynamics of stage-structured communities.

Key words: herbivorous larvae, pollinating adults, ontogenetic niche shift, mathematical model, community dynamics

胡麻斑天牛族群動態的生物多樣性1:羽化期及體形
Biodiversity of population dynamics of *Anoplophora macularia* (Thomson) 1:
emergence stage and body size

馬堪津¹, 彭武康², 何鎧光², 徐爾烈²

Can-Jen W. Maa¹, Wu-Kang Peng², Kai-Kuang Ho², Err-Lien Hsu²

1. 中央研究院生物多樣性研究中心

Biodiversity Research Center, Academia Sinica

2. 國立臺灣大學昆蟲學系

Department of Entomology, National Taiwan University

背景/研究問題/材料方法

星天牛幼蟲有6-10齡期,羽化成蟲由少而增,由增而減如波浪般延着季節展開,呈一族群動態譜。以成蟲觸角長短界定每日雄蟲體形大小為單參數;同天羽化者為日參數;同時段羽化者為群參數;同年羽化者為季參數。集不同年度羽化者各參數相比對。就降雨及溫差及單參數相似性分群;以EXCEL列表;以PRIMER 5作分析,歸納出天牛成長的有效年積溫區;探討族族分層發生年代的增溫及日暑節律變動溫度對天牛羽化期的延展及體形大小族群動態因子的影響。

結果/結論/應用致示

天牛生長有效溫區界於13-29°C;年有效積溫對天牛生態極為重要。引起族群層化的氣溫應在29°C以上;羽化季中90%成蟲分別出現在25到90天之間;羽化峯一到八九個;雄蟲角長:5.46cm到6.12cm,因年而異。由16個成蟲羽化季動態圖譜顯示:族群動態因子因季節而異動。會因為增溫及日暑而反應出現:1.羽化峯的頻率,振幅,谷峯距間,以致於整個羽化季在時序上的位移;2.成蟲大小個體出現的時序也會位移;3.羽化季雄蟲總參數的差異等諸族群動態因子也因逐年度的氣溫非律動變動溫度導致族群層化的發生。推論增溫及暑熱對天牛生理的衝擊有決定的影響。

關鍵詞 (Key word): 胡麻斑天牛 *Anoplophora macularia* (Thomson), 族群動態 (population dynamics), 多樣性 (biodiversity), 羽化期 (Emergence stage), 體形 (body size).

胡麻斑天牛族群動態生物多樣性(2):翅鞘斑及性比率

Biodiversity of population dynamics of *Anoplophora macularia* (2)
maculate pattern and sex ratio

馬堪津¹, 徐爾烈², 何鎧光², 彭武康²

Can-Jen W. Maa¹, Kai-Kuang Ho², Err-Lien Hsu², Wu-Kang Peng²

1. 中央研究院, 生物多樣性研究中心

Biodiversity Research Center, Academia Sinica

2. 國立臺灣大學, 昆蟲學系

Department of Entomology, National Taiwan University

背景/研究問題/材料方法

臺北淡水河紅樹林胡麻斑天牛的雌雄性比率依例雄少於雌1.0:1.5. 2010年持續的增溫使2014年雄雌比近乎持平:1.0:1.1. 同此成蟲翅鞘斑型的變異,也自2012年明顯. 就集不同年度羽化者各參數相比對. 參斟降雨及溫差及單參數相似性分群; 以EXCEL列表; 以PRIMER 5作分析, 歸納出天牛成蟲性比率及翅鞘斑變異可能發生異常的因素及相關性, 來評詁環境壓力影响到生物族群的盛衰或存滅. 天牛週邊的其他昆蟲也予觀察.

結果/結論/應用致示

胡麻斑天牛的雌雄性比率今年破例雄多於雌 1.00:0.93: 相差去年, 少了百分之40. 斑型的全黑化也倍於去年, 顯示了斑型的異化與性比率的翻轉有所關聯, 是生物對極端環境壓力所呈現的反應. 考其原因推論如后: 1. 因為不明的原因導致羽化的成蟲有各種附節殘缺的現象, 觸角最常見足及翅其次之. 2. 往年羽化期末, 僅有雌蟲出現, 而雄蟲早亡, 今年則反行其道. 3. 翅鞘黑化加劇, 唯其黑化的群參數已不在羽化期末. 4. 多年來, 與天牛為鄰的荔枝椿象大量減少; 盾背椿象今年絕踪, 顯示了長期的增溫 (Climatic warming) 對棲群分化 (population stratification) 的影响甚於日暑.

關鍵詞 (Key words): 胡麻斑天牛 (*Anoplophora macularia* (Thomson)), 族群動態 (population dynamics), 翅鞘斑型 (maculation pattern), 性比率 (sex ratio), 棲群分化 (population stratification)

Diversity pattern of phytophagous insects associated with the forests of
Taiwan Beech

Yu-Feng Hsu

Department of Life Sciences, National Taiwan Normal University

Background/Question/Methods

The forests of Taiwan Beech are considered one of the “relict” forests in Taiwan as beech trees have a northern distribution in North Hemisphere, with Taiwan being the southern limit. They have been a focus on conservation concern due to the current trend of global warming. A survey for establishment of the inventory and diversity of phytophagous insects associated with Taiwan Beech have been conducted over the past few years, with special reference to lepidopterous insects.

Results/Conclusions

Surprisingly more than 100 species of phytophagous insects have been found associated with Taiwan over past seven years. Approximately one third of species found are specialists, with a few undescribed species. The number of species shows clear area-species effect, with large-sized specialists only found in larger patches of the Taiwan Beech forests. Thus fragmentation of large forest patch due to climate change, notably rise in temperature, may threaten the survival of these species. A few general feeders were also found on Taiwan Beech, and they sometimes consume considerable amount of foliage. The rising temperature seems to favor the increase of these general feeders as they tend to be multivoltine species.

Key words: *Fagus hayatae*, Lepidoptera, species richness, inventory, conservation

有機耕作及農地地景對臺灣苗栗地區水稻田節肢動物多樣性之影響

The effect of organic practices and agricultural landscapes on arthropod diversity in rice fields in Miaoli, Taiwan

黃寄綸¹、陳泓如²、黃千育¹、羅英元³、蔡志偉¹

Chi-Lun Huang¹, Hung-Ju Chen², Chien-Yu Huang¹, Ying-Yuan Lo³, Chi-Wei Tsai¹

¹國立臺灣大學昆蟲學系 Department of Entomology, National Taiwan University

²行政院農業委員會苗栗區農業改良場 Miaoli District Agricultural Research and Extension Station, Council of Agriculture, Executive Yuan

³行政院農業委員會特有生物研究保育中心 Endemic Species Research Institute, Council of Agriculture, Executive Yuan

背景/研究問題/材料方法

近年有機農法日益受到重視，有機操作與生物多樣性的關聯性已有許多研究。依據往昔研究，使用化學肥料及農藥的慣行農法在生物多樣性上較有機農法來得低。且除施肥、噴藥等耕作措施外，農地地景亦會影響生物多樣性。本研究於苗栗選定三個試驗區(里山、里地、里海)，各有一塊有機與慣行田。自水稻成活期開始，每兩週以掃網方式採集稻株上昆蟲與蜘蛛。本研究的目的是比較兩種農法和三種農地地景之水稻田節肢動物功能群比率與多樣性。

結果/結論/應用啟示

我們於2017年第一期稻作共進行7次採樣，總樣本數為2,726隻，共計昆蟲10目56科74屬83種、蜘蛛8科9屬13種。天敵比率部分，各試驗區有機田均大於慣行田，里山及里地地區有機和慣行田之天敵比率具顯著差異。以農地地景區分，里山、里地和里海地區天敵比率無顯著差異。以Shannon-Weiner's, Simpson's, Pielous's indexes 檢測生物多樣性，三項指數和各試驗田之天敵比率呈高度相關；里山、里地、里海地區三項指數檢測結果和有機、慣行田結果亦呈高度相關。差異性檢測部分，有機與慣行田和里山、里地、里海地區試驗田以此三種指數檢驗之結果均未具顯著差異。希望藉由長期調查分析結果來釐清耕作措施及地景特徵與生物多樣性之間的關聯性，並作為農田管理與蟲害防治策略選擇上的一項參考依據。

關鍵詞 (Key words): 有機農法(organic farming)、慣行農法(conventional farming)、昆蟲(insects)、蜘蛛(spiders)、生物多樣性(biodiversity)

東沙島之昆蟲相調查及島上訪花昆蟲行為之初探

The insect fauna of Dongsha Island and preliminary study of flower insect visitors

廖一璋¹、江東權¹、劉哲元¹、董景生²、楊曼妙¹

Yi-Chang Liao, Tung-Chyuan Chiang, Che-Yuan Liu, Man-Miao Yang

¹ 國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing University

² 林業試驗所植物園組 Botanical Garden Division, Taiwan Forestry Research Institute

背景/研究問題/材料方法

東沙島是東沙環礁唯一露出海平面之珊瑚礁島嶼，長期以來東沙生態研究以海洋資源及鳥類為主，陸域昆蟲資源相對缺乏。本團隊過去於2008年及2012年在東沙島上進行系統性的昆蟲相調查，主要以定置式馬氏網進行樣本蒐集，並輔以掉落式陷阱、掃網及目視手採等方式進行採樣工作。今年執行第三度調查，主要仍以長期架設之馬氏網為主要採樣方式並輔以其他方法，昆蟲樣本鑑定至形態種並給予編號，同時於今年度嘗試以縮時攝影機記錄島上訪花昆蟲之日週行為，所選擇植物以島上優勢及特色植物為主，期望能更全面瞭解島上昆蟲相以及昆蟲與植物之交互作用。

結果/結論/應用啟示

昆蟲相部分從2008年至今共登島15次，樣本累計個體數已達10萬隻，包含18目160科724形態種，已鑑定至種級共141種，優勢類群分別為膜翅目、半翅目及雙翅目昆蟲，不同年度之調查除了持續發現新紀錄形態種，也有物種就此消失，顯示島上仍持續發生物種拓殖及滅絕事件，藉由昆蟲相的瞭解可推測昆蟲登島的遷移途徑。攝影機已記錄到11種島上開花植物之昆蟲訪花行為，初步結果顯示小蘆蜂(*Braunsapis* spp.)及熱帶大頭家蟻(*Pheidole megacephala*)為島上主要的日間訪花昆蟲，至於夜間開花植物的授粉昆蟲為何，值得進一步追蹤。

關鍵詞 (Key words)：多樣性(Diversity)、環礁(Atoll)、物候學(Phenology)、形態種(Morphospecies)

白斑蛾蚋幼蟲飼育密度對其族群增長表現效果探討

Effect of larval rearing density on population increasing rate of *Clogmia albipunctata* (Diptera: Psychodidae)

鍾閔旭、段淑人

Ming-Hsu Chung, Shu-Jen Tuan

國立中興大學昆蟲系 Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

白斑蛾蚋 (*Clogmia albipunctata*) 為雙翅目 (Diptera) 蛾蚋科 (Psychodidae) 之昆蟲，常於室內衛浴設施及室外下水道、汙水槽等環境中群聚生長。目前有關於此環境衛生害蟲之研究資料多以分類及地理分布調查為主，故在此以兩性生命表進行幼蟲飼育密度對蛾蚋族群增長速率之影響評估。實驗於固定溫度 $25\pm 1^\circ\text{C}$ 及濕度 $70\pm 10\%$ RH 之生長箱環境內，進行不同幼蟲密度 (1、10、50、100 1st larva/9cm²，各組進行三重複) 飼育之個體及群體生命表試驗。以酵母粉發酵菌膜餵養幼蟲，每日觀察並記錄其存活數、發育齡期及成蟲壽命與產卵量，並以 TwoSex MSChart 分析與評估其族群生長表現。

結果/結論/應用啟示

由結果可發現：於低密度 (1、10 larva/9cm²) 狀況下，白斑蛾蚋幼蟲會產生滯育現象，約 10%~20% 之二、三齡幼蟲無法發育至下一齡期，而於較高密度 (50、100 larva/9cm²) 狀況下，幼蟲則未發生滯育；經比較發現白斑蛾蚋之淨增值率 (R_0 ，由 77.4 降至 22.5)、內在增值率 (r ，由 0.2049 降至 0.1142 d⁻¹)、終極增長率 (λ ，由 1.2310 降至 1.1210 d⁻¹) 皆隨族群密度上升而下降，平均世代時間 (T ，由 20.73 升至 27.26 d) 則隨密度上升而增加，由此結果可推得其生長表現確實受到幼蟲群聚密度所影響，亦即在高密度下，其幼蟲族群間可能具競爭作用及自殘行為影響其族群生長表現。此結果可以作為研究昆蟲族群表現多樣性之一環，以供未來昆蟲生態研究之基礎資料使用。

關鍵詞(Key Words)：白斑蛾蚋(*Clogmia albipunctata*)、兩性生命表(two-sex life table)、溫度(temperature)、幼蟲密度(larval density)

陽明山國家公園不同棲地之螞蟻群聚結構研究

The research of the ant community structure in different habitats in
Yangmingshan National Park

許峰銓、林宗岐

Feng-Chuan Hsu¹, Chung-Chi Lin²

國立台灣大學生態學與演化生物學研究所 Institute of Ecology and Evolutionary
Biology, National Taiwan University

國立彰化師範大學生物學系 Department of Biology, National Changhua University
of Education

背景/研究問題/材料方法

陽明山地區長期缺少蟻科的完整調查報告，物種名錄等生物多樣性相關資料付之闕如，本研究於陽明山國家公園的二子坪遊憩區、擎天崗特別景觀區、磺嘴山生態保護區以及鹿角坑生態保護區等四個區域進行螞蟻相調查，每個區域選擇兩種棲地類型，分別設置3個調查樣區，共設置24個樣區。使用3種調查方法，分別為落葉袋採集法、地面掉落式陷阱以及樹幹環形掉落式陷阱，於春、夏、秋、冬等4季各進行1次採集，以了解陽明山地區不同環境之螞蟻群聚結構。

結果/結論/應用啟示

本研究自2016年7月至2017年4月調查期間，共採獲7亞科、32屬、71種螞蟻，其中並未記錄到外來入侵種螞蟻。物種豐富度最高的區域為鹿角坑生態保護區 (43種)，最低的為二子坪遊憩區 (33種)。由於氣候及物理因子的差異，使得不同棲地類型具有不同的螞蟻群聚結構。整體而言，草原棲地之間的螞蟻群聚結構較為相似，而森林環境之間的螞蟻群聚結構歧異度較大。本研究除了提供初步的陽明山國家公園螞蟻物種多樣性資料以外，透過比較不同棲地的螞蟻群聚結構，更揭示了不同地景及棲地保育的重要性。

關鍵詞 (Key words)：落葉袋採集法 (Winkler bag method)、地面掉落式陷阱 (ground pitfall traps)、樹幹環形掉落式陷阱 (circle trunk pitfall traps)、蟻科 (Formicidae)、指標生物 (bioindicator)。

台灣瘿蚧蟲瘿之豐度及組成

Richness and composition of midge galls in Taiwan

林聖豐、楊曼妙

Sheng-Feng LIN, Man-Miao YANG

國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

雙翅目瘿蚧科目前全世界已記錄6,590種分屬7亞科812屬，生態特性變化大，食性包含菌食、肉食、植食等，其中以產卵行為或取食刺激植物細胞並使之形成蟲瘿最受矚目，故稱瘿蚧。造瘿瘿蚧為造瘿昆蟲類群中物種數量最多的一群，其對寄主植物及蟲瘿形態具高度專一性，因此在瘿蚧各時期標本難以同時取得的狀況下，常依蟲瘿及寄主資訊判定形態種，做為評估該地區瘿蚧多樣性之指標。本研究彙整自1996年至2017年的瘿蚧蟲瘿採樣紀錄，進行分析並探討其多樣性成因。

結果/結論/應用啟示

結果顯示於42個植物科群記錄到214瘿蚧蟲瘿形態種，最優勢產瘿植物類群為樟科植物，共計67種，次為殼斗科及菊科各為14種，此三植物科之蟲瘿數量共計95種佔全部瘿蚧蟲瘿的44.4%，其餘119蟲瘿形態種分散於39個植物科，每個植物科所包含的蟲瘿類型數均不高於10。以寄主專一性而言，進一步檢視優勢產瘿植物之造瘿類群，反映部分瘿蚧類群在此三植物科群有較高的物種豐度。另由造瘿部位分析顯示，台灣瘿蚧蟲瘿形態種有103種(48%)發現於葉片、51種(23.8%)發現於莖部、21種(9.8%)發現於芽、21種(9.8%)發現於果實、11種(5.1%)發現於葉柄、僅7種(3.3%)發現於花。反映葉片組織提供台灣產造瘿瘿蚧在拓殖時有較高優勢之可能。

關鍵詞 (Key words)：瘿蚧科(Cecidomyiidae)、蟲瘿(Insect gall)、多樣性(Diversity) 分化(divergence)、拓殖(Colonization)

溫度對粉斑螟蛾發育繁殖之影響

Effect of temperature on the development and reproduction of *Cadra cautella* (Lepidoptera: Pyralidae)

林亞穎、段淑人

Ya-Ying Lin, Shu-Jen Tuan

國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing University

粉斑螟蛾(*Cadra cautella* (Walker))可為害多種穀物、加工水果乾及椰棗等，係熱帶及亞熱帶地區重要的倉貯害蟲。在台灣貯存進口糙米之糧倉中，均有此蟲為害的情形發生。由於倉庫貯存溫度可影響此害蟲棲群密度消長情形，在全球日益暖化的趨勢下，要預防因升溫而致使害蟲為害率上升、引發糧食短缺的窘境，必須掌握該害蟲棲群增長速率，予以適時地防治。本實驗係以兩性生命表理論研究粉斑螟蛾於不同溫度下(15~35°C)取食糙米之群體生命表，並利用 TwoSex MSChart、Timing MSChart 程式(Chi 2017)分析探討倉貯溫度對其族群增長表現之影響。

實驗結果顯示粉斑螟蛾於 20、25、30°C 時，其平均總發育日數隨著溫度升高而縮短，30°C 下具有最高的內在增殖率(r)為 0.1401 d^{-1} 、族群增長倍數(λ)為 1.1504 d^{-1} 及淨增殖率(R_0)為 144.1 offspring。最長的平均世代時間(T)發生在 20°C 下(72.9 d)，且可發現將近 20% 之供試蟲體具有明顯的生長滯育現象，然而，在 25°C 和 30°C 時僅有 1.3% 及 2% 發生生長滯育，35°C 則未發現滯育現象。於 15°C 下，粉斑螟蛾卵雖可孵化，但幼蟲皆無法發育至下個齡期。而在 35°C 時，此蟲存活率及繁殖率極低，表示 15°C 低溫和 35°C 高溫均不利於粉斑螟蛾生長。尤其 15°C 的研究數據，將可做為國內冷藏倉庫的低溫條件的設定參考值，以抑制粉螟蛾大發生的頻度。本研究結果尚可進一步模擬其在穀倉之族群增長模式，並透過與農業試驗所應用動物組實務監測資料整合比對，更深入精準地了解溫度對其族群動態之影響，以提供防治此蟲時機之參考。

關鍵詞(Key words)：粉斑螟蛾 (*Cadra cautella* (Walker))、兩性生命表 (Two-Sex life table)、倉貯害蟲 (Stored-product pest)、族群增長預測 (Population projection)

台灣直翅目昆蟲海拔分布特性

The elevational distribution of Orthopteran insects (Insecta: Orthoptera)
in Taiwan

詹明澍、楊正澤

Ming-Shu Chan, Jeng-Tze Yang國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing
University

背景/研究問題/材料方法

在台灣，海拔變化大造就地形多變氣候多樣，生物群落的組成與物種的分布模式是脆弱的島嶼生物多樣性，因應氣候變遷之重要議題。本研究沿著台灣中部橫貫公路，設計系統性調查直翅目昆蟲相海拔分布特性。在 18 個不同海拔之樣區中，2015 年 2 月起至 2016 年 7 月，設定每兩個月採集調查一次，使用生物多樣性監測的定量掃網採集方法。希望能使用系統性調查的結果，重新定義直翅目昆蟲於台灣海拔高度分佈之變異範圍。

結果/結論/應用啟示

結果共採到 2054 個標本，依外形分類為 238 個形態種，鑑定結果共有 7 科。個體數而言，最大的類群為蝗科，共採集到 1067 隻標本(佔 55.3%)，其次為蟋蟀科 345 隻標本(佔 17.9%)。形態種而言，也是以蝗科(佔 29.8%)最多，其次為菱蝗科(佔 29.0%)。經過不同海拔各分類群形態種歸群分析，重新定義直翅目昆蟲海拔高度分佈變異範圍，主要為低海拔((500-700), 1000, 1100m)；其次為高海拔(2000-2500m)都是以蝗亞目(Califera)為主；最後是中海拔(1500-2000m)以螽斯亞目(Ensifera)為主。棲地特性對直翅目是重要且直接的影響，調查樣區環境因子分析結果顯示，至少在低海拔地區，棲地植群(47%)及綠色指標指標值(61%)的相似性相對較高。海拔高度體型差異，以蝗科做為測量類群，海拔 2000m 以上的蝗科體型明顯小於海拔 1100m 以下的類群，不同於以往的環境直減率假說，而是高海拔與低海拔分成兩群。系統規劃採集調查的貢獻，除了分析定義各分類群海拔分布形式提供生態學基本資料；各分類群的海拔分布範圍可作為氣候暖化昆蟲海拔分布變化的界標，或以分類群的海拔分布模式作為環境變化監測的指標。

關鍵詞 (Key words)：海拔分布(Elevation distribution)、直翅目(Orthoptera)、歸群分析(Clustering analysis)

病媒、生物防治、蟲害管理
論文宣讀摘要集

Oral Session:
**Disease vector, biological
control and pest management**

Evaluation of intercrop plants for the cultural control of tomato yellow leaf curl disease

Fang-Yu Hu, De-Fen Mou and Chi-Wei Tsai

Department of Entomology, National Taiwan University, Taipei, Taiwan

Background/Question/Methods

Tomato yellow leaf curl disease is a devastating viral disease which leads to 20%-100% reduction in the yield of tomato worldwide. The disease is associated with a group of tomato yellow leaf curl viruses that belong to the genus *Begomovirus* in the family *Geminiviridae*. *Bemisia tabaci* transmits tomato yellow leaf curl viruses in a persistent-circulative mode. *Tomato yellow leaf curl Thailand virus* (TYLCTHV) is now one of the predominant viruses in Taiwan. To control plant viruses transmitted by insects in a nonpersistent mode, intercropping with appropriate barrier plants can intercept the insect vectors thus reduces the transmission efficiency of the viruses. However, there are few studies related to the cultural control of persistently transmitted plant viruses by intercropping. The objectives of this study were to select non-host plants of TYLCTHV as intercrop plants to intercept the virus-transmitting *B. tabaci* and to examine whether feeding on the non-host plants reduces the virus transmission efficiency.

Results/Conclusions

The host preferences of *B. tabaci* (TYLCTHV-infected and non-viruliferous) to five candidate plant species (cucumber, Chinese kale, okra, corn, and soybean) compared to tomato were examined. Cucumber and okra were more attractive to the non-viruliferous *B. tabaci* than tomato, whereas soybean and corn were less attractive than tomato. The TYLCTHV-infected *B. tabaci* preferred cucumber to tomato but disliked corn. Therefore, we chose cucumber, Chinese kale, and okra to examine whether feeding on these plants after the acquisition of TYLCTHV reduces the virus transmission rate. Results showed that both virus titer and vector transmission rate were not significantly different after TYLCTHV-infected *B. tabaci* fed on these plants for 6, 12, and 24 hours. For TYLCTHV transmitted by *B. tabaci* in a persistent-circulative mode, intercropping may not be an effective control strategy, but further research is needed to determine the effect of intercropping in the fields.

Key words: *Bemisia tabaci*, *Begomovirus*, tomato, intercropping, cultural control

The population distribution and vector control strategies of autochthonous
Culex pipiens molestus

Kai-Di Yu¹, Tsai-Ying Yen², Chin-Seng Chen³, Kun-Hsien Tsai^{1,4}

¹ Institute of Environmental Health, National Taiwan University,

² Institute of Epidemiology and Preventive Medicine, National Taiwan University,

³ Department of Bioscience Technology, Chang Jung Christian University,

⁴ Department of Public Health, National Taiwan University

Background/Question/Methods

Culex pipiens molestus, an invasive mosquito, was first documented by Lien et al. in 1996 in subtropical Taiwan; and these nuisance mosquitoes severely affected people's daily life and even posed risks on public health concerns. However, the systematic survey of its distribution in Taiwan remained unclear. As for the control strategies, many pest control operators (PCOs) frequently used adulticides which may potentially cause resistant to these species. The use of chemical larvicides such as pyriproxyfen are been used to clean up underground septic tanks, and these methods are currently regarded as eco-friendly to the environment. Recently, a product named Effective Microorganisms (EM) is claimed to enhance the treatment of sewages. Thus, it is suggested that by using the EM, it could become a method to solve the mosquitoes breeding source. We aimed to investigate the ecological distribution of *Cx. p. molestus* in metropolitan cities of Taipei, and further evaluate the effectiveness of EM as a vector control strategy. In the study, the larvae or adult of *Culex* mosquitoes were collected in underground facilities in 12 administrative districts in Taipei city during October 2015 to September 2017. The samples were identified by both the morphological features and molecular analysis. Activated effective microorganism was diluted into different concentration in order to evaluate the mortality to the 3rd to 4th larva.

Results/Conclusions

The testing revealed that *Cx. p. molestus* was dominant in the underground parking lots of public buildings in all administrative districts in Taipei, indicating a takeover (12/12; 100%) by the invasive species. In total 109 investigated buildings in Taipei, 73 buildings were severely harassed by *Cx. p. molestus*. Preliminary laboratory experiments showed that by the interaction between EM and sewage water, it could increase the mortality rate on larva. However, the application in field sewage water should be further evaluated.

Key words: autochthonous, stenogamous, hypogamous, *Culex pipiens molestus*, effective microorganism

防護罩噴撒技術防治臺灣蚊蠓之成效評估

Effectiveness Evaluation of Control for
Forcipomyia (Lasiohelea) taiwana: Diptera by Using Barrier Spray

陳遠哲¹、黃基森²、楊育年³、林信安⁴

Yuan-Che Chen¹, Ji-Sen Hwang², Yu-Nien Yang³, Hsin-An Lin⁴

1 臺北市立大學地球環境暨生物資源學系研究生 Department of Earth and Life Sciences, University of Taipei, Postgraduate

2 臺北市立大學地球環境暨生物資源學系副教授 Department of Earth and Life Sciences, University of Taipei, Associate Professor

3 行政院農業委員會動植物防疫檢疫局技士 Bureau of Animal and Plant Health Inspection and Quarantine Council of Agriculture, Executive Yuan, Associate Specialist

4 則越廣告行銷有限公司經理 Tse Yueh Advertising Co., Ltd., Manager

本研究配合行政院八大部會辦理臺灣蚊蠓（俗稱小黑蚊）防治示範，由在地社區進行環境自主管理，同時選擇防護罩噴撒新技術於示範區進行客製化專業防治，達到抑制小黑蚊之終極目標。密度監測採用「人體誘集法」，在小黑蚊活動高峰時於選定的調查區以三角形三點的形式進行，同時採用三種方法進行噴藥成效評估。

研究結果得知：(1)106年6月、7月與8月於青潭、山頂、國福與快官四所學校分別進行三次防護罩噴撒，在防治期間小黑蚊密度(隻/20min)已大幅下降。防治前密度為6.7~116.7隻/20min，防治後的6月期間小黑蚊密度降至0.7~15.7隻/20min，7月密度為1.3~9.7隻/20min，8月為0.3~2.3隻/29min。(2)在青潭、國福與山頂國小進行三次噴藥(殺成蟲、幼蟲劑與除藻劑)後，小黑蚊的防治率在98.6~99.7%之間。噴藥防治組與不噴藥對照組進行比較，相關密度指數(RPI)為0.1~8.8之間。快官國小進行三次噴藥(噴撒殺幼蟲劑與除藻劑)後，小黑蚊的防治率在80.6~88.6%之間。噴藥防治組與不噴藥對照組進行比較，相關密度指數(RPI)為9.7~25.9之間。106年在四所學校進行小黑蚊防護罩噴撒法之新技術，同時採用殺成蟲、幼蟲與除藻劑的三合一策略進行防治成效顯著，可做為爾後小黑蚊輔助的防治方法。

關鍵詞 (Key words)：臺灣蚊蠓(*Forcipomyia (Lasiohelea) taiwana*)、小黑蚊 (Bloodsucking biting midges)、人體誘集法(Human bait method)、防護罩噴灑法 (Barrier Spraying)、相關密度指數(Relative Population Index, RPI)

畸翅病毒對西洋蜂幼蟲壽命路徑的影響評估
Evaluation of the influence on the longevity mechanism of deformed
wing virus-infected honey bee (*Apis mellifera*) larvae

許博雅¹、黃玉峰²、陳子翰²、邱國平²、陳裕文¹、乃育昕¹

Po-Ya Hsu, Yu-Feng Huang, Zu-Han Chen, Kuo-Ping Chiu, Yue-Wen Chen and Yu-Shin Nai

1. 生物技術與動物科學系，國立宜蘭大學

Department of Biotechnology and Animal Science, National Ilan University

2. 基因體中心，中央研究院

Genomics Research Center, Academia Sinica

背景/研究問題/材料方法

感染西洋蜂 (*Apis mellifera*) 的病毒中，以畸翅病毒 (Deformed wing virus, DWV) 最為普遍，屬於 Iflaviridae，正單股 RNA 病毒。其感染方式可由垂直及水平傳播，由於帶原 DWV 之內勤蜂仍需哺育巢內幼蟲，故可能將帶原之 DWV 傳播至幼蟲體內。本實驗藉病毒定量感染人工飼養的幼蟲方式，釐清 DWV 對幼蟲之影響，為更清楚研究 DWV 感染幼蟲後基因之調控，取對照組與感染組之 7 日齡幼蟲進行轉錄子分析。

結果/結論/應用啟示

感染組幼蟲期的死亡率於感染後第 9 天後開始上升至化蛹階段且各階段檢測蟲體內帶原病毒量均較對照組高。此外，感染後，羽化蜂后形態畸形比例亦較對照組高，推測感染後可能對蜜蜂生理、發育方面有多方面影響。進行轉錄子分析，結果顯示 DWV 感染幼蟲後共有比對到 1359 個差異表現基因 (Fold change > 2)，其中 756 個為下調 (down regulated)，603 個為上調 (up regulated) 基因。進行 KO (KEGG Orthology) 分析結果顯示，共有 687 有基因涉及 236 種不同的生理代謝途徑之調控。進一步探討壽命調控相關機制 (Longevity related mechanism)，經分析，許多差異表現基因涉及 P53 途徑以及 FOXO 途徑之調控進而影響壽命調控機制，此兩機制皆與細胞活化及凋亡有關；P53 路徑中 *sestrins* 能夠促進 DNA 修復及預防 DNA 受損；FOXO 路徑則有 *SOD2* 及 *CAT* 能去除 ROS 的活性，而 *ATG5* 則會產生自噬作用去除嚴重受損的細胞，推測幼蟲期死亡率無明顯上升之原因可能與蟲體本身此類基因表現上調有關；另外，值得注意的是 FOXO 路徑中 *artogin-1* 表現與肌肉萎縮相關，是否與造成蜜蜂畸翅有關，未來有待進一步釐清。上述關鍵基因之表現，也將進一步驗證，及深入研究探討並作為蜜蜂健康風險評估之指標。

關鍵詞(Key words)：畸翅病毒(deformed wing virus)、西洋蜂 (*Apis mellifera*)、人工幼蟲飼養 (artificial rearing of larvae)、P53 途徑 (P53 pathway)、FOXO 途徑 (FOXO pathway)

西瓜銀斑病毒的感染對南黃薊馬取食行為的影響
Effect of *Watermelon silver mottle virus* infection on the feeding behavior
of *Thrips palmi*

朱英迪、蔡志偉

Ying-Di Chu, Chi-Wei Tsai

國立臺灣大學昆蟲學系 Department of Entomology, National Taiwan University

背景/研究問題/材料方法

植物病毒多藉由具有刺吸式口器的昆蟲傳播。為了增加病毒的傳播效率，植物病毒會透過感染昆蟲直接操控或藉由改變植物生理間接影響媒介昆蟲的生活史特徵（發育速率、存活率與產卵量等）與行為。番茄斑萎病毒屬 (*Tospovirus*) 藉由薊馬經持續性增殖型 (persistent-propagative) 模式傳播，病毒會在薊馬體內感染與增殖。許多證據指出 *Tospovirus* 對薊馬的生活史特徵與取食偏好有顯著的影響。由南黃薊馬 (*Thrips palmi*) 傳播的西瓜銀斑病毒 (*Watermelon silver mottle virus*, WSMoV) 是 *Tospovirus* 的一員，前人研究證實 WSMoV 間接地影響南黃薊馬的發育速率與取食偏好。本實驗透過昆蟲刺探電位圖譜 (electrical penetration graph, EPG) 監測南黃薊馬的取食行為，比較 WSMoV 的感染對南黃薊馬取食行為直接及間接的影響。

結果/結論/應用啟示

研究結果顯示感染 WSMoV 的南黃薊馬與健康的薊馬在健康植株上的取食行為沒有差異，不論雄蟲或雌蟲，病毒皆未直接影響兩者的取食行為。此外，南黃薊馬雌蟲的取食行為間接地受到 WSMoV 的影響，健康雌蟲在接種病毒的植株上的非取食穿刺 (non-ingestion probe) 與取食穿刺 (ingestion probe) 的頻率皆顯著地少於在健康植株上取食；而雄蟲則沒有顯著差異。綜合以上結果，WSMoV 對南黃薊馬雌蟲的取食行為有顯著的間接效應，雌蟲偏好取食健康的西瓜植株。此研究以 EPG 證明植物病毒對媒介昆蟲取食行為的影響，增進對病毒、媒介昆蟲與寄主植物交互作用的了解。

關鍵詞 (Key words)：昆蟲刺探電位圖譜 (electrical penetration graph)、取食行為 (feeding behavior)、薊馬 (thrips)、番茄斑萎病毒屬 (*Tospovirus*)、持續性增殖型傳播 (persistent-propagative transmission)

台灣南地區登革熱病媒蚊之化學防治

The chemical control efficacy of the dengue vectors from Southern Taiwan

侯佳慧、曾偉倫、羅怡珮

Jia-Hui Hou, Wei-Lun Tsen, Yi-Pey Luo

嘉南藥理大學生物科技系 Department of Biotechnology, Chia-Nan University of Pharmacy and Science

背景/研究問題/材料方法

登革熱的緊急防治策略就是要進行化學防治以消滅帶毒的病媒蚊，遏止其繼續傳染。本研究評估以熱煙霧機進行26種環境衛生用藥對南部地區斑蚊的藥效評估，以玻璃筒噴灑法檢測7種環境衛生用藥對台南市南區及高雄市鹽埕區埃及斑蚊的致死效果，以殘效噴灑法檢測5種環境衛生用藥對台南市南區及高雄市鹽埕區埃及斑蚊的致死效果，並檢測17種包括自動噴霧劑、煙霧劑及燻煙劑對高雄地區埃及斑蚊和白線斑蚊的防治效果。相關資料可提供緊急防治時採行正確化學防治的參考，得有效降低病媒蚊密度。

結果/結論/應用啟示

以熱煙霧機檢測26種環境衛生用藥對南部地區斑蚊的藥效，合成除蟲菊劑對埃及斑蚊成蟲的有效防治劑量(mg/m^3)隨各地區埃及斑蚊的抗藥性程度具差異性，需調整藥劑的稀釋倍數以達有效防治效果。以玻璃筒噴灑法檢測7種環境衛生用藥，按照廠商推薦的稀釋倍數，對台南市南區及高雄市鹽埕區埃及斑蚊的致死效果都達95%以上。以殘效噴灑法檢測5種環境衛生用藥對台南市南區及高雄市鹽埕區埃及斑蚊的致死效果，高雄地區埃及斑蚊較台南地區埃及斑蚊具明顯抗藥性；噴灑在木板的殘效性較佳，在濾紙的殘效較差；百滅寧、亞滅寧殘效較陶斯松、亞特松及撲滅松佳。

關鍵詞 (Key words): 登革熱病媒蚊 (Dengue vectors)、化學防治 (chemical control)、殺蟲劑 (insecticide)

珍貴老樹之白蟻危害調查與台灣家白蟻之專一性防治

Termite infestation survey of protected old trees and species-specific control of *Coptotermes formosanus* (Isoptera: Rhinotermitidae)

賴佑宜、李後鋒

Yu-Yi Lai, Hou-Feng Li

國立中興大學昆蟲學系

Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

台灣都市地區存在許多珍貴老樹，除了具有景觀綠化的功能，許多老樹更與當地歷史或宗教信仰有關，因此受到政府及民間單位的重視。本研究調查台中市政府受保護樹木的白蟻發生率、分析樹種與危害白蟻物種的相關性以及白蟻發生率與樹木生長狀態的關係。此外，有鑑於台灣家白蟻 *Coptotermes formosanus* (Shiraki) 發生率最高，且具有蛀蝕樹幹中心的生態習性，危害嚴重時可能造成樹幹折斷，因此我們亦針對遭受台灣家白蟻為害的芒果樹進行防治試驗。

結果/結論/應用啟示

調查 196 棵台中市受保護樹木，白蟻發生率為 30.6%，鼻白蟻科 (Rhinotermitidae) 物種的發生率最高，占 18.9%；其次為白蟻科 (Termitidae, 8.7%)；而木白蟻科最低 (Kalotermitidae, 5.1%)。樹種顯著影響白蟻物種的組成 (PERMANOVA: $F = 6.661, p < 0.001$)：榕樹、樟樹、芒果樹上易發現的白蟻分別為木白蟻科、白蟻科以及鼻白蟻科。白蟻發生率和樹木生長狀態並無顯著關係，推測是由於樹木年齡皆高，生長狀態接近所致。我們在芒果樹周圍埋設地下餌站並施用白蟻餌劑，約兩個月內能使族群活動下降，且經過 9 個月的監測皆未再發現白蟻活體，顯示白蟻餌劑能完全消滅為害芒果樹的台灣家白蟻。

關鍵詞 (Key words)：台灣家白蟻 (*Coptotermes formosanus*)、白蟻餌劑 (termite bait)、白蟻防治 (termite control)、都市樹木保護 (urban tree protection)

A study on feeding preferences of monomorium ants (*Monomorium chinensis*) on boric and fipronil based gel baits.

Samantha Rose Gangai¹, Wang Yu Ming², * Leknath Kafle¹

¹ Department of Tropical Agriculture and International Cooperation, National Pingtung University of Science and Technology, Pingtung 912, Taiwan

² Department of Civil & Water Engineering, National Pingtung University of Science and Technology, Pingtung 912, Taiwan

* Corresponding author: kafle@mail.npust.edu.com

Background/Question/Methods

Current control measures for common household ants in urban and agricultural settings in general include perimeter applications of insecticides. These often result in potential problems of poisoning non-target organisms, insecticidal runoff and environmental contamination. Solid baits also tend to degrade when exposed to extreme conditions. Hence, gel baiting techniques are an alternative to provide effective ant control with reduced amount of insecticides being applied into the environment.

A series of tests were conducted on the feeding preferences of *M. chinensis* on boric and fipronil based gel baits under lab conditions. Two commercial baits; No.1 (2.5% boric) and No.2 (fipronil 0.01%) were evaluated against four new baits formulated from fructose and molasses each with two different concentrations; No.3 (5% boric) and No.4 (10% boric). The products were tested in two sets. The commercial baits (No. 1 and No. 2) were tested against the new fructose and molasses baits (No.3 and No.4). Individual tests were replicated four times using approximately 100 ant workers per test. Observations were recorded with 60 minute videos of individual tests at respective feeding stations. In the fructose tests, the ants preferred the commercial baits more than the fructose baits (fructose + boric 5% and fructose + boric 10%). In the molasses tests, bait No.4 (molasses + boric 10%) performed much higher than the commercial boric based bait (boric 2.5%) and bait No. 3 (molasses + boric 5%).

Results/Conclusions

The results revealed that *M. chinensis* preferred commercial fipronil bait and newly formulated bait No.4 (molasses + 10% boric) over commercial boric bait No.1 (2.5% boric). Based on these results, it was noted that; (1) the newly formulated bait (molasses +boric 10%) has the potential to replace the current commercial boric bait, (2) boric can be an alternative to the hazardous fipronil as the active ingredient in current ant baits.

Key words: monomorium chinensis, ant bait, insecticide

The insecticide resistance of field and insecticide-selected brown planthopper (*Nilaparvata lugens*) in Taiwan

Namsuwat Ladawan and Dai-Shu Mei

Department of Entomology, National Chung-Hsing University, Taichung, Taiwan

Background/Question/Methods

Brown planthopper (*Nilaparvata lugens*) is the most destructive insect pest on rice crops in Asian countries including China, Vietnam, Thailand, etc. *N. lugens* causes extensive damage to rice by sucking rice phloem sap and blocking phloem vessels, which stunts plant growth as with many other sucking pests. *N. lugens* is an efficient vector of plant viruses including rice ragged stunt virus and rice grassy stunt virus which can cause rice grassy stunt and ragged stunt diseases, respectively. These factors can cause severe yield reduction and significant economic losses. This insect pest had developed resistance to many insecticides, such as organophosphates and carbamates. In order to investigate the resistance of *N. lugens* to commonly used insecticide registered and approved by Taiwan agricultural chemicals and toxic substances research institute, five field populations collected from Northwestern, Southern and Eastern Taiwan, as well as chlorpyrifos-, imidacloprid- and fipronil-selected strains of *N. lugens* were used.

Results/Conclusions

The results have shown that the *N. lugens* collected from Kaoshing Meinong has the highest resistance to buprofezin (5.1 fold), pymetrozine (3.5 fold) and imidacloprid (2.5 fold). In addition, 2.6-fold resistance to flonicamid and 2.5-fold resistance to imidacloprid have been detected on *N. lugens* collected from Tainan Liouying and Taitung Luye, respectively. Among three selected strains, the imidacloprid-selected strain has developed 2.2-fold resistance to imidacloprid and 6.1-fold cross resistance to flonicamid.

These results suggest that *N. lugens* collected from Southern Taiwan might develop higher resistance to frequent used insecticides and imidacloprid-resistant *N. lugens* might develop cross-resistance to flonicamid. Therefore, the management of *N. lugens* using insecticide rotation needs to be well designed.

Keywords: *Nilaparvata lugens*, brown planthopper, insecticide resistance, neonicotinoids, buprofezin, pymetrozine, flonicamid

煙草粉蝨 B 型生物小種傳播 CCYV 技術及其保毒時間初探
A technique of *Bemisia tabaci* B biotype transmitted-*Cucurbit chlorotic yellows virus* and its persistent period

林蕙盈、黃莉欣

Hui-Ying Lin, L.H. Huang

行政院農業委員會農業藥物毒物試驗所 Taiwan Agricultural Chemicals and Toxic Substances Research Institute, COA

背景/研究問題/材料方法

瓜類褪綠黃化病毒(*Cucurbit chlorotic yellows virus*, CCYV)是由煙草粉蝨 B 型生物小種 (*Bemisia tabaci* B biotype)以半持續性方式傳播，罹病植株葉片出現褪綠、黃化甚至嚴重致白化及脆化等現象，已危害國內許多重要的瓜類經濟作物，包括胡瓜、香瓜、洋香瓜等為主。因 CCYV 是由粉蝨以半持續性方式傳播，其保毒能力會與傳毒能力有關，本文將觀察均一齡期之粉蝨感染 CCYV 後之保毒能力。未獲毒之粉蝨以非 CCYV 寄主植物-青花菜苗飼養，取出蟲源粉蝨成蟲放置在新鮮青花菜苗上，經 24 h 後，取出被產卵之青花菜苗，待成蟲羽化後，取 3-5 日齡成蟲進行獲毒及保毒試驗觀察。保毒試驗是將獲毒 48 h 之粉蝨成蟲移至青花菜苗飼養，不同時間取出定量成蟲，以 RT-PCR 檢測帶毒粉蝨比率，以瞭解 CCYV 在粉蝨成蟲體力保毒時間。

結果/結論/應用啟示

將帶毒病葉葉柄插入帶有浸溼棉花的燒杯中，使用石蠟磨將燒杯杯口包住，將 3-5 日齡成蟲放入，用透明塑膠桶罩住，置放在 26°C 定溫箱中。獲毒 48 h 後，立即收集成蟲 10 隻，以 RT-PCR 檢測結果帶毒蟲比率為 70%，分別於 0.5、1、2、4、6、24 及 48h 時取出各 10 隻成蟲檢測帶毒情形，其帶毒比率分別為 70-100%，顯示粉蝨獲毒後該病毒已可殘留在蟲體內，且 48 h 的保毒時間仍可維持在 70-100%。後續將延長觀察時間至少 7 天，以確定帶有 CCYV 之粉蝨的保毒時間，可作為防治時機的參考。

關鍵詞(Key words)：煙草粉蝨 B 型生物小種(*Bemisia tabaci* B biotype)、瓜類褪綠黃化病毒(*Cucurbit chlorotic yellows virus*)、保毒時間 (persistent period)

推薦藥劑對嘉義地區水稻褐飛蝨及白背飛蝨之室內藥效評估

Evaluating the effect of recommended insecticides for controlling the brown planthopper and whitebacked planthopper in Chiayi district under laboratory condition

黃守宏、陳柏宏、王泰權、梁鈺平

Shou-Horng Huang, Po-Hung Chen, Tai-Chuan Wang and Yu-Ping Liang

嘉義農業試驗分所植物保護系

Department of Plant Protection, Chiayi Agricultural Experiment Station, Taiwan
Agricultural Research Institute

背景/研究問題/材料方法

褐飛蝨及白背飛蝨為台灣水稻重要且具遷移性之害蟲，嚴重危害可導致水稻蝨燒，影響產量至鉅，藥劑防治為農民主要防治方法之一。目前台灣推薦防治之藥劑種類除早期登記者外，尚包含公告延伸使用種類，對於目前發生族群之防治效果有待進一步評估。本研究於室內利用噴佈法及秧苗浸藥法檢測嘉義地區之族群，每處理3重複，處理後於24、48及72小時調查，期望所獲得結果有助於農民防治用藥之參考。

結果/結論/應用啟示

以噴佈法進行檢測，褐飛蝨3天後死亡率達70%以上者，有25%賽速安SG、20%達特南SG、20%免扶克EC、48.34%丁基加保扶EW及50%丁基滅必蝨EC；對白背飛蝨則有16%可尼丁SG、75%歐殺松SP、20%達特南SG及25%派滅淨WP。以秧苗浸藥法進行檢測，對褐飛蝨具毒殺效果(70%以上)者有75%歐殺松SP及48.34%丁基加保扶EW；對白背飛蝨則有20%免扶克EC、48.34%丁基加保扶EW、25%派滅淨WP、10%氟尼胺WG及40%納乃得SG。另外評估對黑盲椿之毒效，3天後死亡率40%以下者，僅有16%可尼丁SG及25%賽速安SG在秧苗浸藥法檢測結果有達此標準。依目前檢測結果可得知20%達特南SG、48.34%丁基加保扶水基EC及75%歐殺松SP對上述兩種飛蝨同時具防治效果，但對兩種飛蝨之天敵-黑盲椿也同樣具有毒殺作用。

關鍵詞 (Key words)：褐飛蝨(*Nilaparvata lugens* (Stål))、白背飛蝨(*Sogatella furcifera* (Horváth))、黑盲椿(*Tytkus mundulus* (Breddin))、殺蟲劑 (Insecticide)

臺灣蚊蠓之危害現況與生活痛苦指數問卷調查

Questionnaire Survey of Nuisance Situation and Life Misery Index on the
Forcipomyia (Lasiohelea) taiwana: Diptera黃基森¹、楊育年²、林信安³Ji-Sen Hwang¹, Yu-Nine Yang², Hsin-An Lin³1 臺北市立大學地球環境暨生物資源學系副教授 Department of Earth and Life
Sciences, University of Taipei, Associate Professor2 行政院農業委員會動植物防疫檢疫局技士 Bureau of Animal and Plant Health
Inspection and Quarantine Council of Agriculture, Executive Yuan, Associate
Specialist

3 則越廣告行銷有限公司經理 Tse Yueh Advertising Co., Ltd., Manager

本研究以問卷調查社區民眾遭臺灣蚊蠓(俗稱小黑蚊)滋擾危害程度、叮咬處理方式、參與防治現況與意願。選擇北、中、南、東小黑蚊危害區以經由專家效度審查後之問卷進行調查，採立意取樣共計發出 300 份，有效問卷 280 份。問卷整理後以統計套裝軟體(SPSS)進行描述性分析。

調查結果顯示:1.民眾防治生活經驗方面:(1)小黑蚊防治知識來源多元，其中以政府機關與網路最高;(2)平時接獲地方政府之防治資料與訓練或民眾自主防治仍偏低。2.危害程度方面:(1)八成民眾曾遭小黑蚊叮咬，叮咬數量多，次數也頻繁，造成癢痛、紅斑與丘疹或有過敏反應;(2)叮咬之部位以足或腿最多，手或手臂、頸部、頭部或其他裸露部位也被叮咬;(3)遭叮咬之處所以社區公園最多，其次包括學校、觀光憩區、運動休閒區、家裡，且在春夏秋冬季節均有被叮咬經驗。3.生活痛苦指數與防治作為方面:(1)痛苦原因以癢痛難耐最高，此外也影響工作與生活作習、花錢買藥、影響生意，仍有一成民眾擔心傳播疾病，而持續未改善也是民眾痛苦之原因;(2)預防方面以著長袖衣褲最高，依序為使用防蚊液、地段與時段之迴避、使用殺蟲劑或蚊香驅趕;(3)叮咬後之處理方式包括:擦藥、冰敷，有 4% 必須就醫;(4)對政府現行的防治滿意度為普通，希望政府協助環境清理與清除雜草最高，其次為教育宣導、噴藥、補助經費或設立告訴牌。有八成民眾意配合政府參與社區共同防治工作或活動。小黑蚊仍為地方政府加強施政之工作，強化各土地管理機關推動教育訓練與棲地環境管理，同時加強民眾自我管理與社區參與，以降低小黑蚊之擴散與危害。

關鍵字:臺灣蚊蠓(*Forcipomyia (Lasiohelea) taiwana*)、小黑蚊(Bloodsucking biting midges)、生活痛苦指數(Life misery index)、棲地環境管理(Habitat environment management)、社區自主管理(Community self management)

薤菜小金花蟲有機及化學防治之初步研究

Preliminary study of organic and chemical control of *Chaetocnema confinis* (Coleoptera: Chrysomelidae)梁鈺平¹、林郁欣¹、陳柏宏¹、王泰權¹、黃守宏¹Yu-Ping Liang¹, Yu-Sin Lin¹, Po-Hung Chen¹, Tai-Chuan Wang¹, and Shou-Horng Huang¹¹行政院農業委員會農業試驗所嘉義農業試驗分所植物保護系¹Department of Plant Protection, Chaiyi Agricultural Experiment Station, Taiwan
Agricultural Research Institute, Council of Agriculture, Executive Yuan.

背景/研究問題/材料方法

薤菜小金花蟲 (*Chaetocnema confinis* Crotch) 為葉用甘藷之常見害蟲，亦會危害其它旋花科植物如空心菜等。其成蟲嚙食葉肉，在葉片上留下褐色凹陷細紋，影響葉用甘藷品質。然而，目前欠缺此蟲有機防治方法之研究，亦不明瞭化學藥劑之防治效果。因此，本研究利用市售黏紙（黃、藍、綠及白色）調查各顏色對此蟲之誘引效果，並進行印棟素、可濕性硫磺、白殭菌及矽藻素4種有機資材，與亞滅培、培丹、達特南及佈飛松等公告延伸使用藥劑對薤菜小金花蟲之室內藥劑試驗。

結果/結論/應用啟示

黏紙誘引結果顯示，黃色黏紙誘集蟲數最多，表示黃色為後續研究此蟲族群動態及物理防治效果較佳之顏色。有機資材試驗結果顯示，除白殭菌處理14天後死亡率為32.4%外，其他3種有機資材皆無明顯防治效果。化學藥劑試驗結果顯示，以嘉義農試所內之蟲源測試，培丹之殺蟲效果最佳，推薦濃度下於第3日可達97.5%之死亡率，達特南、佈飛松及亞滅培之死亡率亦有70%以上，且各藥劑於減半濃度下仍有70—85%的殺蟲效果。另以新港鄉之蟲源測試，則除培丹與佈飛松外，其他延伸藥劑於原推薦及減半濃度下，於第3日死亡率皆達70%以上。本研究之結果顯示，目前測試之有機資材對此蟲之防治效果似乎不佳，而化學藥劑應可有效防治，雖不同地區族群對藥劑之感受性可能不同。

關鍵詞 (Key words): 薤菜小金花蟲 (*Chaetocnema confinis*)、化學防治 (Chemical control)、有機防治 (Organic control)、甘藷 (Sweet potato)

柑橘锈螨於三種柑橘上的族群消長、分布及化學防治之研究

Population Dynamic, Distribution, and Chemical Control of the Citrus Rust Mite, *Phyllocoptruta oleivora* (Ashmead) on Three Varieties of Citrus in Taiwan

陳柏宏、黃守宏、王泰權

Po-Hung Chen, Shou-Horng Huang, Tai-Chuan Wang

行政院農業委員會農業試驗所嘉義農業試驗分所植物保護系

Department of Plant Protection, Chiayi Agricultural Experiment Station, Taiwan

Agricultural Research Institute, Council of Agriculture, Executive Yuan.

背景/研究問題/材料方法

柑橘锈螨 (*Phyllocoptruta oleivora*) 為柑橘作物重要害螨，大量發生時會造成果實產生銹褐色或黑褐色粗糙表皮，嚴重影響商品價值。本研究於2016年1–12月，以膠帶黏貼法 (adhesive tape method) 調查於尤利加檸檬 ('Eureka' lemon)、波斯萊姆 ('Persian' lime) 及茂谷柑 ('Murcott' tangor) 果實及葉片上的柑橘锈螨族群消長與分布，並檢測現行登記於柑橘類作物上螨類防治藥劑對柑橘锈螨的毒殺效果。

結果/結論/應用啟示

三種柑橘中，以小果至大果期為柑橘锈螨族群數量高峰期，果實為锈螨主要為害部位，老葉次之，新葉上螨數相對較少。於葉片上，又以葉背螨數顯著多於葉面。此外，5–10月的柑橘锈螨密度極低，降雨量與降雨頻度為影響柑橘锈螨田間族群密度的關鍵因子。空間分布分析上，分散指數 (index of dispersion)、平均擁擠度 (Lloyd's index of mean crowding) 及聚集指數 (Lloyd's index of patchiness) 皆顯示，柑橘锈螨族群一般呈現聚集型分布，惟密度極低時則轉為均勻型或逢機型分布。室內藥劑檢測結果顯示，共5種柑橘锈螨防治藥劑 (50%汰芬隆可濕性粉劑、20%畢達本水懸劑、25%丁基加保扶可濕性粉劑、50%芬佈賜水懸劑及10%歐殺滅水溶液) 與4種柑橘葉螨防治藥劑 (20%三亞蟎乳劑、46.5%愛殺松乳劑、39.5%扶吉胺水懸劑及0.04%畢汰芬水懸劑) 的殺蟎效果極佳，可造成90%以上之锈蟎死亡率。

關鍵詞 (Key words)：殺蟎劑 (Acaricide)、生物檢定 (Bioassay)、柑橘锈螨 (*Phyllocoptruta oleivora*)、族群動態 (Population dynamic)、空間分布 (Spatial distribution)

探討台灣埃及斑蚊抗藥性品系鈉離子通道內含子多型性之現象

Discovery of intron polymorphism in the voltage-gated sodium channel from pyrethroid resistance *Aedes aegypti*

陳彥圻^{1,2}、陳易呈^{1,2}、鄧華真¹

Yen-Chi Chen^{1,2}, I-Cheng Cheng^{1,2}, and Hwa-Jen Teng¹

¹衛生福利部疾病管制署檢驗及疫苗研製中心

²財團法人國家衛生研究院國家蚊媒傳染病防治研究中心

¹Centers for Disease Control, Ministry of Health and Welfare, Taipei, Taiwan

²National Mosquito-Borne Diseases Control Research Center, National Health Research Institutes, Miaoli, Taiwan

背景/研究問題/材料方法

登革熱(Dengue fever)傳播遍及全球，對於眾多熱帶及亞熱帶國家的人民來說，是嚴重的生命威脅。在台灣，埃及斑蚊 *Aedes aegypti* (L.) 為傳播登革熱最主要的病媒蚊。由於高頻率使用殺蟲劑，埃及斑蚊對於除蟲菊精類的抗藥性已成為防治登革熱的最大阻力。研究顯示，鈉離子通道(Voltage-gated sodium channel)的突變與抗藥性有關。近來，國外團隊相繼報導，在鈉離子通道上，Domain IIS6具有內含子多樣性(Intron polymorphism)，根據長度可分成A型(250 bp)和B型(234 bp)。本實驗室利用南部地區採集之埃及斑蚊作為實驗對象，分析具有除蟲菊精類抗藥性之成蚊基因，觀察台灣族群是否具有內含子多樣性。

結果/結論/應用啟示

我們利用高雄三民區採集之埃及斑蚊，在實驗室中建立除蟲菊精類殺蟲劑的抗藥性品系，經由軟體進行序列比對，Exon 20、Exon 21之間的內含子確實具有兩種型態，並推測若定序有雜訊者為異型合子。實驗結果分成A型同型合子(A form Homozygote)、B型同型合子(B form Homozygote)，以及A/B型異型合子(A/B form Heterozygote)，與此基因上的突變點交叉比對，觀察到B型內含子的存在與F1534C突變點具有連動性。此外，2016年季中，不論在台南，或是高雄其他區域(小港區、前鎮區)所採集之埃及斑蚊，F1534C突變個體，也都可以觀察到B型同型合子的存在。我們將會持續分析各埃及斑蚊族群，鈉離子通道內含子多型性之現象，並探討與突變位點之間的關係。

關鍵詞 (Key words)：埃及斑蚊 (*Aedes aegypti*)、抗藥性 (Insecticide resistance)、內含子多型性 (Intron polymorphism)、鈉離子通道 (Voltage-gated sodium channel)

埃及斑蚊對除蟲菊精類殺蟲劑抗藥性快速檢測方法之建立

陳易呈^{1,2}、陳彥圻^{1,2}、鄧華真¹¹ 衛生福利部疾病管制署² 國家衛生研究院國家蚊媒傳染病防治研究中心

背景/研究問題/材料方法

埃及斑蚊能夠傳播數種病毒性疾病，其中登革熱每年都對台灣的民眾造成威脅，2014 年本土病例到達 15,492 人，而 2015 年更達 43,419 例。目前，病媒蚊的防治是被認為減低登革熱危害程度的一個快速有效的方法，但是長期使用除蟲菊類殺蟲劑的情況下已使蚊蟲產生抗藥性，如果能夠掌握埃及斑蚊抗藥性狀況，勢必有助於防疫策略的擬定。然而，抗藥性程度的檢測相當耗時，當病情爆發時勢必緩不濟急。因此，我們希望建立一套快速檢測埃及斑蚊抗藥性的方法來輔助抗藥性的偵測，進而提升登革熱以及其他埃及斑蚊媒介疾病的防治效率。

結果/結論/應用啟示

昆蟲對除蟲菊精類殺蟲劑的抗性被廣泛報導跟電壓門控鈉離子通道 (voltage-gated sodium channel) 基因的點突變有關，我們已在台灣埃及斑蚊族群的該基因中發現四個跟抗性有關的點突變，為了驗證是否可利用這些點突變在族群中的分布狀況推估埃及斑蚊實際的抗藥性，我們建立了數個對除蟲菊精類殺蟲劑具有不同程度抗性的品系，結果顯示抗性越高的品系族群內具有越高比例的點突變，證實了我們的構想的確可行。我們將進一步分析這些突變群之間個別的比例以及彼此間的交互影響，以期能更準確地評估埃及斑蚊的抗藥性程度。

關鍵詞 (Key words)：埃及斑蚊 (*Aedes aegypti*)、登革熱 (dengue fever)、除蟲菊精類殺蟲劑 (pyrethroid insecticide)、電壓門控鈉離子通道 (voltage-gated sodium channel)

評估百利普芬、克凡派、賜諾殺及益達胺對於荔枝細蛾防治效果

The control efficacy of pyriproxyfen, chlorfenapyr, spinosad and imidacloprid to the litchi fruit borer (*Conopomorpha sinensis* Bradley)

王泰權、程子軒、陳柏宏、梁鈺平、黃守宏

Tai-Chuan Wang, Zi-Xuan Cheng, Po-Hung Chen, Yu-Ping Liang, Shou-Horng Huang

行政院農業委員會農業試驗所嘉義農業試驗分所植物保護系 Department of Plant Protection, Chaiyi Agricultural Experiment Station, Taiwan Agricultural Research Institute, Council of Agriculture, Executive Yuan.

背景/研究問題/材料方法

荔枝為國內重要外銷水果之一，荔枝生產過程常受荔枝細蛾危害而造成產量與品質不佳，本研究以4種於國外訂有容許量之藥劑進行室內藥劑試驗及田間防治效果，以11%百利普芬EC(稀釋1000倍)、10%克凡派SC(稀釋1000倍)、11.6%賜諾殺SC(稀釋3000倍)及18.2%益達胺SC(稀釋3000倍)，以2.4%第滅寧SC(稀釋1500倍)及50%芬殺松EC(稀釋1000倍)輪用做為正對照組，噴水做為負對照組，進行落果浸藥試驗、成蟲接觸藥劑試驗及田間試驗評估對荔枝細蛾之毒效及田間防治效果。

結果/結論/應用啟示

室內落果浸藥試驗比較藥劑處理受害落果後終齡幼蟲化蛹數目，對照組平均化蛹數為9.0隻，藥劑處理以賜諾殺藥效最佳，平均化蛹數為1.3隻。成蟲接觸浸藥濾紙試驗顯示接觸藥劑24小時後，以芬殺松最具毒殺效果，死亡率即達80.0%，48-72小時後，克凡派、賜諾殺及第滅寧處理皆出現毒殺效果。田間試驗調查結果顯示樹上果危害率較低，因此以採收前3週之危害率進行防治效果評估，以百利普芬、賜諾殺及益達胺具防治荔枝細蛾的潛力，危害率分別為0.0-6.7%、0.0-3.3%、0.0-3.3%，對照組為10.0-20.0%。根據上述試驗作綜合評估，賜諾殺雖對成蟲無急性接觸毒性，但可影響受害落果中幼蟲化蛹數，且田間試驗防治效果亦為最佳，推論賜諾殺為最具防治荔枝細蛾潛力的藥劑。

關鍵詞 (Key words)：荔枝細蛾 (*Conopomorpha sinensis*)、荔枝 (litchi)、殺蟲劑 (insecticides)

草莓田二點葉蟎 (*Tetranychus urticae*) 族群動態與蔗糖酸酯及礦物油
的室內防治效果評估

Population fluctuations of *Tetranychus urticae* in strawberry field and
control evaluations of sucrose ester and mineral oil in laboratory

薛道原¹、莊益源^{1,2}

Dao-Yuan Xue¹, Yi-Yuan Chuang^{1,2}

¹ 國立中興大學植物醫學暨安全農業碩士學位學程

The Master Program for Plant Medicine and Good Agriculture Practice,

National Chung Hsing University

² 國立中興大學昆蟲學系

Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

二點葉蟎 (*Tetranychus urticae*) 為草莓 (*Fragaria x ananassa*) 栽培區之重要有害生物，嚴重影響產量甚至導致植株枯死。田間初步調查發現此葉蟎在不同品種草莓上的發生情形與危害並不相同，值得進一步探討。另外，農友普遍認為目前推薦農藥效果不佳，且有機栽培業者並無適當資材可供防治應用。本研究調查與比較二種草莓品種上二點葉蟎的族群動態，並於室內篩選測試農藥及非農藥資材之防治效果。

結果/結論/應用啟示

本試驗於 2016 年 10 月至 2017 年 3 月期間，在苗栗縣大湖鄉相鄰栽培豐香及香水品種的二處草莓園調查二點葉蟎之族群動態，結果顯示此葉蟎於豐香品種葉片上之發生率在三月時達最高為 100 %，平均每片葉上達 1047.2 顆卵及 53.2 隻雌成蟎，高於香水品種上的發生率 21.5 %。實驗室內評估非農藥資材蔗糖酸酯及精鏈油的防治效率，同時選取推薦藥劑中 6 種不同作用機制之農藥進行測試，利用葉片藥膜法，測試防治效果。初步結果顯示，賽洛寧、阿巴汀、依殺蟎、芬普蟎、賜滅芬、賽芬蟎等 6 種農藥，依照推薦濃度處理後 48h，二點葉蟎死亡率分別為 22.9 %、49.2 %、20.0 %、40.7 %、4.2 %、22.2 %；而 0.2% 精鏈油、1 % 及 2 % 蔗糖酸酯溶液處理後 48 h，二點葉蟎的死亡率分別可達 83.3 %、57.8 %、81.5 %，皆較同時測試的推薦農藥高，顯示此二者均具有應用於防治之潛力。

關鍵詞 (Key words)：草莓 (strawberry)、二點葉蟎 (*Tetranychus urticae*)、族群動態 (population fluctuation)、藥膜法 (leaf-dip method)、蔗糖酸酯 (sucrose ester)

以次世代定序資訊探討解毒酵素與東方果實蠅對有機磷殺蟲劑抗藥
性之關聯

Understanding the relationship of detoxification enzymes in
Organophosphate resistance of *Bactrocera dorsalis* through NGS
data

余俊瑩、吳昌昱、許博凱、陳倩瑜、許如君

Chun-Ying Yu¹, Chang-Yu Wu¹, Po-Kai Hsu¹, Chien-Yu Chen², Ju-Chun Hsu¹

¹ 國立臺灣大學昆蟲學系 Department of Entomology, National Taiwan University

² 國立臺灣大學生物產業機電工程學系 Department of Bio-Industrial Mechatronics
Engineering, National Taiwan University

背景/研究問題/材料方法

抗藥性 (Resistance) 是進行蟲害管理時的重大挑戰，其中解毒酵素在抗藥性的發展中扮演重要的角色。昆蟲體內的解毒酵素可分成三類，分別是羧酸酯酶 (Carboxylesterases, COE)、穀胱甘肽硫轉移酶 (Glutathione S-transferases, GST) 和細胞色素 P450 (cytochrome P450s, CYP)，透過分析室內建立對有機磷類 (organophosphate) 抗性的東方果實蠅 (*Bactrocera dorsalis* (Hendel)) 品系可以了解解毒酵素與有機磷類殺蟲劑抗藥性的關聯性。將用次世代定序技術 (Next generation sequencing, NGS) 可以獲得東方果實蠅數百個不同的解毒酵素的轉錄體資訊，透過和感性蟲的比較可以篩選出具表現量差異的標的。

結果/結論/應用啟示

在 4 種有機磷類抗性品系挑選同時具有兩倍以上差異的轉錄子來進行 RT-PCR (real-time PCR) 做進一步表現量的確認，COEs 有 8 條轉錄體，歸屬 6 條基因，其中在乃力松抗性品系有最高表現量差異 10.6 倍；而 GSTs 則有 18 條轉錄體，屬於 8 條基因，在馬拉松抗性品系最高表現量差異達 8.13 倍；CYPs 則是挑選具有 8 倍以上差異的轉錄體，共有 23 條轉錄體，屬於 6 條基因，在乃力松抗性品系有最高表現量差異為 116 倍。最後利用昆蟲桿狀病毒表現系統及 RNAi 等技術來確認較高表現量基因的功能性。

關鍵詞 (Key words)：代謝抗性 (metabolic resistance)、羧酸酯酶 (Carboxylesterases)、胱甘肽硫轉移酶 (Glutathione S-transferase)、細胞色素 P450 (cytochrome P450)

二點葉蟎在密滅汀的亞致死效應下之族群表現

The population performance of *Tetranychus urticae* (Acari: Tetranychidae) under the sublethal effects of milbemectin洪乙庭^{1,2}、林明瑩²

Yi-Ting Hong, Ming-Ying Lin

¹ 國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing University² 國立嘉義大學植物醫學系 Department of Plant Medicine, National Chiayi University

背景/研究問題/材料方法

二點葉蟎是農作物上的重要害蟎，具有生活史短及繁殖率高之特性，在田間常因不易防治，進而族群密度居高不下，嚴重為害作物，影響植株生長及其果實品質與產量。二點葉蟎在接觸到噴灑的殺蟎劑後，存活下來的個體，當代及後代族群繁殖的表現如何，是本試驗探討的課題。以採集自嘉義縣中埔鄉網室栽培木瓜園之二點葉蟎，以密滅汀為供試藥劑，於室內進行半致死效應下二點葉蟎族群表現之探討。將甫羽化的雌成蟎以半致死濃度(67 ug/mL)進行噴施，於 $27 \pm 1^\circ\text{C}$ 、12:12 (L:D)、RH $70 \pm 10\%$ 的條件下，觀察雌蟎之繁殖與後代之發育及繁殖的表現，並與噴水之對照組進行比較。

結果/結論/應用啟示

噴施密滅汀後存活的雌蟎壽命為9.95日，顯著較對照組的7.42日為長，其平均產卵量為29.77粒與對照組的32.30粒間無顯著差異。噴施密滅汀存活個體之後代之族群表現，處理組與對照組之雌雄蟎之發育期介於7.11~7.81日之間，雌成蟎處理組的產卵量(55.70粒/雌蟎)顯著高於對照組的29.18粒卵。在族群介量的部份，處理組的內在增殖率(r)、終極增長率(λ)、繁殖淨值(R_0)和平均世代時間(T)分別為 0.2863 d^{-1} 、 1.3315 d^{-1} 、39.08粒卵及12.79日，其內在增殖率、繁殖淨值均大於對照組。試驗結果以密滅汀噴施後存活之二點葉蟎當代的繁殖量無顯著差異，但其後代的族群卻有更高的族群繁殖表現。如何提高田間二點葉蟎防治成效，減少噴施殺蟎劑後存活下來的個體，將是管理上的重要課題。

關鍵詞 (Key words)：二點葉蟎 (*Tetranychus urticae*)、密滅汀 (Milbemectin)、半致死劑量 (LC₅₀)、族群介量 (Population parameters)

Demographic characteristics of *Tetranychus ludeni* on eggplant leaves
and the effects of prey's density and stage on predation rate of
Orius strigicollis

Wei-Han Lai, Shu-Jen Tuan

Entomology, National Chung Hsing University, Taichung, Taiwan

Background

Tetranychus ludeni Zacher distributes throughout the tropics and has been recorded from over than 300 plant species worldwide. Recently, this spider mite has been frequently found on many vegetable crops in Taiwan. The population of *T. ludeni* increases fast because of short generation time and high fecundity, while, there is little information has been addressed about mite's management. *Orius strigicollis* (Poppius), a commonly acariphagous bug, has been used as biological control agent against spider mites. The population characteristics of *T. ludeni* and the augmentation strategy of natural enemy would be a critical issue for pest control. Demographic characteristics of *T. ludeni* on eggplant, *Solanum melongena* L. will be determined based on two-sex life table. Furthermore, the preference of *O. strigicollis* to mite's stage as well as the appropriate predator: prey ratios of 1: 60, 2: 60, and 3: 60 were evaluated in the laboratory at 25°C.

Results

The net reproductive rate (R_0), intrinsic rate of increase (r), and finite rate of increase (λ) of *T. ludeni* feeding on eggplant leaves was 36.14 offspring, 0.2248, and 1.2520 d^{-1} . There was no significant difference of predacious preference observed in *O. strigicollis* adults to the egg, larva, or deutonymph stage of *T. ludeni*. The optimal release rate of *O. strigicollis* against *T. ludeni* was 2: 60 with a 75.2% reduction of prey density in 1 day post releasing, and consequently effectively decreased 98.6%, of *T. ludeni* in 3 days later. This study shows that *O. strigicollis* has the potential for suppressing population of *T. ludeni* on eggplant at the release ratio of 1:60 to 3:60, but the predator: prey ratio of 2:60 would be recommended.

Key words: *Tetranychus ludeni*, *Orius strigicollis*, two-sex life table, biological control, release ratio

臺南市登革熱清潔隊員之知識態度行為之研究

Study on Knowledge, Attitudes and Practices of Dengue Fever Cleaner
Team in Tainan City

黃基森、張少典

Ji-Sen Hwang, Shao-Dian Jhang

臺北市立大學地球環境暨生物資源學系

Department of Earth and Life Science (Master's program of Environmental Education
& Resources), University of Taipei

本研究依據世界衛生組織發展登革熱「行為改變溝通計畫」新策略與方法，探討登革熱流行區之清潔隊員對登革熱之知識、態度及行為的現況。採量化研究方法及運用 KAP 問卷為研究工具，根據社群母體群以方便取樣(Convenience sampling)進行問卷施測，同時以統計套裝軟體(SPSS)進行描述性統計分析，問卷發放 55 份，有效樣本回收率為 96.4%。

研究結果顯示，臺南市清潔隊員對登革熱防治之相關知識與資訊來源主要為政府機關、電視、報章雜誌與網路。在登革熱防治知識之平均知曉率為 76.54%，除了登革熱媒介傳播方式與減少幼蟲孳生方法兩項知曉率偏低外，其餘部分知曉率高於 6 成。在態度方面，清潔隊員對於登革熱防治態度已有正向發展，唯對登革熱防治分成室內與內外不會感到混淆且認為於登革熱爆發流行的區域旅遊是沒有危險的。在行為方面也均有正向發展，但於「參加志工隊的行動」方面意願卻偏低，顯示登革熱清潔隊員可能在工作之外，不太會主動以志工型態進行登革熱病媒蚊防治行動。臺南市登革熱清潔隊員已具有防治之專業知能，且在態度與行為均有正向發展，有助於登革熱防治成效的展現。本次研究中所發現到清潔員在登革熱傳播方式與幼蟲生源概念較缺乏，因此爾後宜加強清潔隊員病媒蚊孳生源與傳播方式的教育訓練，以提升登革熱防治成效。

關鍵字：登革熱(Dengue fever)、病媒蚊(Vector mosquitoes)、行為改變溝通計畫(Communication for behavioral impact, COMBI)、知識態度與行(Knowledge, attitude and practices, KAP)

南台灣埃及斑蚊之抗藥性調查研究

Survey of insecticide resistance of *Aedes aegypti* (Diptera: Culicidae) in Southern Taiwan

林欣樺、戴淑美

Hsin-Hua Lin, Shu-Mei Dai

國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

埃及斑蚊為南台灣傳播登革熱的主要病媒蚊，且每年均造成不同程度的登革熱疫情，因此大量仰賴化學防治作為防治手段。為了掌握各地埃及斑蚊對不同合成除蟲菊殺蟲劑的抗藥性發展程度，本實驗以國家蚊媒傳染病防治研究中心提供之高雄、台南市的埃及斑蚊進行成蟲擊昏與幼蟲浸浴試驗，使用藥劑包含合成除蟲菊、有機磷、胺基甲酸鹽與尼古丁乙醯膽鹼受體異位調節劑。成蟲採用半數擊昏時間評估抗擊昏程度，幼蟲藥劑試驗則以半數死亡濃度或半數死亡時間檢測；所有實驗結果均與感性NS品系比較，獲得抗性倍率等相關數據。

結果/結論/應用啟示

高雄市以鹽埕區的埃及斑蚊對合成除蟲菊的抗藥性最高，成蟲對賽滅寧的抗擊昏能力高達269倍，幼蟲雖未以除蟲菊防治卻對芬化利與賽飛寧分別有17,680和355倍的抗藥性；台南市則以北區的埃及斑蚊最具有抗藥性，成蟲對百滅寧有84倍的抗擊昏能力，幼蟲對芬化利、百滅寧分別有4,843和208倍之抗藥性。雖然高雄市與台南市的埃及斑蚊雌蚊與幼蟲皆對除蟲菊具有高度抗藥性，但是高雄市的幼蟲對有機磷、安丹、賜諾殺則未發現明顯抗藥性，台南市的成蟲對第滅寧的抗藥性相對較低。這些結果顯示未來的田間防治策略，可以在平時使用有機磷或賜諾殺等藥劑防治幼蟲，疫情緊急時才使用擊昏效果較佳的藥劑進行成蚊防治。

關鍵詞 (Key words)：埃及斑蚊 (*Aedes aegypti*)、抗藥性 (Insecticide resistance)、合成除蟲菊 (Synthetic pyrethroids)

運用酵素連結免疫吸附法檢測殺蟲劑可尼丁之殘留

Development of enzyme-linked immunosorbent assay for the insecticide clothianidin

吳許斌、蔡佳馨、蕭順榮、沈振峯、何明勳、許如君

Hsu-Bin Wu¹, Chia-Hsin Tsai¹, Shuen-Rung Hsiao², Jenn-Feng Sheen², Ming-Hsun Ho³, Ju-Chun Hsu¹

¹ 國立臺灣大學昆蟲學系 Department of Entomology, National Taiwan University

² 國立虎尾科技大學 Department of Biotechnology, National Formosa University

³ 農業藥物毒物試驗所 Taiwan Agricultural Chemicals and Toxic Substances Research Institute

背景/研究問題/材料方法

免疫分析方法主要是利用抗體對抗原具有專一性的辨認專長，而被廣泛的應用在研究、治療、醫療檢測或是農藥檢測上，最常使用免疫分析的技術為 enzyme-linked immunosorbent assays (ELISA)，此技術可提供待測樣品做快速準確且高專一性之篩檢，在此我們欲取代須高專業性、高成本及高耗時的層析方法，來達到快速篩檢多種作物農藥殘留之方法，藉此我們運用免疫分析 ELISA 進一步衍伸之技術，非直接競爭性 ELISA，用來檢測抗體、抗原與農藥之相互競爭能力與可檢測範圍。

結果/結論/應用啟示

目前我們已製備出可針對可尼丁單株抗體，其對農藥反應範圍在 1-1000 ppb 之間，半抑制濃度(I₅₀)為 38.3 ppb，偵測極限(I₁₀)為 3.5 ppb。在檢測有機溶液與菠菜基質三種淨化方式對抗體干擾性，使用乙睛溶劑對抗體影響最大，降低了抗體 73-88% 之親和能力，同樣的在甲醇有機溶劑則只降低了 40-54%；在農作物基質淨化的部分主要可分為僅離心、UCT QuICK QuEChERS (UCT) 和 Tip-in-Tip clean up (Tip) 三種淨化方式，其三種淨化基質內含甲醇溶液中對抗體干擾程度為 53-54%、40-44% (5% 甲醇基質)、45-53% (10% 甲醇基質)，其中以 UCT 淨化方式效果最佳。另外，在臺灣公告小葉菜類中可尼丁安全容許殘留量為 0.5-1 ppm，因此此單株抗體之可檢測範圍足夠做為日後快篩工具之開發。

關鍵詞 (Key words)：可尼丁、單株抗體、ELISA、基質影響

粳稻及秈稻在貯藏期害蟲發生及為害比較

Comparison of pest occurrence and damage in Japonica rice and Indica rice during storage period

姚美吉、李啟陽、呂家榮

Me-Chi Yao, Chi-Yang Lee, Jia-Rong Lu

農業試驗所應用動物組 Applied Zoology Division, Agricultural Research Institute

背景/研究問題/材料方法

台灣粳稻栽培最主要品種主為台南 11 號，秈稻則為台中秈 10 號，在收穫後約 30~40%由政府收購，進行長期貯藏以備民生各種需求，貯藏期常受積穀害蟲的為害造成嚴重損失。為了瞭解此兩種水稻品種在貯藏期之積穀害蟲發生與為害情形，本研究於彰化伸港鄉農會與鹿港鎮農會進行兩品種貯藏一年間之害蟲發生調查，並比較主要害蟲總數與數量差異，於一年後進行碾成糙米，瞭解害蟲發生與為害對兩種水稻品種貯藏損失量之影響。

結果/結論/應用啟示

由貯藏期之害蟲調查結果顯示，伸港鄉農會兩種品種稻穀之害蟲總數均隨貯藏時間增加而遞增，粳稻一年後達到 2318 隻，秈稻更達到 4168 隻。鹿港鎮農會之粳稻一年後達到 1665 隻，秈稻則達到 2828 隻。伸港鄉農會一年後之秈稻總蟲數顯著高於粳稻害蟲數；在伸港與鹿港兩處之兩品種害蟲之發生，均以穀蠹 (*Rhyzopertha dominica*) 數量最多，秈稻上之發生數量仍多於粳稻；碾成糙米評估損失狀況，伸港粳稻碾糙率為 79.57%，秈稻為 71.21%；鹿港粳稻碾糙率為 78.37%，秈稻為 71.36%，顯示秈稻之害蟲發生高於粳稻，可能導致造成其稻穀為害損失高於粳稻的主因。

關鍵詞(Key words): 粳稻 (Japonica rice)、秈稻 (Indica rice)、穀蠹 (*Rhyzopertha dominica*)、碾糙率 (milling yield of brown rice)

智能糧倉防蟲系統之規劃與測試 6

Programming and testing of intelligent insect-control management system
in rice storehouse

姚美吉、李啟陽、邱相文、賴明信

Me-Chi Yao¹, Chi-Yang Lee¹, Hsiang-Wen Chiu², Ming-Hsin Lai³¹ 農業試驗所應用動物組 Applied Zoology Division, Agricultural Research Institute² 農業試驗所農業工程組 Agricultural Engineering Division, Agricultural Research
Institute³ 農業試驗所作物組 Crop Science Division, Agricultural Research Institute

背景/研究問題/材料方法

台灣稻穀貯藏以常溫為主，但近年來為提升米質及降低害蟲發生，已逐步改為低溫冷藏筒貯藏，甚至貯藏溫度亦能利用網路監控。但在貯藏期稻穀之害蟲發生卻仍停留在人工檢查，無法即時了解害蟲發生狀況，以降低害蟲發生。為建置智能糧倉防蟲系統，於今年7月在彰化二林壽米屋公司之方形冷藏筒進行試驗，於倉頂放置 LED (light-emitting diodes) 誘蟲器，結合無線感測網路 (WSN, wireless sensor networks) 技術，可即時回傳誘蟲器捕捉到之蟲數及穀倉之溫度、濕度。並藉由所設定經濟限界 (economic threshold)，利用簡訊即時回傳給管理者。

結果/結論/應用啟示

利用 LED 積穀害蟲誘蟲器及實際取樣監測，主要發生害蟲為麥蛾 (*Sitotroga cerealella*) 及米象 (*Sitophilus oryzae*)。試驗之低溫冷藏方筒貯藏量為 235 公噸，倉溫控制在 18°C，當倉頂或倉底溫度高於 22°C，即自行進行降溫處理。預期貯藏期之經濟損失控制在 1% 以內，評估其造成經濟為害水平之蟲數，當推倉頂每時或每天之監測蟲數達到此蟲數，能即時利用簡訊回傳給管理者，以進行糧倉之降溫或翻倉處理。

關鍵詞(Key Words): 積穀害蟲 (stored product insects)、智能防蟲系統 (intelligent insect-control management system)、經濟限界 (economic threshold)、麥蛾 (*Sitotroga cerealella*)、米象 (*Sitophilus oryzae*)

不同柑橘類嫩葉影響柑橘木蝨之寄主選擇偏好性

The effects of rutaceous plant flushes on the host preference
of *Diaphorina citri* Kuwayama (Hemiptera: Liviidae)

花譽展、黃榮南、蕭旭峰

Yu-Chan Hua, Rong-Nan Huang, Shih-Feng Shiao

國立臺灣大學植物醫學碩士學程 Master Program for Plant Medicine, National
Taiwan University

背景/研究問題/材料方法

柑橘木蝨為傳播柑橘黃龍病之重要媒介昆蟲，感染黃龍病的植株、樹勢衰弱，果實失去商品價值，嚴重影響全球柑橘產業，因此本研究將著重於媒介昆蟲相關實驗。柑橘類作物為柑橘木蝨寄主植物，其嫩葉是柑橘木蝨雌蟲繁衍下一代不可或缺的一環，有鑑於此，先比較不同柑橘類作物嫩葉對柑橘木蝨偏好程度，之後以最具吸引力品種為代表，透過水萃法將該柑橘葉片中的揮發物萃取，嘗試不同倍率稀釋下，柑橘木蝨對其反應，並期望應用於黃色黏板，提升黏板監測效果，以利田間蟲害管理，減少農藥使用。

結果/結論/應用啟示

柑橘整株試驗比較椪柑、柳丁、文旦和檸檬台灣常見栽培之柑橘品種，在帶有嫩葉的相同條件下，於蟲網內釋放 50 隻柑橘木蝨，分別在 24 小時和 48 小時觀察偏好程度，實驗結果顯示柑橘木蝨相對偏好椪柑，其次為柳丁，檸檬次之，文旦與其他三種品種無顯著偏好差異。椪柑是台灣種植面積最大，也是最易感染黃龍病之品種，經上述實驗結果，決定椪柑作為萃取的主要對象，將其葉片和部分枝條剪碎放入圓底燒瓶，加入二次水約六分滿，透過加熱包加熱，蒸氣經冷凝管冷卻後獲得精油和純度較低之花香水，取精油部分加入含硫酸鈉容器去除多餘水分，保存於 -4°C 冷凍庫，目前從 324.58g 椪柑枝葉可獲取約 1.84g 精油，萃取率約 0.57%。

關鍵詞 (Key words): 柑橘木蝨 (*Diaphorina citri* Kuwayama)、柑橘黃龍病 (citrus Huanglongbing)、嫩葉有機揮發物 (volatile organic compound of flush)

油茶彫木蛾(鱗翅目：織蛾科)發生生態及藥劑防治

Study on the ecology and chemical control of Tea stem borer (*Casmara patrona* Meyrick) (Lepidoptera: Oecophoridae)

陳巧燕

Chiao-yen Chen

桃園區農業改良場

Taoyuan District Agricultural Research and Extension Station, Council of
Agriculture, Executive Yuan

背景/研究問題/材料方法

彫木蛾(*Casmara patrona* Meyrick)為山茶科油茶作物之蛀莖性害蟲，幼蟲終年藏匿枝條蛀食，導致受害枝條內部中空，油茶植株枯萎。目前防治藥劑可參考植物保護手冊，登記於山茶科作物鱗翅目害蟲之藥劑，但其推薦藥劑僅有第滅寧及蘇力菌，皆為接觸胃毒性藥劑，然其幼蟲屬鑽食危害，若無掌握防治適期及使用系統性藥劑，其防治效果不佳。本研究進行彫木蛾發生生態及幼蟲蛀入孔分佈調查，並選用茶樹鱗翅目害蟲用藥進行田間防治試驗，選用藥劑分別為85%加保利可濕性粉劑(稀釋2,000倍)、5.87%賜諾特水懸劑(稀釋2,000倍)及20%達特南水分散性粒劑(稀釋3,000倍)，無處理為對照。

結果/結論/應用啟示

根據田間觀察結果，1~3月可於被害枝條檢視到老熟越冬幼蟲，4月開始化蛹，5月下旬進入成蟲羽化期，成蟲開始產卵，6月下旬幼蟲盛發，8月上旬後開始見到枯梢。105年於新竹縣湖口鄉油茶田調查彫木蛾發生率達44%，每株油茶樹平均蟲數為 5.3 ± 3.1 隻/30株，幼蟲蛀入孔分佈以南面(23.6%)及西面(18.7%)最多，分佈區段以中段(70~140cm)侵入蟲數(51.7%)最高，可推測其成蟲產卵習性偏好於植株南面及西面之中段區域，並選於5月下旬(成蟲羽化期)開始進行藥劑防治，每隔7天施藥1次，連續3次，於8月上旬進行彫木蛾危害枯枝數調查。結果顯示，85%加保利可濕性粉劑2,000倍、5.87%賜諾特水懸劑2,000倍及20%達特南水分散性粒劑2,000倍處理之總枯枝數分別為73枝、1枝及13枝，對照組總枯枝76枝。5.87%賜諾特水懸劑及20%達特南水分散性粒劑3,000倍處理與對照組比較具顯著差異，具防治效果。

關鍵詞 (Key words): 小果油茶(*Camellia brevistyla*)、油茶彫木蛾(*Casmara patrona*)、化學防治(chemical control)

以新型硼酸溶液產卵桶防治登革熱病媒蚊之田間評估

Field evaluation of a novel ovitrap with boric acid solution to control dengue mosquitoes

巫國志¹、賴昇廷²、蔡坤憲^{3,4}

Kuo-Chih Wu¹, Yi-Ting Lai², Kun-Hsien Tsai³

¹國家衛生研究院國家蚊媒傳染病防治研究中心 National Mosquito-Borne Diseases Control Research Center, National Health Research Institute

²國立臺灣大學公共衛生碩士學位學程 Master of Public Health Degree Program, National Taiwan University

³國立臺灣大學環境衛生研究所 Institute of Environmental Health, National Taiwan University

⁴國立臺灣大學公共衛生學系 Department of Public Health, National Taiwan University

背景/研究問題/材料方法

傳統誘蚊產卵桶主要用來監測區域的病媒蚊密度，兼具靈敏、被動監測且成本低廉等優點，但也因為產卵桶易被忽略反而成為孳生源，以致使用上受到限制。據文獻指出，以1%硼酸糖水溶液餵食蚊成蟲後，可以滅殺98%以上的蚊成蟲。實驗室評估測試則顯示，以不含糖之1%硼酸溶液供其產卵和吸食，亦可降低成蟲壽命。不同濃度(0%、0.5%、1%)之硼酸溶液不影響雌蚊產卵偏好。後續新孵出之一齡幼蟲均失去活性。本研究於高雄和臺南實務評估上述溶液條件，以確認新式硼酸溶液產卵桶對成蚊和幼蟲之滅殺成效。

結果/結論/應用啟示

105年7月至106年3月期間，於臺南和高雄之積水地下室、社區、校園共佈放約150個硼酸溶液產卵桶，平均斑蚊產卵率為20%，蚊幼蟲孳生率為1%。106年7月至9月期間，於臺南和高雄之社區、校園共佈放約80個硼酸誘殺桶，定期監測結果顯示：斑蚊產卵率約為56%，蚊幼蟲孳生率為0。新式硼酸溶液產卵桶在無外力影響下具有誘殺成蚊、滅殺幼蟲之功效，透過觀察蚊卵亦可達到監測目的且不會形成孳生源，深具應用推廣之潛能。

關鍵詞 (Key words)：登革熱 (Dengue fever)、病媒控制 (Vector control)、產卵桶 (Ovitrap)、硼酸 (Boric acid)

化學藥劑搭配矽藻土防治十字花科小葉菜類黃條葉蚤之初探
Preliminary trial on collocation of insecticides and diatomaceous earth for
control striped flea beetle in Cruciferae small leaf vegetables

戴從伊、陳麗芳、黃莉欣

Chung-I Tai, Li-Fang Chen, Li-Hsin Huang

農業委員會農業藥物毒物試驗所 Taiwan Agricultural Chemicals and Toxic
Substances Research Institute, Council of Agriculture

背景/研究問題/材料方法

黃條葉蚤 (*Phyllotreta striolata*) 為十字花科蔬菜重要害蟲，幼蟲棲息於土中，羽化後成蟲取食危害地上部之菜葉，受害葉片呈不規則蟲孔，影響商品價值及產量。目前農民主要以化學藥劑防治成蟲，且以接觸型藥劑為主。成蟲密度高時，甚至一日噴灑一次防治藥劑。本試驗共三處理，對照組為農民慣行法，處理組分別為矽藻土組及矽藻土搭配可尼丁粒劑組，二處理組地上部施藥種類與對照組相同，惟施藥次數較對照組少。自灑種後第 10 日開始調查，共 6 次，每次每處理組以系統採樣法調查 50 株植株，計算葉片總數及受黃條葉蚤危害葉片數，以受害率評估防治成效。

結果/結論/應用啟示

第一次調查時對照組受害率為 47%，矽藻土處理組為 35%，矽藻土搭配可尼丁粒劑處理組 18%。矽藻土處理組於第四次調查時，受害率高於對照組。採收時，三個處理組受害率分別為 36%、40%、25%。種植期間，對照組共施用 10 次藥劑，兩個處理組施用 6 次藥劑。矽藻土搭配可尼丁粒劑處理組，葉片受害率顯著低於對照組。雖然矽藻土處理組葉片受害率高於對照組，但在減少農藥施用的次數下，仍能與對照組有相近的結果。目前可尼丁粒劑僅登記使用防治斑潛蠅類，本試驗為初步試驗，礙於試驗環境，未來將再重複試驗 2~3 次，再次評估黃條葉蚤與潛蠅共同防治之可行性。

關鍵詞 (Key words)：黃條葉蚤 (*Phyllotreta striolata*)、十字花科小葉菜類 (Cruciferae small leaf vegetables)、可尼丁粒劑 (Clothianidin GR)、矽藻土 (Diatomaceous Earth)

Serological evidence of scrub typhus in the Democratic Republic of Sao Tome and Principe

Tsai-Ying Yen¹, Lien-Fen Tseng², Kun-Hsien Tsai^{2,3}

¹ Institute of Epidemiology and Preventive Medicine, College of Public Health, National Taiwan University, Taipei, Taiwan,

² Taiwan Anti-malaria Advisory Mission, Sao Tome, Sao Tome and Principe,

³ Institute of Environmental Health, College of Public Health, National Taiwan University, Taipei, Taiwan

Background/Question/Methods

Scrub typhus is an acute, febrile illness that is caused by *Orientia tsutsugamushi*. The disease was considered to be confined to a part of the world known as the tsutsugamushi triangle, from far-eastern Russia in the north, to the northern Australia in the south, and to Pakistan in the west. However, accumulating evidence has suggested that the pathogen was present farther afield. In Africa, relatively few resource was invested in scrub typhus while sporadic reports indicated a possible transmission of *O. tsutsugamushi* on the continent. The study explored *O. tsutsugamushi* exposure in the Democratic of Sao Tome and Principe (DRSTP), an island nation in Central Africa. Sera from 563 pregnant women collected during 2003 to 2004 were examined against recombinant 56 -kDa antigen by enzyme-linked immunosorbent assay (ELISA). Additional 240 dry blood spot (DBS) samples were selected from the sample set of a proactive mass screening of malaria conducted from January to March in 2016 according to their gender and ages. Immunofluorescence assay (IFA) was performed to detect antibodies to *O. tsutsugamushi*. Results for seropositive samples were confirmed by western blot.

Results/Conclusions

Indirect ELISA found that 87 samples (15.5%) were positive for *O. tsutsugamushi* IgG, and 103 samples (18.8%) were positive for IgM among pregnant women. The DBS eluent showed a seroprevalence of 5.8% (n=14, titer $\geq 64X^{-1}$), and most of them were females (n=10), indicating sex as a possible risk factor. The median age of positive samples was 44.5 (21-72) years. Further isolation of the pathogen and identification of the natural hosts are being investigated. Our findings suggested an expanded geographical distribution of scrub typhus. Given that scrub typhus resulted in at least 140,000 deaths annually in the Asia-Pacific region, this neglected disease might cause an even bigger burden in another part of the world than previously recognized.

Key words: scrub typhus, *Orientia tsutsugamushi*, seroprevalence

台南地區登革熱病媒蚊室內外產卵監測
Surveillance of oviposition of *Aedes* mosquitoes in peridomestic premises
in Tainan area

蕭翔宇¹、楊佳樺¹、鄭惠菁¹、黃旌集^{1,2}、杜武俊^{1,3}

Hsiang-Yu Hsiao¹, Chia-Hua Yang¹, Hui-Ching Cheng¹, Chin-Gi Huang^{1,2}, Wu-Chun
Tu^{1,3}

¹ 國家蚊媒傳染病防治研究中心 National Mosquito-borne Disease Control
Research Center, National Health Research Institute

² 臺北市立大學地球環境暨生物資源學系
Department of Earth and Life Science, University of Taipei

³ 國立中興大學昆蟲學系
Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

近年台灣南部登革熱疫情嚴重，2015年的爆發流行更造成高達43,784個病例、218人死亡的慘痛紀錄；尤其許久沒有爆發重大疫情的台南市，該年登革熱病例人數高達22,777人。此次疫情除造成民眾惶恐外，更重創台南觀光旅遊產業。台灣的登革熱病媒蚊主要是埃及斑蚊與白線斑蚊，而這些病媒蚊並不只在室外活動，它也會進入室內活動、棲息、孳生；惟病媒蚊在居家室內的活動情形，至今尚未有具體的研究。本監測調查利用誘蚊產卵桶(ovitrap)，選擇台南市南區的新興、田寮、文華等三個里為試驗樣區進行監測調查。分別住家的室外、客廳、廚房、臥室、浴廁等五個地方各放置一個誘卵桶，進行為期一年、每週一次的監測調查。

結果/結論/應用啟示

結果顯示，室外、室內誘卵桶年平均陽性率分別為27%與20%；即室內陽性率約為室外的60%~75%；顯示室內也是病媒蚊活動的主要場所之一；因此有效的登革熱病媒為防治不能忽略室內防治。監測誘集的斑蚊卵室外平均卵數為178顆/週、室內為58顆/週；經孵化鑑定後有96.68%為埃及斑蚊、3.32%為白線斑蚊，顯示都市社區中埃及斑蚊為主要病媒蚊種。誘卵桶監測也顯示不同里別的病媒蚊密度差異顯著；此外，季節變化亦影響病媒蚊在室內外產卵行為。

關鍵詞 (Key words)：埃及斑蚊 (*Aedes aegypti*)、白線斑蚊 (*Aedes albopictus*)、誘蚊產卵桶 (Ovitrap)、室內(Indoor)、室外(Outdoor)

斑蚊產卵高度偏好性探討
Oviposition of *Aedes* mosquitoes in different height

吳逸鈞¹、楊曉峰¹、林怡瑩¹、郭又瑄¹、李宜勳¹、李侖遠¹、黃旌集^{1,2}、
杜武俊³

Yi-Jun Wu, Shau-Fong Young, Yi-Ying Lin, You-Syuan Guo, Yi-Shiun Lee,
Lun-Yuan Li, Chin-Gi Huang, Wu-Chun Tu

¹ 國家蚊媒傳染病防治研究中心 National Mosquito-Borne Diseases Control
Research Center, National Health Research Institute

² 臺北市立大學地球資源暨生物資源學系 Department of Earth and Life Science,
University of Taipei

³ 國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing
University

背景/研究問題/材料方法

台灣登革熱病媒蚊主要為埃及斑蚊與白線斑蚊，而這兩種病媒蚊的幼蟲以容器積水、天然積水等小型水域為其孳生場所。這些孳生源不全然分布於地面上，而是呈立體空間分布的狀態。現行利用誘卵桶所進行的密度監測和各種誘殺桶的設置，均以擺置於地面為唯一的設計考量，而擺放地面誘引蚊蟲是否為最佳的作法，是值得探討的問題。本試驗分為公園與住宅區兩部分，將誘卵桶擺放於不同高度誘引雌蚊產卵，第一部分為公園試驗，設計三個高度分別為 0、75、150 公分；第二部分為住宅區試驗，設計四個高度分別為 0、50、100、150 公分，以討論斑蚊產卵時最為偏好的高度及習性。

結果/結論/應用啟示

在公園試驗時每週平均陽性率分別為 $97.1 \pm 3.6\%$ 、 $93.6 \pm 5.1\%$ 、 $89 \pm 10.6\%$ ，其平均卵粒數自地面至 150 公分高度，依序分別為 91.1 ± 56.9 顆、 42.6 ± 29.8 顆、 36 ± 22.0 顆，占總卵數的比例為 52.4%、25.2%、22.4%，所採集的卵經孵化鑑定全數為白線斑蚊。在住宅區試驗時每週平均陽性率分別為 $13.5 \pm 10.7\%$ 、 $29.5 \pm 16.5\%$ 、 $28.1 \pm 20.5\%$ 、 $17.5 \pm 14.0\%$ ，其平均卵粒數自地面至 200 公分高度，依序分別為 42 顆、91.1 顆、93.8 顆、41 顆，占總卵數的比例為 42.0 ± 37.5 顆、 91.1 ± 78.7 顆、 93.8 ± 76.2 顆、 41.0 ± 43.0 顆，經孵卵鑑定後全數為埃及斑蚊。綜和以上結果，白線斑蚊偏好將卵產在地面誘卵桶，且有分散高度產卵的情況。埃及斑蚊則偏好的產卵於 50-100 公分高度，且產卵較無分散性。此結果可提供登革熱病媒蚊防治實務具體參考。

關鍵詞 (Key words)：埃及斑蚊 (*Aedes aegypti*)、白線斑蚊 (*Aedes albopictus*)、誘蚊產卵桶 (Ovitrap)、產卵 (Oviposition)

全英文場次

論文宣讀摘要集

Oral Session:

Full English section

The silverleaf whitefly (*Bemisia tabaci*): a potential pest of rice in eastern Taiwan

Jintana Chaiwong, Kwok-Ching Wong

Department of Natural Resources and Environmental Studies, National Dong Hwa University, Shoufeng, Hualien, Taiwan

Background/Question/Methods

The Silverleaf whitefly (*Bemisia tabaci*) is a polyphagous insect pest on several host plants; include fruit, ornamental, and vegetable plants. Silverleaf whitefly first observed in western central Taiwan in 1990 to nowadays, it spreads all over Taiwan. It attacks many agricultural crops and some counties have reported its outbreak on rice crop. In former periods, it was not reported as an insect pest of rice in Taiwan. However, it can become a major pest in suitable conditions, especially under climate change. Therefore, the objective of our study was to examine the populations of Silverleaf whitefly in eastern Taiwan, conducted in paddy fields of Shoufeng, Ji'an, Guangfu, and Hualien townships, Hualien County, Taiwan in April-May and September-October 2015. Insects were sampled using a standard sweep net by sweeping randomly towards the edge of the paddy bund to end of each plot. Adult Silverleaf whiteflies were identified into species, using the keys of European and Mediterranean Plant Protection Organization 2004.

Results/Conclusions

Results showed that, the seasonal affect on numbers of silverleaf whiteflies population is higher in fall than spring, especially in October had the highest populations. They are the second most insect pests in fall season, inferior to white-backed planthoppers, which are the most in population and serious insect pests in paddy fields. This result indicated that Silverleaf whiteflies could become to major pests in paddy fields because, previously there were no reports of these insects in Taiwanese paddy fields or they were, perhaps, they have not been looking in the fields. Therefore, this result suggested that insect surveillance in paddy field is very important in the future. Silverleaf whiteflies can increase rapidly because; Taiwan is in the climate ranges from tropical to subtropical, which is very suitable for development and reproduction.

Key words: Silverleaf whitefly, paddy field, seasonal occurrence, surveillance, major pest

Effects of starvation on food intake and detection by German cockroaches (*Blattella germanica* L.) (Dictyoptera: Blattellidae) under Laboratory conditions

Anil Chandra Neupane, Phillip Cheng and Lekhnath Kafle*

Department of Tropical Agriculture and International Cooperation, National Pingtung University of Science and Technology, Pingtung 912, Taiwan

*Corresponding to "kafle@gmail.com"

Background/Question/Methods

The German Cockroach, *Blattella germanica* (L.), the most important urban pests. Their infestation and protein produced by them cause allergy and asthma. Moreover, it is a vector for disease-causing micro-organisms. Using baits is the most effective method of controlling German cockroach population. This is also safer than others methods of control, such as spray and broadcast. Many scholars are working for the development of safe and environmentally friendly baits however, there are some issues associated with the baits such as aversion, less attractive and effective with ageing, and expensive. For the development new bait, starvation period should be considered. Very limited research has been executed to determine the starvation period on food intake and detection by German cockroach. This research has been pursued to identify the effect of starvation on food intake and detection by the German cockroaches. Eight starvation periods (1, 3, 6, 12, 24, 48, 72, and 96 h) were tested to identify the effect of the periods on dog chow intake and detection by the German cockroaches.

Results/Conclusions

A direct correlation was observed in between starvation duration and amount of food removed, whereas indirect correlation was observed in between starvation and food detection time. The effect of starvation on amount removal shows that weight removed by the cockroach was significantly different in different starvation periods. The amount removed at 96, 72, and 48 starvation hours were significantly different with the amount removed at 1,3,6,12, and 24 starvation hours. Similarly, starvation period had a significantly different with food detections time. For food detection time, starvation period of 1, 3, and 6 hours are significantly different with rest 12, 24, 48, 72, and 96 hours. To conclude, this result suggests that the minimum starvation period should be at least 12 hours for the detection of food and 48 hours for the intake of food by German cockroach.

Key words: starvation, intake, detection, amount removed, *Blattella germanica*

Host range of a newly identified parasitoid, *Apanteles opacus* (Ashmead)
(Hymenoptera: Braconidae)

Mei-Ying Lin¹, Shih-Ying Huang² and Ramasamy Srinivasan¹

¹Entomology Group, World Vegetable Center, Shanhua, Tainan, Taiwan,

² Department of Entomology, National Chung Hsing University, Taichung, Taiwan

Background & Methods

Leafwebber, *Spoladea recurvalis* Fabricius (syn. *Hymenia recurvalis*) (Lepidoptera: Crambidae) is a destructive pest of amaranth in tropics and subtropics. A solitary endoparasitoid, *Apanteles opacus* (Hymenoptera: Braconidae) was identified as the major parasitoid of *S. recurvalis* in Southern Taiwan during 2014-2015. After standardizing the mass-culturing techniques, studies were conducted to determine the host range of this newly identified parasitoid. Two other moths from Crambidae, *Maruca vitrata* Fabricius and *Crociodolomia pavonana* Zeller, and a moth from Noctuidae, *Spodoptera litura* Fabricius were selected. Each moth was assessed in an individual experiment, in which three treatments were used: (i) *S. recurvalis* alone (ii) alternate moth species alone, and (iii) *S. recurvalis* + alternate moth species. Ten replications were maintained for each treatment, and twenty first instar larvae were exposed to two pairs of parasitoids in each replication. After two days, the parasitoids were removed and the larvae were reared on their diet or host plant and monitored continuously. Larvae were maintained until parasitoid or moth adults emerged from them.

Results & Conclusions

We found that *A. opacus* parasitized only *S. recurvalis* in most of the experiments, and the parasitism rate was 25-72%. However, it was observed from the experiment involving *M. vitrata*, the parasitoid attacked about 1% of the *M. vitrata* larvae. Although this parasitism rate is statistically insignificant, further studies should be conducted to find whether *A. opacus* can infest and develop on this moth species in a no-choice condition, in order to confirm the host range of *A. opacus*. In earlier studies, *A. opacus* was found to infest rice leafroller, *Cnaphalocrocis medinalis* Guenée, another Crambidae moth in Malaysia. Since *A. opacus* has a wide geographical presence in South- and Southeast Asia, determining its host range becomes imperative.

Key words: amaranth leafwebber, *Apanteles opacus*, Crambidae, Noctuidae, host range

Polydnavirus-encoded microRNA exerts different effects on the immune responses in *Spodoptera litura* and *Snellenius manilae*

Cheng-Kang Tang, Yueh-Lung Wu

Department of Entomology, National Taiwan University

Background/Question/Methods

Parasitoid wasps have multiple mechanisms to inhibit the immune and physiological responses of their hosts. These mechanisms include the use of symbiotic viruses such as polydnaviruses (PDVs). PDVs differs from other viruses in that they are symbiotic with parasitoid wasps, and can help parasitoid wasp larvae infect lepidopteran larvae through the inhibition of host growth and immune reactions. PDVs display different infective symptoms in different hosts, and we believe that miRNAs are responsible for these differences. Rapid development of miRNA research has confirmed the involvement of miRNA in host-pathogen interactions. However, the role of miRNA has yet to be fully understood. This study aims to examine the role of miRNA in insect immune mechanisms through the differing immune responses that PDVs invoke in insects. With the technic of small RNA Hiseq next generation sequencing, we could screen the most crucial miRNAs which induce immunosuppression.

Results/Conclusions

We found that Toll-7 expression levels of PDV-infected hosts are extremely down-regulated compared with wild-type and NPV-infected larvae. We performed next generation sequencing (NGS) to analyze RNA expression levels displayed upon PDV infection. These miRNAs account for 49.4% of the miRNAs species in our results and 45.0% of total reads compared with non-parasitized data. There are three miRNAs target on Toll pathway and eighteen for JNK/STAT pathway. With the stem-loop RT-qPCR results, the mir-2989 and mir-199-5p are induced by PDV infection. We hope to utilize RNAi technics, miRNA mimics and sponges in future experiments to manipulate miRNAs values in parasitized *Spodoptera litura* larvae and thus further examine the role of miRNAs. Finding the specific miRNAs responsible for immunosuppression and regulation of the immune system can not only improve our knowledge of insect pathology and provide potential methods for pest management control, but may also translate into better techniques for human medical sciences.

Key words: Polydnaviruses, miRNA, immunosurppression, Toll, JNK/STAT pathway

A rapid method to survey pyrethroid resistance of *Aedes aegypti*

I-Cheng Cheng^{1,2}, Yen-Chi Chen^{1,2}, and Hwa-Jen Teng¹

¹Centers for Disease Control, Ministry of Health and Welfare, Taipei, Taiwan

²National Mosquito-Borne Diseases Control Research Center, National Health Research Institutes, Miaoli, Taiwan

Background/Question/Methods

Dengue fever has been a lethal threat in tropical and subtropical countries worldwide. In Taiwan, there were 15,492 indigenous cases in 2014 and next year the case number even hit the record high to 43,419. This arthropod-borne disease becomes a serious issue of public health. In the absence of specific drug and vaccine, the vector control is now considered a more effective approach. However, due to the long-term usage of pyrethroid insecticide, the primary vector *Aedes aegypti* population of nowadays become more insecticide resistant. The surveillance of resistance level require time-consuming bioassay. It will lead to a difficulty on pest control during breakouts. Here, we are currently developing a rapid method to survey *A. aegypti* pyrethroid resistance level.

Results/Conclusions

Pyrethroid insecticide specifically targets voltage-gated sodium channel (VGSC). It was widely reported that pyrethroid resistance links to VGSC point mutations. Indeed, we observed 4 *vgsc* point mutations – S989P, V1016G, F1534C, and D1763Y – in Taiwan *A. aegypti* population. We have established several resistant strains. The resistant level is correlated to the ratio of mutation loci among the population in those strains. When these results are taken together, it suggests that VGSC gene mutations dynamics in the population may serve as a putative marker for a prompt measurement for *A. aegypti* pyrethroid resistance level.

Key words: *Aedes aegypti*, dengue fever, pyrethroid, insecticide resistance, voltage-gated sodium channel (VGSC)

系統分類、族群遺傳、演化
壁報展示摘要集

Posters:
Systematics, population genetics
and evolution

豔苔蛾屬與美苔蛾屬屬級定義的重新評估（鱗翅目，裳蛾科，燈蛾亞科，苔蛾族）

Evaluating the generic definitions of *Miltochrista* Hübner, [1819] and *Barsine* Walker, 1854 (Lepidoptera, Erebidae, Arctiinae, Lithosiini)

吳士緯

Shipher Wu

中央研究院生物多樣性中心 Biodiversity Research Center, Academia Sinica

Background/Question/Methods

The immature stage has long been proposed to harbor more information for assessing higher classification than the adult morphology in the speciose subtribe Lithosiini of Arctiinae, however, the separation of both species-rich genera *Miltochrista* Hübner, [1819] and *Barsine* Walker, 1854 were previously based only on the male genitalia. The present study re-evaluated their definitions based on the wing venation and immature characters of available taxa.

Results/Conclusions

The recent treatment regarding *Miltochrista* and *Lyclene* Moore, [1860] as synonyms based on male genitalia, is herein also supported through the immature character: a dense band of short, carpet-like setae locating on verrucae, and all known larvae feed on mosses. The forewing SC adjacent to R1 or connecting to R1 can be adopted to separate the two potential lineages in *Miltochrista* (i.e., *Miltochrista sensu stricto* and *Lyclene sensu stricto*). The larvae of typical *Barsine* species, *B. sauteri* (Strand, 1917), feed on dead leaves and bear dense, long secondary setae at thoracic and abdominal segments. The results emphasize the importance of compensating larval morphology for generic judgment in *Miltochrista-Barsine* group, together with known adult morphology can place described and undescribed species into suitable genus further.

Key words: generic assessment, immature stage, wing venation, *Miltochrista*, *Barsine*

Taxonomic revision of Genus *Cylindera* tiger beetles (Coleoptera:
Carabidae: Cicindelinae) in Taiwan

Ming-Hsun Chou, Wen-Bin Yeh

Department of Entomology, National Chung Hsing University

Background/Question/Methods

Cylindera kaleea and *C. elisae* are widespread species in East Asia, and each of them has two subspecies coexisting in Taiwan Island. Previous study shown Taiwanese *C. kaleea* has divergent COI haplotypes (didn't mention which subspecies they are), and *C. e. formosana* belongs to a widespread lineage, but *C. e. reductelineata* forms a separated lineage. The elytra spot patterns of Taiwanese *C. kaleea* change gradually among individuals, and it's difficult to identify its subspecies according to the original description by Bates (1866) and Mandl (1955). We'll examine whether two subspecies of *C. kaleea* coexist in Taiwan Island, and the possibility that *C. e. reductelineata* and *C. e. formosana* are different species because they have diverged morphologically. Moreover, Acciavatti proposed that the type specimen of *C. sauteri* is not the one as same species as *C. sauteri* described commonly, therefore, the type specimen and more samples are necessary to address this taxonomic issue. As for the other *Cylindera* in Taiwan, their genetic compositions will be established and applied to study the above taxonomic debate.

Results/Conclusions

Mitochondrial 16S rDNA of 59 individuals of *Cylindera* and one *Calomera angulata* (outgroup) was amplified and sequenced successfully using primer pairs 16SR21 and 16S22 except *C. psilica psilica* and *C. redunculata*. Taiwanese *C. kaleea* from different localities are grouped into several clades, while the population from Yilan forms a separated clade. *Cylindera elisae* shows a high divergent pattern which could be traced back to about 2.75 million years ago, and *C. e. formosana* and *C. e. reductelineata* are grouped into the same lineage showing a different resolution from the previous study. Unexpectedly, 16S rDNA analysis shows *C. pseudocylindriformis*, *C. cylindriformis* and *C. sauteri* all belonging to the subgenus *Cylindera* were paraphyly.

Key words: *Cylindera*, subspecies, 16S rDNA

Multiplex PCR to Identify Quarantine Western Flower Thrips
(Thysanoptera: Thripidae, *Frankliniella occidentalis*)

Watchalawalee Boonmee and Wen Bin Yeh

Department of Entomology, National Chung Hsing University, Taichung, Taiwan

Background/Question/Methods

Thrips is polyphagous insect that feeds by puncturing and sucking upon plants. It is an important pest to many agricultural plants in the world. Many thrips species were therefore found on the list of quarantine pests. The objective of this study would like to observe the distribution frequency of quarantine species of western flower thrips (*Frankliniella occidentalis*) in Taiwan's montane area. Multiplex PCR based on specific primers, an alternative simplifying identification method additional to morphological characters, was used to identify thrips sampling from montane area such as Wuling, Lishan, Qingjing and Hehuan-shan. Specific molecular markers based on the internal nuclear spacer (ITS), which is a well-known with different patterns among thrips species, can be easily and reliably performed.

Result/Conclusions

Multiplex PCR shown at least two frequency species, i.e. *F. occidentalis* and *F. intonsa*, were commonly found in mountain area while the former one is still commonly found in imported agricultural products. Our results demonstrate multiplex PCR based on ITS can be a reliable, independent and diagnostic tool to identify quarantine western flower thrips.

Key words: Multiplex PCR, thrips, *Frankliniella occidentalis*,

台灣鞘翅目及鱗翅目蟲癭
Coleopteran and Lepidopteran galls of Taiwan

楊心語、林聖豐、楊曼妙

Hsin-Yu YANG, Sheng-Feng LIN, Man-Miao YANG

國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing
University

背景/研究問題/材料方法

蟲癭是昆蟲藉由雌蟲產卵或幼蟲取食刺激植物組織形成，其形態往往被視為造癭者的表型延伸，且造癭者對植物具有專一性，因此在許多調查報告結合此二蟲癭特性反映造癭物種的多樣性。細究其蟲癭發育模式可分為癭蚋模式、癭蜂模式、葉蜂模式，三種模式各自反映造癭類群的演化適應結果。台灣癭學研究鮮有葉蜂模式蟲癭的探討案例，主因往昔調查均無發現造癭類葉蜂所致，然而同被歸類在葉蜂模式下的鞘翅目蟲癭及鱗翅目蟲癭在台灣有所記錄。本研究整理自 1996 至 2017 年此兩目物種的蟲癭紀錄共計 78 筆，就造癭者的寄主特性及產癭部位進行分析其多樣性與相關特性。

結果/結論/應用啟示

結果顯示鞘翅目蟲癭共計 12 蟲癭形態種，分佈於 7 植物科，蟲癭發生部位多著生於植物莖部(9 種)；鱗翅目蟲癭則有 33 蟲癭形態種，分佈於 16 個植物科，其蟲癭著生部位亦是植物莖部最多(17 種)，於葉片造癭次之(13 種)。相較台灣過往記錄的鞘翅目蟲癭(1 種)和鱗翅目蟲癭(4 種)，新增許多蟲癭形態種，此亦反映過往此兩類群造癭者的物種多樣性有低估的狀況。另分析寄主特性顯示蟲癭多樣性隨著特有植物數量提升而增加，具正相關，反映特有植物的比例可能是影響兩類造癭者多樣性的因素之一。

關鍵詞(Key words)：造癭昆蟲(Gall-inducing insect)、鞘翅目(Coleoptera)、鱗翅目(Lepidoptera)、物種豐度(species richness)、多樣性(Diversity)

建立台灣地區重要農業害蟲COI DNA條碼
Establish COI DNA barcodes of important agricultural pests in Taiwan

蔡正隆¹、郭美華¹、宋一鑫²、林明瑩²、葉文斌¹

Cheng-Lung Tsai, Mei-Hwa Kuo, I-Hsin Sung, Ming-Ying Lin, Wen-Bin Yeh

¹ 國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing University

² 國立嘉義大學植物醫學系 Department of Plant Medicine, National Chiayi University

背景/研究問題/材料方法

農業害蟲種類繁多，非分類專長的專家學者，難以鑑定至種，有效投藥防治；加上傳統形態分類人力式微，鑑定時程愈加難以掌握，更增加農作物進出口防檢疫的困擾。近年來，COI DNA條碼在昆蟲分類鑑定上的實用性已廣為分類相關研究採納，除確立鑑定正確性外，亦可由GenBank、生命條碼資料庫系統(Barcode of Life Data Systems, BOLD)收集分析廣布型害蟲序列，了解各國族群變異，預防不同遺傳組成的族群進入台灣，改變台灣族群原有遺傳組成，造成更大經濟損失。

結果/結論/應用啟示

本研究目前共採得560筆國內常見半翅目、鱗翅目、鞘翅目、雙翅目等農業害蟲與10筆檢疫類害蟲，依循BOLD系統建置資料庫，建立標本存證照，也已定序300餘條序列；其中僅約不到50%物種序列可在GenBank明確比對至該種，顯見建立防檢疫、一般性農業害蟲的遺傳資料庫，加速比對鑑定的重要性。在世界貿易組織WTO全球性貿易活動下，全面建立農業害蟲的DNA條碼資料庫，不僅可增加害蟲物種鑑定的時效性，亦可加速農作產品進出口防檢疫的有效性。DNA條碼也可應用於區域間、生物地理區的害蟲遺傳組成比對，如全球廣布危害各種作物的小黃薊馬(*Scirtothrips dorsalis*)、棉蚜(*Aphis gossypii*)及太平洋地區嚴重危害果樹的東方果實蠅(*Bactrocera dorsalis*)等，均可藉由DNA條碼的分析，了解其族群組成及結構，維持各國及(或)區域的單源群特性，防堵不同遺傳組成的害蟲族群間之基因交流，加重危害程度，也進而增加台灣與世界各國的研究合作契機。

關鍵詞 (Key words)：農業害蟲(agricultural pests)、檢疫(quarantine)、DNA條碼(DNA barcodes)、分子鑑定(molecular identification)。

外來入侵南洋肥角鍬形蟲形態變異研究
Morphological variations of the alien invasive *Aegus chelifer* in Taiwan

周瑜淵¹、蔡正隆²、許家維¹、葉文斌²、謝佳宏¹
Yu-Yuan Chou¹, Cheng-Lung Tsai², Chia-Wei Hsu¹, Wen-Bin Yeh², and Chia-Hung Hsieh¹

¹ 中國文化大學森林暨自然保育學系 Department of Forestry and Nature Conservation, Chinese Culture University

² 國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

南洋肥角鍬形蟲 (*Aegus chelifer* MacLeay, 1819) 為肥角屬鍬形蟲的模式物種，廣泛分布於東南亞地區。隨著貿易活動盛行，本種於 1993 年首度發現於高雄的原木工廠，有成蟲及幼蟲採集紀錄，當時相關學者專家將其認定為外來種昆蟲，推測可能是隨著東南亞大型原木進口入侵至台灣。目前已在南部建立族群，主要分布於高雄、屏東與台東。野外觀察發現南部與東部族群在外觀形態上有些許差異，因此本研究採集高雄、屏東及台東樣本進行相關比對分析，並針對南部與東部族群間形態差異的可能原因，提出三種可能假設：(1)生理適應上的差異；(2)不同入侵源；(3)不同種。研究方式採集野外族群，分析其形態與分子特徵，解析南洋肥角鍬形蟲在台灣拓殖及不同族群間的遺傳差異。

結果/結論/應用啟示

野外觀察發現，氣候因素會影響幼蟲與成蟲的生活史階段變化，高雄族群因乾溼季分明氣候影響，成蟲會在雨季繁殖，冬季水分析少，不易於羽化。台東族群乾溼季不明顯，常可見幼、成蟲共棲於朽木中。根據形態統計結果，台東族群與高雄族群外部形態並無明顯差異，顯然並無因生理適應產生的形態變異。然而，COI 的分析結果則顯示這些族群可分為兩個演化系群，支系間的遺傳差異達 7%，明顯已超過鍬形蟲物種的種間界線，因此推測台灣的南洋肥角鍬形蟲可能有兩次不同源入侵事件或隱蔽種問題，冀望未來取得東南亞各地族群，方能進一步解析檢視。

關鍵詞 (Key words)：鍬形蟲 (stag beetle)、入侵種 (invasive species)、形態特徵 (Morphological characteristics)、遺傳多樣性 (Genetic diversity)

樹皮象鼻蟲亞科(鞘翅目:象鼻蟲科)單模屬大量出現的原因探討
Molytinae (Coleoptera, Curculionidae) comprised of high proportion
of monotypic genus

郭宇廷、楊正澤

Yu-Ting Kuo、Jeng-Tze Yang

國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing
University

背景/研究問題/材料方法

象鼻蟲(weevils)為昆蟲綱(Insecta)、鞘翅目(Coleoptera)、象鼻蟲總科(Curculionoidea Latreille,1802)所屬成員的統稱。作者 2015 年於台灣阿里山的含笑(*Michelia* sp.)上採集到 19 隻 *Pimelocerus* 屬象鼻蟲，經過鑑定後確定為 *Pimelocerus pusutulatus* Kôno,1933，*Pimelocerus* 屬為樹皮象鼻蟲亞科(Molytinae)下的一屬，嗣後陸續在該處皆有採得樣本。樹皮象鼻蟲亞科(Molytinae)目前共有 620 種，分為 22 族 92 屬。成蟲、幼蟲危害各種植物。樹皮象鼻蟲亞科(Molytinae)體黑褐色或紅褐色，針狀鱗片覆蓋全身；吻部長又粗；觸角溝接近吻部的末端，前胸腹板前緣內凹，翅鞘遮蔽後胸側片；前足左右基部連接，腿節棒狀末端粗；脛節稍扁。日本東北農業研究發現 *Pimelocerus shikokuensis* Kôno,1934 和 *Pimelocerus perforatus* Roelofs, 1873 的幼蟲在樹幹與地面交界之處的木質部上穿孔危害造成乾枯，葡萄科(Vitaceae)和薔薇科(Rosaceae)重要經濟作物可能因此致死。本研究提供名錄和初步分類問題分析，探討樹皮象鼻蟲亞科(Molytinae)單模屬大量出現的原因。

結果/結論/應用啟示

為了要進行台灣的 *Pimelocerus* 屬分類修訂，經由整理文獻建立 Molytinae Schoenherr,1823 亞科的物種名錄，共計 620 種，92 屬，其中有 35 個單模屬(monotypic genus)。另有一屬 *Plinthus* Germar,1817 達到 75 種，還有兩屬分別是 31 種和 33 種，依據自然類群(nature group)的分類原則比較不尋常。因此以各屬的種組合數目的頻度分析，單一屬種數的變異很大，由 1 到 75 種。分析時分為 5 級，將一屬 1 種的單模屬為第 1 級，第 2 級為 $2 \leq 10$ ，第 3 級為 $11 \leq 20$ ，第 4 級為 $21 \leq 30$ ，第 5 級為 $31 \leq 75$ ，再分析各級屬群建立年代，此亞科的建立年代從 1807-2011 總共 204 年，其中單模屬發生在 1951-1999 也就是在 20 世紀後半期為多，共 15 個屬，佔所有單模屬的 39.5%，經查 Catalogue of Palaearctic Coleoptera Volume 8，Morimoto 發表了 69 篇論文，其中一篇論文題為 Descriptions of a new subfamily, new genera and species of the family Curculionidae of Japan 發表了 20 屬，15 種，詳細閱讀文獻發現，這篇發表的屬都是單模屬。除了單模屬特別多之外，單屬種數達到 30 種以上，甚至高達 75 種的狀態，應該是此亞科未來分類修訂值得深入探討的問題。

關鍵詞(Key words):單模屬(monotypic genus)、樹皮象鼻蟲亞科(Molytinae)、名錄(check-list)

行為、生理、個體生物學
壁報展示摘要集

Posters:

**Ethology, physiology and
organismic biology**

尼泊爾埋葬蟲與尾足蟎之攜遷關係
Phoresy by Uropodina in *Nicrophorus nepalensis*

周匡文¹、廖祥延¹、乃育昕²

Kuang-Wen Chou¹, Hsiang-Yen Liao¹, Yu-Shin Nai²

¹ 國立宜蘭大學森林暨自然資源學系

Department of Forestry and Natural Resource, National Ilan University

² 國立宜蘭大學生物技術與動物科學系

Department of Biotechnology and Animal Science, National Ilan University

背景/研究問題/材料方法

尼泊爾埋葬蟲 (*Nicrophorus nepalensis* Hope) 為親屍性昆蟲，在食物鏈基層扮演重要分解者角色；此埋葬蟲體壁常附著尾足蟎 (Uropodina) 藉此拓展其族群分佈，稱為攜遷 (Phoresy)。本次調查目的為探討尾足蟎在尼泊爾埋葬蟲體壁上附著部位、數量及兩者之關聯性。實驗地點位於宜大延文林場，竹子崙山區，以誘餌掉落式陷阱，進行約一年之採樣調查；蒐集之尼泊爾埋葬蟲，進行蟲體大小測量並記錄蟎類或附著器出現部位及數量，以 F 檢定比較附著部位差異，再以 Multi-Variate Statistical Package (MVSP) 進行群聚分析呈現各體型之附著相似度。

結果/結論/應用啟示

採樣總計 252 隻尼泊爾埋葬蟲，其中 70 隻 (27.8%) 帶有尾足蟎或其附著構造 (180 隻蟎及 105 個附著構造)。蟎類附著位置主要位於前足 (99 筆，34.7%) 及前胸腹面 (69 筆，24.2%)，中足 (32 筆，11.2%) 及後足 (42 筆，14.7%) 次之，腹部 (19 筆，6.6%) 及主腹片 (16 筆，5.6%) 第三，而頭部 (3 筆，1%) 及翅鞘側面 (5 筆，1.7%) 最少；推測尾足蟎附著部位，可能受埋葬蟲清潔、移動取食等行影響。故尾足蟎出現位置以前胸下方為主 (具較佳保護性)。而尾足蟎在頭部分布數量較低，可能為避免影響攜遷宿主感官之現象。MVSP 分析結果顯示，尼泊爾埋葬蟲體型與尾足蟎附著數量無顯著關聯。由上述現象觀察，推測對攜遷現象而言，附著之部位選擇比宿主體型大小重要。

關鍵詞 (Key words): 攜遷 (Phoresy)、尼泊爾埋葬蟲 (*Nicrophorus nepalensis*)、尾足蟎 (Uropodina)、覆葬甲屬 (*Nicrophorus*)、法醫昆蟲學 (forensic entomology)

低溫衝擊無法證實藍紋鋸眼蝶(*Elymnias hypermnestra hainana*)
具有翅色季節型

Cold-shock can not prove that *Elymnias hypermnestra hainana*
has seasonal forms

魏嬭如、顏聖紘

Wei Shann-Ru, Yen Shen-Horn

國立中山大學生物科學系(National Sun Yat-sen University, Department of
Biological Sciences)

背景/研究問題/材料方法

許多眼蝶亞科(Satyrinae)蝶種被認為具有翅面眼紋(eye spots)之季節多態性(seasonal polyphenism)。一般而言這樣的斑紋變化被認為與在高溫季節威赫天敵，而在低溫季節降低醒目性(conspicuousness)有關。為了瞭解溫度對於翅紋發育的影響，過往研究通常在蛹期使用低溫衝擊(cold shock)誘導產生低溫型翅紋。在所有的眼蝶亞科(Satyrinae)物種中，鋸眼蝶屬(*Elymnias*)的多數物種不具任何眼紋，只棲息在常綠棕櫚森林之中，而且不具備由眼紋造成的警訊(warning signal)，因此在過去並未有學者主張鋸眼蝶具有季節多態性。然而在 2013 年，徐堉峰教授指出台灣產藍紋鋸眼蝶具有季節型。他認為相較於高溫型來說，低溫型雌蟲翅面具有較大的暗紅色區域，而雌雄兩性之翅膀腹面也具較清楚之中線(medial line)。由於藍紋鋸眼蝶為小紫斑蝶(*Euploea tulliolus koxinga*)的擬態者(mimic)，而小紫斑蝶並不具備斑紋多態性，因此若擬態者真的呈現多變翅色則會違反貝氏擬態的理論預測。為了印證徐教授的主張，我們採用日本研究者對眼蝶斑紋調控研究的低溫衝擊實驗條件，在使用壽山產族群進行試驗。我們自 6 隻野生雌蝶獲得 48 顆卵，並將幼蟲在 25°C 定溫環境中飼養。最後參考台灣歷年冬季氣溫，在 12L : 12D 的光週期下，將化蛹 12 小時內的蛹分別在 5°C、10°C 與 15°C 下進行 72 小時的低溫衝擊，並與 25°C 組對照。

結果/結論/應用啟示

我們以影像分析軟體評估所有雌性個體翅紋之後發現三個低溫與對照組狀態飼養所得之雌性翅色並無顯著差異，因此我們認為低溫衝擊可能無法佐證藍紋鋸眼蝶翅色季節型的存在。此外在檢視了數位典藏計畫中來自三個博物館的藍紋鋸眼蝶標本影像之後，我們也無法證實雌蟲翅色與物候的關聯性。

關鍵詞 (Key words) : 表型可塑性(Phenotypic plasticity)、低溫衝擊(cold-shock)、季節型性狀(Seasonal Polyphenism)、貝氏擬態(Batesian mimicry)、眼蝶亞科(Satyrinae)

四黃斑蛾之生物學初探
Preliminary ecological study on *Artona flavipuncta* (Lepidoptera:
Zygaenidae)

張宸睿、徐堉峰

Chen-Jui Chang, Yu-Feng Hsu

國立臺灣師範大學生命科學系 Department of Life Science, National Taiwan
Normal University

背景/研究問題/材料方法

四黃斑蛾 *Artona flavipuncta* 成蟲目前在臺灣被視為稀有種的蛾類，因此本種的相關資訊如生活史及生態方面的資料不足，但根據觀察，本種幼蟲的數量實際上不少，並且取食多種薑科 Zingiberaceae 植物。鱗翅目幼蟲的種類、生態習性及行為等具有豐富的多樣性，研究指出群聚和群體的配合協調能夠互相幫助和加強防禦，幼蟲在群體所織出的蟲巢(shelter)中能有效阻止寄生蜂的攻擊。本種幼蟲具有切斷葉片的特殊行為，可於薑科寄主植物上發現明顯的食痕，遭受啃咬的葉片乾枯捲曲形成蟲巢，幼蟲則群聚躲藏其中。由於發現被切葉的葉片數與該植株上幼蟲數量並不吻合，顯示幼蟲並非每隻個體都會切葉，因此幼蟲的切葉行為發生之條件與個體之間的關係值得探討。本研究欲了解四黃斑蛾基礎生活型態、幼蟲切葉的目的和機制以及與其他物種的交互作用關係。

結果/結論/應用啟示

四黃斑蛾應為多世代物種，雌蟲偏好將卵產於上有喬木遮蔽的寄主植物葉背，為聚產，數量最多時可近 130 顆。幼蟲發育時間約為 43 天、蛹期約 2 周，羽化之成蟲性別比雌性略高於雄性。幼蟲共有九個齡期，五齡時部分的幼蟲開始切葉，所造成之枯葉會使取食相同寄主之袖弄蝶 *Notocrypta curvifascia* 幼蟲死亡。

關鍵詞 (Key words)：四黃斑蛾(*Artona flavipuncta*)、切葉行為(Leaf cutting behavior)、群聚(Aggregation)

Roles of duplicated amino acid transporter genes in the developmental integration of the pea aphid and its obligate intracellular symbiont
Buchnera

Hsiao-ling Lu^{1,2,3}, Chun-che Chang¹, Alex C. C. Wilson²

¹Department of Entomology, National Taiwan University, Taipei, Taiwan

²Department of Biology, University of Miami, FL, USA

³Department of Post-Modern Agriculture, MingDao University, Changhua, Taiwan

Background/Question/Methods

The best-studied model of insect symbiosis is that of the pea aphid, *Acyrtosiphon pisum* and its intracellular bacterial symbiont, *Buchnera aphidicola*. *Buchnera* are metabolically and developmentally integrated with their host. *Buchnera* live in specialized aphid cells called bacteriocytes that assemble into an organ-like structure called the bacteriome. Amino acid biosynthesis occurs in the bacteriocytes to compensate for the low availability of some nutrients in the aphid's plant phloem sap diet. *Buchnera* are maternally inherited via transovarial transfer. Reproductive failure is observed when *Buchnera* are eliminated by antibiotic treatment. While the metabolic importance of the symbiosis is clear, the molecular mechanisms underlying *Buchnera* transmission and integration during aphid development are largely unknown. Extensive amino acid transporter (AAT) gene duplication has been identified in the pea aphid genome; duplications which are important for sustaining the nutritional interactions of the host with its endosymbionts. Among the duplicated AAT genes, we selected to study the developmental expression of bacteriocyte enriched AATs to gain insights into their potential roles at the aphid/*Buchnera* interface during embryogenesis.

Results/Conclusions

We tracked the expression and localization of the top three bacteriocyte enriched AAT genes: *ACYPI000536*, *ACYPI008904* and *ApGLNT1*. We found that *ACYPI000536* and *ACYPI008904* were expressed in the posterior region of the blastula embryos where the embryos uptake the maternal endosymbionts. Our results suggest that expression of *ACYPI000536* and *ACYPI008904* genes may play novel developmental roles in symbiont recruitment and bacteriome development. *ApGLNT1*, the only functionally characterized aphid AAT gene, localized to the embryonic follicular epithelium and sheath cells, but did not localize to the bacteriocyte membrane during embryogenesis. In contrast in the maternal bacteriome *ApGLNT1* localizes to the bacteriocyte cell membrane. These ontogenetic shifts in localization of *ApGLNT1* protein in the host bacteriome demonstrate that maternal and embryonic bacteriomes are not equivalent.

Key words: amino acid transporter, *ApGLNT1*, aphid, endosymbiont, developmental integration

兩種農田濕地常見共域蜻蜓水蠶之掠食行為研究
A study of foraging behavior in ecological context for two coexist larval
Anisoptera in farm pond

歐德娜¹、蔡思聖²、黃國靖³

Odchimeg Nyamsvren¹, Sih-Sheng Cai², Kwok-Ching Wong³

蒙古國立生命科學大學農業生態學院生態與保育學系講師¹/ 行政院農業委員會
花蓮區農業改良場²/ 國立東華大學³

Lecturer of Ecology and conservation biology department, Agroecology school,
Mongolian University of Life Sciences¹/ Hualien District Agricultural Research and
Extension Station, Council of Agriculture, Executive Yuan²/ National Dong Hwa
University³

背景/研究問題/材料方法

麻斑晏蜓 *Anax panybeus* Hagen, 1867 與大華蜻蜓 *Tramea virginia* (Rambur, 1842) 為廣泛分布且並存於東台灣地區的農田水域中。本研究探討此二不均翅亞目物種的掠食行為受到不同生態因子的影響所產生的改變，亦即頂層掠食者的出現、競爭壓力、底質移除三種情景。實驗處理包括採用大紅娘華 *Laccotrephes robustus* Stal, 1870 做為頂層掠食者出現、共域競爭壓力以及底質移除的移動障礙。本研究觀察中，掠食行為反應可區分成侵略、搜尋、噴射與靜止四大類行為與其細項。誘發掠食行為的食餌則採用莫氏樹蛙蝌蚪以及大肚魚。Mann-Whitney 檢定法檢驗各情景配對處理以及兩物種間的掠食行為差異。

結果/結論/應用啟示

在掠食者出現、競爭壓力的場景，大華蜻蜓的侵略行為於對照組已展現低活動力而無顯著差異，麻斑晏蜓與大華蜻蜓皆有類似的活動抑制表現而有顯著較長的靜止時間。底質移除場景中，兩物種活動力顯著增加並花費更多的時間在水平移動上，麻斑晏蜓在此場景中，侵略行為皆顯著降低並反映在捕食量的減少，大華蜻蜓則未受到明顯的負面影響。從大多數的行為反應可以發現麻斑晏蜓有較大華蜻蜓高的活動量，屬於“快打型適應策略”。許多農田水利工程的水泥化整治以及降雨分布不均所造成的區域乾早已逐漸影響天然水域中的微棲地組成。水蠶種間互動可能因而漸趨頻繁並影響掠食行為之表現與族群動態。

關鍵詞: 晏蜓屬(*Anax*)，微誌蜻屬(*Tramea*)，同類相殘(cannibalism)，底質(substrate)，棲地劣化(habitat degradation)、灌溉埤塘(irrigation ponds)

雌性藍紋鋸眼蝶(紫蛇目蝶)的「紅褐色」區塊是否會降低擬態效果？

Does the reddish brown area of wings reduce the effectiveness of mimicry between
Elymnias hypermnestra hainana and *Euploe tulliolus koxinga*?

楊昕、顏聖紘

Yang Hsin, Yen Shen-Horn

國立中山大學生物科學系(Department of Biological Sciences, National Sun Yat-sen
University)

背景/研究問題/材料方法

在一個防禦型擬態關係中，擬態模式(model)與擬態者(mimic)之間對掠食者所展現的訊息相似度決定了擬態的效果與擬態關係的穩定性。也就是說如果擬態者所展現的警訊具備多態性(polymorphism)或不一致性(inconsistency)就有可能降低擬態的利益。然而在不完美擬態(imperfect mimicry)體系中，天擇壓力似乎能夠佳惠不精確擬態者，而使得擬態模式與擬態者所展現的警訊不需精準吻合。以全球尺度來說，擬態模式與擬態者之間的不精準吻合似乎最常見於東亞與東南亞。然而不精準的配合是否就暗示著不完美擬態的存在或甚至是擬態關係的瓦解則很少藉由實驗行為學策略檢驗。在本研究中我們以行為學實驗檢驗藍紋鋸眼蝶雌蟲翅紋的紅褐色翅紋是否影響擬態效果。在過往研究中，藍紋鋸眼蝶被認為是小紫斑蝶的完美貝氏擬態者，然而我們在近年發現有相當比例的雌蟲翅紋具有變異程度很高的紅褐色面積。由於這個顏色並不見於小紫斑蝶，因此我們懷疑這個顏色是否會降低擬態效果，或甚至會增加雌蟲的醒目程度反而提高其被捕食率。我們在本實驗中利用本土的白頭翁與外來的白腰鵲鴿做為捕食者進行室內捕食試驗，並分析翅紋變異程度與被捕食率的關聯性。我們推測若紅褐色部份的確可能降低擬態效果，那麼我們就應探討有害於擬態斑紋在族群中具有高表現頻度的成因；若紅褐色並未降低擬態效果，那麼我們將朝向不完美擬態與婚配選擇方向思考，也就是說紅褐色區域未必降低擬態效果，然而這個性狀卻與雄性對雌性的求偶偏好有關。

關鍵詞 (Key words): 不完美擬態(Imperfect mimicry)、多態性(polymorphism)、季節型性狀(Seasonal Polyphenism)、貝氏擬態(Batesian mimicry)、眼蝶亞科(Satyrinae)

A Visualizing PPL2ab neurons connectivity with transsynaptic tracer

Shiu-Ling Chen, Yu-Hui Chen, Tsai-Feng Fu

Department of Applied Chemistry, National Chi-Nan University, Nantou 545, Taiwan

Background/Question/Methods

Our knowledge of the neurobiological basis of the decline of male sexual desire in aging is limited by our poor understanding of the brain circuitry and neuronal pathways that control male sexual desire. There are a number of studies indicating that dopamine (DA) affects sexual desire in many species. We used genetic tools and behavioral assays to identify a novel subset of DA neurons that regulate age-associated male courtship activity in fruit fly, *Drosophila*.

Results/Conclusions

We found that increasing DA levels in a subset of PPL2ab neuronal cluster was necessary and sufficient to boost courtship strength in both young and aged male flies. Our preliminary results highlight the importance of DA levels in PPL2ab neurons and the potential role of novel processes related to visual cue-dependent inter-male courtship behavior. However, we found that male courters preferred female courteses, which implies the increased DA levels in PPL2ab neurons did not change male sexual orientation. In this study, we proposed a series tools to build an inducible genetic intersectional strategy to determine PPL2ab neurons are necessary and sufficient, through dopamine, modulate male sexuality and inter-male courtship. As such a complicated behavior could be simply controlled by this neural circuitry, anatomical tracing of neural circuits originating from specific PPL2ab neurons may shed light on the pattern of sex-specific wiring of neural circuitry in fly brain. So, we will to generate a series transgenic flies carrying different. Wheat germ agglutinin (WGA)-based or non-toxic tetanus toxin C-fragment (TTC)-based neuronal tracer that is progressing fairly concretely, provide an enlightening glimpse into the worthy scientific strides being made in our understanding of the *Drosophila* sexual brain.

Key words: Inter-male courtship, Dopamine, PPL2ab

蘭嶼與巴布延島的大圓斑球背象鼻蟲的幼蟲齡期與成蟲體型的比較
Larval stage and body size of endemic *Pachyrhynchus sarcitis*
(Coleoptera: Curculionidae) from Lanyu and Babuyan Islands

黃龍椿¹、黃文山²、林仲平³、Olga M. Nuñez⁴、曾惠芸^{2*}、唐欣潔^{1*}
Lung-Chun Huang¹, Wen-San Huang², Chung-Ping Lin³, Olga M. Nuñez⁴
Hui-Yun Tseng^{2*}, Hsin-Chieh Tang^{1*}

¹ 台北市立動物園 Conservation and Research Center, Taipei Zoo, Taipei, Taiwan

² 國立自然科學博物館 Department of Zoology, National Museum of Natural Science, Taichung, Taiwan

³ 台灣師範大學 Department of Life Science, National Taiwan Normal University, Taipei, Taiwan

⁴ 民達那峨大學 Department of Biological Sciences, Mindanao State University–Iligan Institute of Technology, Tibanga, Iligan City, Philippines

背景/研究問題/材料方法

海洋島嶼上的特有物種因為海洋阻隔、有限的棲地承載量、較小的有效族群量、與其他的隨機因素影響，較大陸型物種更容易面臨生存的威脅。對瀕危物種而言，人工圈養繁殖技術的建立是重要的保育與經營管理策略之一。大圓斑球背象鼻蟲 (*Pachyrhynchus sarcitis*) 為不會飛的鞘翅目昆蟲，身上有極為亮眼的圓斑，主要分布於台灣的蘭嶼、綠島、菲律賓巴布延群島等島嶼上。雖然球背象鼻蟲在島嶼上的特有性極高，且面臨了極大的棲地破壞與採集壓力，而迄今有關球背象鼻蟲的生活史資料仍然極為匱乏。本研究利用火筒樹 (*Leea guineensis*) 作為大圓斑球背象鼻蟲幼蟲食草，首次成功完成這個物種的人工繁殖。除了詳細紀錄人工繁殖的球背象鼻蟲生活史資訊，並比較蘭嶼與巴布延島兩個族群的幼蟲齡期與成蟲體型的差異。

結果/結論/應用啟示

人工繁殖結果顯示兩個族群的大圓斑球背象鼻蟲的幼蟲齡期有顯著的差異，蘭嶼族群有較高的幼蟲齡期數（四齡至八齡），卵至羽化天數約 123 天至 229 天；而巴布延族群的幼蟲齡期數較少（四齡至六齡），卵至羽化約 111 天至 173 天。成蟲離開蛹室後斑紋的顏色才會出現，硬度則會逐漸變硬。人工繁殖的蘭嶼族群成蟲體型和野外的族群相似，但是人工繁殖的巴布延族群則體型較野外小。以蘭嶼族群來看，幼蟲期的長短和成蟲體型並無相關。幼蟲發育齡期與成蟲體型的差異可能與食草適應有關，而這兩個族群是否為不同種則需要更多的研究。

關鍵詞 (Key words): 隱蔽種 (cryptic species)、島嶼特有 (island endemic)、幼蟲發育 (larval development)、生活史 (life history)

生物多樣性、
族群與群聚生態學
壁報展示摘要集

Posters:
**Biodiversity, population and
community Ecology**

「黃金」中的昆蟲秘密－排遺 DNA 高通量條碼分析探討
Detecting the insect prey by diet analysis: metabarcoding of fecal samples

廖崇甫、黃羽萱、郭晉緯、林政道、方引平*

Chong-Fu Liao, Yu-Hsuan Huang, Chin-Wei Kuo, Cheng-Tao Lin, Yin-Ping Fang*

國立嘉義大學生物資源學系 Department of Biological Resources, National Chiayi University

背景/研究問題/材料方法

傳統食性分析以消化過程中殘留的獵物碎片進行鑑定，然而可鑑定到物種者極少。隨著 DNA 高通量條碼分析技術 (DNA metabarcoding) 的發展，分子食性分析可增加鑑定的精細度。其中，食蟲性蝙蝠排遺碎片分子分析在國外已有許多研究報導，然國內尚少。為瞭解此方法應用在臺灣蝙蝠食性分析的可行性，以及探討序列比對的問題，本研究利用 6 個排遺 DNA 混合樣本 (各含 30 顆排遺)，分別進行粒線體 COI 基因部分序列擴增；其後將產物進行次世代定序。獲得之大量序列資料以 RStudio 軟體自行編寫程式進行整理，並與 NCBI 資料庫進行比對。本報告僅針對比對結果中序列相似度>98%的單型與其對應物種進行討論。

結果/結論/應用啟示

6 個樣本共得 670,419 條序列，可分析出 6,022 單型；與資料庫相似度>98%的共有 1,522 單型，其中可鑑定到物種有 1,053 單型，部分需要人工檢核確認。鑑定出的節肢動物有 87 種，昆蟲占 82 種，主要為鱗翅目與雙翅目。然而，許多對應到的序列缺乏分類資訊，或對應到數個物種。原因可能為臺灣昆蟲物種 DNA 條碼資料尚未完整，或此基因序列在部分類群解析力較差。有趣的是，有些物種在臺灣並無分布，可能為新紀錄種。食蟲性蝙蝠的分子食性分析除可瞭解蝙蝠本身的取食特性外，也提供另個探索當地昆蟲物種的管道。因此，臺灣昆蟲物種 DNA 條碼資料若能持續增加，應有助於瞭解昆蟲類群與其捕食者的生態連結。

關鍵詞 (Keywords)：食蟲性蝙蝠 (Insectivorous bats)、次世代定序 (NGS)、DNA 條碼技術 (DNA barcoding)、鱗翅目 (Lepidoptera)

掠食者發育過程中的覓食策略轉移可能會促進獵物性狀選汰壓力的
多樣性

Ontogenetic shift of predator foraging strategy may promote divergent
selection on prey phenotype

周育霆、顏聖紘

Yu-Ting Chou, Shen-Horn Yen

國立中山大學生物科學系 Department of Biological Sciences, National Sun Yat-sen
University

背景/研究問題/材料方法

許多研究顯示，在自然環境中，掠食者群聚結構的異質性與時空變化會造就具備不同警戒或擬態性狀昆蟲在適存度上的差異。而掠食者本身的覓食偏好隨著個體發育而改變有可能對獵物產生完全不一樣的天擇效應。因此，我們認為有必要瞭解同一種掠食者在不同成長階段對同一種昆蟲所造成的捕食壓力以及對不同部位的性狀選汰是否有差異。評估昆蟲所受捕食壓力的方法之一便是度量並比較遭受掠食者攻擊的頻度與被攻擊後產生的傷口樣態。在本研究中，我們嘗試使用不同發育階段的斯文豪氏攀蜥來攻擊各種共棲的鱗翅目昆蟲，並記錄攀蜥對同一套性狀組合的接收、反應與攻擊頻度。並以形態測量學比較傷口的位置、面積、形狀，與對稱性，找出能區別不同成長階段之掠食者的關鍵標記。

結果/結論/應用啟示

根據我們的觀察與測試紀錄，發現越幼年的攀蜥對具備橘、白色色斑的蝶翅具有較短的攻擊準備時間及較高的攻擊頻度，對於不可食的蝶種則有較高的試誤次數。而獵物受損形態的測量結果，發現幼年期攀蜥所造成的傷口多位在前翅的前緣及頂區且無對稱性；然而成熟攀蜥則偏向攻擊蝴蝶頭部。因此我們認為以獵物受損型態來推測掠食者身分時，需考慮掠食者在發育過程中所展現的掠食策略轉移。

關鍵詞 (Keywords)：覓食策略 (foraging strategy)、個體發育 (ontogeny)、捕食壓力 (predation pressure)、斯文豪氏攀蜥 (*Japalura swinhonis*)、鱗翅目 (Lepidoptera)

Effects of experimental warming and transgenic marking on oriental fruit fly *Bactrocera dorsalis*

Ming-Chih Chiu^{1,2}, Yu-Han Ni¹, Kuang-Hui Lu¹, Mei-Hwa Kuo¹,

¹*Department of Entomology, National Chung Hsing University, Taichung, Taiwan*

²*Department of Life Sciences, National Chung Hsing University, Taichung, Taiwan*

Background/Question/Methods

A continuation of global warming and climate change is predicted to occur in the coming decades. Climate change could influence the efficiency of MRR (mark-release-recapture) experiments, which are seldom addressed especially for transgenic marking with fluorescent protein. The oriental fruit fly (*Bactrocera dorsalis*), which is important pest in agricultural ecosystems around the world, was used as a model to evaluate the responses of transgenic-marking strains to future warming. The wild and transgenic fruit fly were subjected to four temperature treatments with oscillating regimes that represent current conditions (mean: 28.6°C) and different scenarios (means: 30, 32.5, and 35°C).

Results/Conclusions

As the simulated temperatures increased, so did the negative effects on the life-history traits and demography of only wild cohorts. However, with a moderate increase in average temperature to 32.5°C, the both types of fruit fly faced decreases in their growth and the lower growth occurred in transgenic than wild cohorts. In addition, a severe increase to 35.0°C caused the failure of all individuals to reach adulthood. Our findings suggested that future warming will affect the demography differentially and consideration of warming effects into marking methodologies can boost robust applications of MRR under the changing future.

Key-words: fruit fly, climate change, demography, temperature regime, warming

海岸山脈農業地景之生物多樣性變異—稻叢與水域無脊椎動物群集
結構比較

Biodiversity Varied in Agricultural Landscape around Coastal Mountain
Range - a Comparative Study on Epigeal and Aquatic Invertebrate
Assemblage

徐仲禹¹、蔡思聖¹、許宏昌¹、黃國靖²、范美玲¹

Chung-Yu Hsu, Cih-Sheng Cai, Hung-Chung Hsu, Kwok-Ching Wong, Mei-Lin Fan

¹ 行政院農業委員會花蓮區農業改良場

Hualien District Agricultural Research and Extension Station

² 國立東華大學自然資源與環境學系

National DongHwa University, Department of Natural Resources and Environmental
Studies

背景/研究問題/材料方法

海岸山脈北起花蓮溪口，南至卑南溪口，最高處為新港山僅 1,682 公尺。除了豐富的生物多樣性資源，其為許多不同原住民族群聚落落腳處，並以農耕活動為主要生計。雖然東部稻田的棲境相對單純，無脊椎動物相卻仍具有極高的物種多樣性（本場累計資料無脊椎動物可達 250-350 種之間）。本研究在海岸山脈段兩側選擇新社村（東）、苓雅聚落（西）之稻田為研究樣點，調查稻叢與水域兩種棲地來呈現稻田內無脊椎動物物種多樣性（ α diversity）。我們採用聚類分析理解樣本間的組成相似性：透過群平均法，將樣本間的相似性距離畫成樹狀圖（dendrogram）。ANOSIM 被用以檢測不同處理間是否顯著分群。SIMPROF 則能以模擬分析找出最適群集樣本的分類模型，可用以探討與實驗處理分群間的差異。

結果/結論/應用啟示

稻叢共採得 177 種無脊椎動物，水域則具 65 種。本研究發現在空間尺度上，海岸山脈東西兩側具有顯著的生物組成差異，同區域內不同農業操作間的生物組成變異在稻叢與水域群集有不同的表現。影響農業地景內稻田生物多樣性變化的成因極為多元、包含人為操作、週邊地景、氣候、物種源、擾動頻度等。未來，週邊的環境變項組合與生物組成間的相關性值得研究人員加以探討，以利於農業地景內的土地資源利用與生物多樣性保育。

關鍵詞（Keywords）：社會生態生產地景（Socio-ecological Production Landscapes and Seascapes）、里山倡議（Satoyama Initiative）、有機農業（Organic agriculture）、水棲昆蟲（Aquatic insect）、稻田（Paddy fields）

Walk with butterflies?
Evaluating city sidewalks as habitat for *Pieris* butterflies

溫彝禎、何傳愷

I-Chen Wen, Chuan-Kai Ho

國立台灣大學生態學與演化研究所

Institute of Ecology and Evolutionary Biology, National Taiwan University

Background/Question/Methods

Human development rapidly increases the size of urban areas. Some studies have evaluated urban environment (e.g., parks) as habitat for wildlife; however, few have examined the role of sidewalks. Given that sidewalks are a common component of cities worldwide (e.g., about 900km long or 1% area in Taipei city), we investigated whether sidewalks in an interactional city (e.g., Taipei) can be suitable habitat for wildlife (e.g., *Pieris* butterflies). Our study included these experiments: (1) To understand the temporal/spatial variation in food resource, we conducted monthly surveys on the host plants of *Pieris* on Taipei sidewalks. (2) To examine whether *Pieris* would inhabit sidewalks, we conducted daily surveys on *Pieris* density during seasons. (3) To test the quality of sidewalks as *Pieris* habitat and the effects of abiotic factors on *Pieris* performance, we raised *Pieris* larvae in both sidewalk and natural habitats. (4) To understand the factors contributing to *Pieris* mortality, we placed *Pieris* eggs and artificial *Pieris* larvae in sidewalk and natural habitats.

Results/Conclusions

The first year results showed that *Pieris* actually inhabited sidewalks in April and May (Exp2). *Pieris* egg density was higher in natural than sidewalk habitat. However, *Pieris* population peaked earlier in sidewalk. Consistently, larvae developed faster in sidewalk than natural habitats (Exp3), likely due to the higher temperature. In addition, eggs seemed to face a lower mortality in sidewalk than natural habitat (Exp4). These results will be further verified. Our results suggest that sidewalks may serve as an underappreciated habitat for wildlife such as *Pieris* butterflies.

Key words: *Pieris*, urban ecology, herbivory

Discovery of a new species of genus *Amblyseius* Berlese (Acari: Phytoseiidae) on organic farm from Taiwan

Jhih-Rong Liao¹, Hsiao-Chin Lee¹, Chyi-Chen Ho², Chiun-Cheng Ko^{1*}

¹Department of Entomology, National Taiwan University, Taipei, Taiwan

²Taiwan Acari Research Laboratory, Taichung City, Taiwan

Background/Question/Methods

Phytoseiid mites have been intensively surveyed in Taiwan during the past several decades because of their potential as biological control agent. There are 58 phytoseiid species recorded in Taiwan thus far. Previous studies mainly focused on agricultural areas of Taiwan to investigate potential biological control agent. This study presents one new *Amblyseius* species found on *Citrus limon* and *Ageratum houstonianum* on organic farm in Puli Township, Nantou County.

Results/Conclusions

This new *Amblyseius* species is belonged to *obtusus* species subgroup and similar with *Amblyseius obtuserellus* Wainstein and Beglyarov. The new species differs from *A. obtuserellus* in narrower ventrianl shield (wider in *obtuserellus*), relative length of macrosetae $Sge\ IV > Sti\ IV > St\ IV$ ($Sge\ IV > St\ IV > Sti\ IV$ in *obtuserellus*). We also found the Chinese specimens of *A. obtuserellus* could be misidentification; they are close to this new species. This species was found can feed on whitefly and spider mites on Lemon, and also on low-growing plants; it may have biocontrol potential but this needs further study. In this study, the new phytoseiid species was discovered from an organic farm but no found in surrounding areas. The organic farm has complicated species composition. Their organic cultivated strategy will provide survival chance for natural enemies of pests. Conservation strategies for biodiversity in agroecosystems have is worth.

Key words: new species, phytoseiid, agroecosystem

病媒、生物防治、蟲害管理
壁報展示摘要集

Posters:

**Disease vector, biological
control and pest management**

2016 年及 2017 年葡萄園及芒果園農藥廢容器調查及分析
Surveys and Analysis of Pesticide Waste Container of Grape and Mango
Orchards in 2016 and 2017

孫浩翔、王順成

Hao-Siang Sun, Shun-Cheng Wang

朝陽科技大學環境工程與管理系

Department of Environmental Engineering and Management, Chaoyang University of
Technology

背景/研究問題/材料方法

台灣農藥使用種類繁多，農藥對環境污染十分複雜，為維護台灣國人及環境之健康，利用間接農藥廢容器收集法調查一般農藥及偽劣農藥之狀況，研究台灣不同農作物農藥使用之狀況，為本研究主要之議題。由農藥廢容器，可更貼近農民農藥使用之真實情況，資料有利於政府農藥管理及企業對農藥使用之參考。本研究調查主要以台灣重要經濟作物葡萄及芒果之農藥廢容器為主，並間接分析農藥使用種類及用藥型態。

結果/結論/應用啟示

民國 104 年 5 月至 105 年 4 月採集葡萄園之農藥廢容器，總樣品數為 908 件，民國 105 年 5 月至 106 年 1 月採集芒果農藥廢容器總數為 948 件。分析結果可以得知使用於葡萄園之農藥以殺菌劑 65.7% 最多，其次為殺蟲劑 23.1%、除草劑 6.6% 次之；芒果園農藥使用以殺菌劑 41% 最多，其次為殺蟲劑 32%、除草劑 6%、次之偽劣藥 12%。葡萄園並無採集到偽劣藥，也顯示出中部地區政府管理及零售商推薦用藥正確；農藥廢容器中，葡萄園使用最多之殺菌劑為達滅芬 (Dimethomorph)，芒果園則是以鋅錳乃浦 (Mancozeb) 為主。以不同縣市各別比較之結果，葡萄園調查結果台中地區及彰化地區之防治藥劑及防治對象大致相同；芒果園調查結果顯示台南地區及屏東地區之間所使用之藥劑差異甚小，說明台灣同作物間因縣市不同之差異較小。於本研究芒果偽劣藥顯示出南部地區所使用偽劣藥比例較高，政府應加強管理。

關鍵字(Key words)：農藥廢容器(Empty pesticide container)、偽藥(Counterfeit pesticides)、殺蟲劑(Insecticide)、殺菌劑(Fungicide)、除草劑(Herbicides)

Ames 測試法探討牛樟芝萃取出主成分 Antrocin 之致變異性與治癌性
The Mutagenic Effect and Potential Cancer Therapy of *Antrodia
cinnamomea* Antrocin by Ames Test

甘珉慈、王順成

Min-Ci Kan, Shun-Cheng Wang

朝陽科大環境工程與管理系

Department of Environmental Engineering and Management, Chaoyan University of
Technology

背景/研究問題/材料方法

牛樟芝為生長於台灣特有種牛樟樹上獨有之真菌，近年來於自然界尋找藥用的議題受重視，牛樟芝的藥理效用逐漸受世人認可，諸如腫瘤抑制、增強免疫等，而其必須築基於毒性劑量觀念之上。根據衛生福利部食品藥物管理署公告之「可供食品使用原料彙整一覽表」中，牛樟芝列為可供食品使用原料菇蕈類之一，而本研究以微生物回復突變性試驗法(mammalian microsomal reversion assay, Ames test)針對牛樟芝次級代謝產物-倍半萜內酯Antrocin進行試驗，同時對Antrocin的致變異性及抗突變表現進行討論。

結果/結論/應用啟示

Antrocin 配製濃度分別為0.1、1、10、100 $\mu\text{g}/\text{plate}$ ，在致突變試驗中，對 *S. typhimurium* TA98及TA100菌株不經肝臟酵素系統試驗自發回復突變率為0.4-1.25%；經肝臟酵素系統試驗自發回復突變率為0.26-1.26%，皆低於2倍自發回復突變率，於試驗劑量範圍內不具致突變性。抗突變試驗中，對 *S. typhimurium* TA98及TA100菌株不經肝臟酵素系統試驗使用誘變劑4NQO，TA98菌株於Antrocin劑量內最高具有5.9%抗致突變，TA100菌株於Antrocin劑量內最高具有13.6%抗致突變，具微弱抗致突變能力；經肝臟酵素系統試驗使用誘變劑2-AF，TA98菌株於Antrocin劑量內最高具有66%抗致突變效果，具高度抗致突變能力。顯示Antrocin在抗致突變之治癌效果需經體內肝酵素之代謝才能產生。

關鍵詞 (Key words)：安姆氏測試法(Ames test)、致變異性(Mutagenicity)、安全性評估(Safety assessment)、牛樟芝(*Antrodia cinnamomea*)、次級代謝物(Secondary metabolites)

由絢小蜂科寄生蜂之生物學探討其防治荔枝癭蚧的可能性
The possibility of using Eulophidae sp. as a control agent to the gall
midge *Litchiomyia chinensis* Yang & Luo (Diptera: Cecidomyiidae)
based on the parasitoid biology

趙宜閔、林聖豐、楊曼妙

Yi-Min Chao, Sheng-Feng Lin, Man-Miao Yang

國立中興大學昆蟲學系

Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

針對2008年入侵的害蟲荔枝癭蚧(*Litchiomyia chinensis* Yang & Luo)，臺灣現行的防治方式以藥劑防治為主，雖能有效壓制族群密度，但就永續防治的角度來看並非最理想的方法。在過往臺灣的荔枝癭蚧相關調查中，已發現一種以上的荔枝癭蚧寄生蜂在田間建立穩定的族群，若能妥善利用，將成為田間防治荔枝癭蚧的一項利器。本研究於高雄市、臺中市、南投縣、臺南市及彰化縣五個荔枝主要產區採樣蒐集荔枝癭蚧寄生蜂，以此建立寄生蜂物種清單，擇其中最優勢者建立生物學資料，並透過不同的成蟲飼養條件及性別比來推測其生殖策略，探討未來寄生蜂用於防治荔枝癭蚧之可行性。

結果/結論/應用啟示

根據自2016至2017年的田間採樣結果，一共蒐集到三種寄生蜂形態種，其中最優勢物種為外寄生之絢小蜂科Eulophidae sp.。將此種絢小蜂成蟲在25°C以不同食物條件(不餵食、餵食清水、餵食10%蜂蜜水)進行飼養。結果顯示：成蜂餵食10%蜂蜜水的壽命為 12.6 ± 5.4 天(n=38)，僅餵食清水壽命為 7.1 ± 1.9 天 (n=17)，不餵食的情況下壽命為 1.9 ± 0.6 天(n=9)。此外，蒐集而得的寄生蜂皆為雌蟲。根據此種絢小蜂成蟲之取食情形及性別比，推測其為應變式(synovigeny)寄生蜂，並可能行孤雌生殖。此資料可為擬定荔枝癭蚧生物防治策略時，寄生蜂施放時機之參考。

關鍵詞 (Key words): 荔枝(Litchi)、寄生蜂(Parasitoid wasp)、生物防治(Biocontrol)、生殖策略(Reproductive strategy)、壽命(Lifespan)

Effects of conventional and organic farming on arthropod food web structure and ecosystem service (biocontrol) in rice paddy farms

Jia-Ang Ou, Gen-Chang Hsu, Chuan-Kai Ho

Institute of Ecology and Evolutionary Biology, National Taiwan University, Taipei, Taiwan.

Background/Questions/Methods

It is often assumed that organic farming is more environmentally friendly than conventional farming. However, the effects of these contrasting farming methods on food web structures and its associated ecosystem service remain largely unexplored. Moreover, whether these effects vary with space and time is also unknown. To fill these knowledge gaps, we investigated 1) how organic and conventional farming affect arthropod food web structures and ecosystem service (biocontrol) of rice farms in central Taiwan, and 2) whether the effects vary with landscape (mountain, plain and coast) and crop stage (seedling, tillering, flowering and ripening). At each farm, we collected arthropods by net-sweeping, classified them by feeding guild, and analyzed their stable isotopes ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) to construct their respective food web structures in "isotopic-niche space". To investigate the biocontrol service, we used stable isotope mixing model to estimate predators' diet composition. Metrics of food web structure and biocontrol service were plotted over farming practices, landscape and crop stage to reveal the effects of the three factors.

Results/Conclusions

While finalizing our data analysis, we expect the following findings: 1) Arthropod food web structures are more complex in organic than conventional rice farms, providing empirical evidence that organic farming may be more environmentally friendly, 2) Predator species richness, density, and proportion (to all arthropods) are higher in organic than conventional rice farms, suggesting that organic farming can promote biocontrol service. 3) Organic (but not conventional) rice paddies have more complex food webs in mountain than other regions, suggesting a landscape-farming practice interaction on food web structure. 4) Regardless of farming practices, arthropod food webs at early crop stages (seedling and tillering) are dominated by detritivores, likely due to abundant detritus and algae at these stages. Overall, the results will advance our understanding on the effects of farming practices on food webs and ecosystem service across landscape and crop stage.

Keywords: food webs, trophic interactions, stable isotopes, agroecology

開發新型簡易蚊蟲餵血裝置
A novel blood meal feeder for mosquitoes blood feeding

莊子瑩¹、李亞哲¹、林宜穎¹、杜武俊^{1,2}、黃旌集^{1,3}
Tzu-Ying Chuang, Ya-Zhe Lee¹, Yi-Ying Lin¹, Wu-Chun Tu^{1,2}, Chin-Gi Huang^{1,3}

¹ 國家衛生研究院蚊媒傳染病防治中心

National Mosquito-borne Diseases Control Research Center, National Health
Research Institute

² 國立中興大學昆蟲學系

Department of Entomology, National Chung Hsing University

³ 臺北市立大學地球環境暨生物資源學系

Department of Earth and Life Science, University of Taipei

背景/研究問題/材料方法

以活體動物提供血液給吸血性昆蟲吸食，一直是飼養和繼代的常用方法，但使用活體動物進行供血時有供血時間的限制、動物的照料成本、與動物保護等諸多問題，開發人工裝置進行供血是必要的趨勢。本試驗利用鐵粉氧化發熱原理設計不需電源加熱的簡易人工餵血裝置；並以埃及斑蚊雌蚊進行此人工吸血裝置與小白鼠進行供血時的效率比較。

結果/結論/應用啟示

實驗結果顯示實驗室品系埃及斑蚊，人工餵血裝置可在 30 分鐘的供血期間內，達到和使用小鼠供血時同樣的雌蚊飽血比率，經測試該人工餵血裝置持續供血達 5 個小時仍可維持 95% 以上的雌蚊飽血率。使用人工餵血裝置進行供血的雌蚊，其平均產卵數略低於使用小鼠供血的組別，但兩者所產出的卵數量及孵化率沒有明顯差異。我們的結果顯示在飼養和繼代大量埃及斑蚊時，使用此人工餵血裝置在成本、效率與人道的考量下，能夠做為取代使用小鼠進行供血的方法。

關鍵詞 (Key words)：人工餵血器 (Artificial Feeder)、埃及斑蚊 (*Aedes aegypti*)

協力劑對登革熱病媒蚊幼蟲表現解毒基因的作用
Role of insecticide synergists on detoxification genes expression in *Aedes aegypti* larvae

張箴毅、曾偉倫、羅怡珮

Chen Yi Chang, Wei-Lun Tsen, Yi-Pey Luo

嘉南藥理大學生物科技系 Department of Biotechnology, Chia-Nan University of
Pharmacy and Science

背景/研究問題/材料方法

協力劑與殺蟲劑混合使用可增強殺蟲劑有效成分的殺蟲效果，藉由抑制昆蟲對殺蟲劑的解毒機制達到殺蟲效果，其中 PBO (piperonyl butoxide) 及 MGK 264 會抑制昆蟲體內 MFO (mixed function oxidase) 的活性，TPP (triphenyl phosphate) 會抑制羧基酯酶的活性，DEM (diethyl maleate) 會抑制麩胺基硫轉移酵素 (GST) 的活性。本研究以PBO、DEM及TPP處理對百滅寧具高度抗性的埃及斑蚊幼蟲，探討協力劑對登革熱病媒蚊幼蟲表現解毒基因的作用

結果/結論/應用啟示

以 PBO、DEM 及 TPP 混合百滅寧進行對抗性品系埃及斑蚊幼蟲的生物檢定，顯示協力劑與百滅寧的比例會影響對百滅寧的協力效果。幼蟲接觸協力劑不同處理時間，會表現對百滅寧不同的感受性。三種協力劑對與殺蟲劑抗性相關的基因 *CYP6BB2*, *CYP9J26*, *GSTe7* 及 *CCEae3a* 具有不同抑制表現的作用。

關鍵詞 (Key words)：埃及斑蚊 (*Aedes aegypti*)、協力劑 (synergists)、抗藥性 (resistance)、解毒基因 (detoxification gene)

IsoPlot: a database for comprehensive gene isoforms in three mosquito vector species

Jia-Hsin Huang¹, I-Man Ng¹, Shang-Chi Tsai¹, and Huai-Kuang Tsai¹

¹Institute of Information Science, Academia Sinica, Taipei, Taiwan

Background/Question/Methods

Alternative splicing (AS), a mechanism by which different forms of mature mRNAs (messenger RNAs) are generated from the same gene, occurs widely in the metazoan genomes to expand functionally distinct mRNA isoforms. AS is a crucial biological mechanism which enables new mosquito control strategies such as genetic modifications and RNA interference on targeting specific transcript variants. With increasing transcriptome data of the major mosquito vector species, a database for visualization and comparison of mRNA isoforms with up-to-date information is needed for further research.

Results/Conclusions

IsoPlot is a publicly available database with visualization tools for exploration of AS events, including three major species of mosquitoes, *Aedes aegypti*, *Anopheles gambiae*, and *Culex quinquefasciatus*, and the fruit fly *Drosophila melanogaster*. IsoPlot includes not only 88,663 annotated transcripts but also 17,037 newly predicted transcripts from massive transcriptome data at different life stages of mosquitoes. Notably, scientists can apply IsoPlot to (a) identify distinctive events of splicing variations under different experimental conditions and (b) compare splice isoforms of orthologous genes in neighboring species through pairwise sequence alignment. IsoPlot could provide a useful resource to biological community for aiding mosquito vector research, which is vital to public health.

Key words: mosquitoes, isoforms, transcriptome, database, Diptera

黑角舞蛾核多角體病毒 ORF105 (APSUP) 之蛋白質結構預測及功能分析
Protein structure prediction and functional assay of ORF105 (APSUP) from
Lymantria xyli multiple nucleopolyhedrovirus

張如君¹、黃鈺峰²、蘇渝晴¹、周怡靜¹、張紫婷¹、李世貞³、王重雄⁴、乃育昕¹
Ju-Chun Chang¹, Yu-Feng Huang², Yu-Ching Su¹, Yi-Ching Chou¹, Zih-Ting Chang¹, Se Jin
Lee³, Chung-Hsiung Wang⁴ and Yu-Shin Nai¹,

1. 生物技術與動物科學系，國立宜蘭大學 Department of Biotechnology and Animal Science, National Ilan University
2. 基因體中心，中央研究院 Genomics Research Center, Academia Sinica
3. 韓國全北大學，農業與生物學系 Department of Agricultural and Biology, Chunbuk National University
4. 國立台灣大學，昆蟲系 Department of Entomology, National Taiwan University

背景/研究問題/材料方法

昆蟲桿狀病毒主要有兩類抑制細胞凋亡基因 (*p35* 及 *iap*)，此類基因在病毒感染初期扮演重要角色。近期研究指出，由吉普賽舞蛾核多角體病毒 (*Lymantria dispar* MNPV, LdMNPV) 基因體鑑定出新的『凋亡抑制基因』 (*apoptosis suppression protein, apsup*)，而台灣特有之黑角舞蛾核多角體病毒 (*L. xyli* MNPV, LyxyMNPV) 基因體中亦存 *apsup* 之同源基因 (即 *lyxy-orf105*)，故本實驗將由 LyxyMNPV 基因體擴增 *lyxy-orf105* 並進行蛋白質結構預測，利用蛋白質快速表現系統進行抑制細胞凋亡活性測試。

結果/結論/應用啟

利用專一性引子對增幅 LyxyMNPV 之 *lyxy-orf105 (apsup)* 後，定序大小為 1,002 bp (胺基酸全長預測為 333 aa)；在 LyxyMNPV 感染 NTU-LY-1 細胞後 1 小時即開始表現至 12 小時大量表現至 72 小時。比較 18 個病毒同源胺基酸序列，發現 APSUP 蛋白具 5 個保守區域 (由 N 端至 C 端命名為 Domain I-V)。蛋白質結構預測具兩結構區域 (1-220 及 221-333)，再透過結構比對 (PDBeFold) 預測在 Domain I (70-71) 與 Domain II (115-120) 可能有配位基 (ligand) 交互作用。抑制細胞凋亡活性結果顯示，全長 (Domain I-V)、Domain I-IV, I-III, I-II 及 Domain I-only 可抑制果蠅 RPR 蛋白及放射線菌素-D (Actinomycin-D, ActD) 所誘導之細胞凋亡，且 Domain I-only 具有較高抑制細胞凋亡活性，但 Domain II-only 則不具抑制果蠅 RPR 蛋白誘導之細胞凋亡活性；經由西方墨點法分析發現，Domain III-V 可能具蛋白酶活性 (protease activity) 而酶切位置可能於 Domain I 之 N 端 (前 5 kDa)，進而調控 APSUP 功能。綜觀上述結果推測 APSUP 之 Domain I 為抑制細胞凋亡之關鍵區域，而 Domain III-V 蛋白酶活性未來將進一步釐清。

關鍵詞 (Key words): 黑角舞蛾核多角體病毒 (LyxyMNPV)、抑制細胞凋亡 (anti-apoptosis)、果蠅 RPR (*Drosophila reaper*)、放射線菌素-D (Actinomycin-D, ActD)、*lyxy105 (lyxy105)*

利用生物廢棄物餵養普通家蠅幼蟲進行生長情形之比較
The difference performance of *Musca domestica* (Diptera)
on feeding biowaste

張鈞詠、黃冠霖、吳尹文

Chun-Yung Chang, Kuan-Lin Huang, Yin-Wen Wu

國立金門大學食品科學系

Department of Food Science National Quemoy University

背景/研究問題/材料方法

製酒業及畜產業為金門縣重要產業，其每年產出逾百噸的生物廢棄物如高粱酒糟 (sorghum distillery residues) 及牛隻排泄物 (cow manure) 有待開發。因近年人口快速膨脹，聯合國農糧組織建議將昆蟲作為主食，若利用生物廢棄物所餵養的昆蟲在生長情形上比起一般飼養來得突出，可用於食品或藥品的開發，以達到生物廢棄物之再利用，並解決環境污染問題。本研究使用5種不同的比例混和牛糞及酒糟作為飼養基質 (A組=4:0、B組=3:1、C組=1:1、D組=1:3、E組=0:4) 並使用實驗鼠飼料作為對照組 (F組) 餵養普通家蠅 (*Musca domestica*)，共6組；觀察不同組之間家蠅生長情形 (化蛹率、羽化率、總存活率及蛹的大小) 之差異。

結果/結論/應用啟示

實驗結果顯示，化蛹率最高為C組；羽化率最高為D組；總存活率最高為C組，經統計結果顯示取食6種不同比例生物廢棄物為基質的家蠅化蛹率及總存活率各組之間有顯著性的差異，而羽化率則無。測量家蠅幼蟲取食6種不同基質之蛹長、寬及重量，蛹長度以B組為最長；蛹寬度以B組為最寬；蛹重量以D組為最重，經統計分析結果得知，取食6種基質之家蠅在蛹之長度及寬度有顯著性差異，而蛹之重量在各組之間則無。綜合上述結果，利用生物廢棄物 (A-E組) 所飼養的普通家蠅生長情形比對照組 (F組) 好，並且生物廢棄物的成本價格低廉，具開發價值。

關鍵字：生物廢棄物 (biowaste)、高粱酒糟 (sorghum distillery residues)、牛隻排泄物 (cow manure)、普通家蠅 (*Musca domestica*)、金門 (Kinmen)

X 光技術於農產品進出口之非破壞性檢疫應用
Non-destructive X-ray quarantine applying to import and export of
agricultural commodities

楊曼妙¹、林達德²、周呈雲²、江昭皚²、楊育誠²、林裕哲¹、林振睿¹
Man-Miao Yang¹, Ta-Te Lin², Cheng-Ying Chou², Joe-Air Jiang²,
Yu-Cheng Yang², Yu-Che Lin¹, Jhen-Ruei Lin¹

¹ 國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing University

² 國立台灣大學生物產業機電工程學系 Department of Bio-Industrial Mechatronics Engineering, National Taiwan University

背景/研究問題/材料方法

隨著交通工具的發展，世界各國貿易日益興盛，許多物種藉此途徑成為侵入其他國家的外來種，而具有隱匿式取食習性的害蟲很容易藉由農產品進出口時入侵其他國家。目前害蟲檢疫工作主要仰賴目視檢查，水果類害蟲檢疫於有疑慮時必需進行侵入性的剖果檢視，但此方式會導致果實喪失商品價值。果實蠅類昆蟲一直是國際間重要的水果害蟲，不論是進出口，在水果檢疫或篩選時需耗費不少人力，再者，近年來台灣出口的蓮霧(*Syzygium samarangense*)多次被輸入國攔截到米爾頓絨小蜂(*Anselmella miltoni*)，其危害部位為種子，被感染之果實無法由外觀辨識。因此，本研究嘗試建立以 X 光技術為主的非破壞性檢疫，除可增加台灣水果出口的產值，也能降低進口農產品夾帶外來害蟲的風險。

結果/結論/應用啟示

藉由將果實蠅卵及幼蟲植入梨果、核果、柑果、漿果及瓜果等五類水果的試驗中，得知除瓜果類與部分果肉較不均質的水果外，其他類水果皆可在危害 6 天內以 X 光成像偵測出來。進一步將此項技術應用於米爾頓絨小蜂的出口檢疫，可經由成像觀察到蓮霧內部是否遭到米爾頓絨小蜂感染，並建立受感染果實的影像資料庫，期望能達到高效率與高檢出率的蓮霧出口之非破壞性自動化檢疫。隨著 X 光影像成像與影像分析技術的日益發達，也期望此項技術能擴展至其他農產品進出口之檢驗。

關鍵詞 (Key words): 外來種(invasive species)、植物隱匿性害蟲(concealed-feeding plant pest)、自動化檢疫(automatic quarantine)、蓮霧(wax apple)

不同溫度下偽菜蚜取食油菜及小白菜的生活史
The life cycle of *Lipaphis erysimi* (Hemiptera: Aphididae) fed on rape
and non-heading type Chinese cabbage at different temperatures

黃郁涵¹、朱政龍¹、蕭文鳳²

Yu-Han Huang Cheng-Lung Chu Wen-Feng Hsiao

¹ 國立嘉義大學植物醫學系 Department of Plant Medicine, National Chiayi
University

² 嘉義市

背景/研究問題/材料方法

偽菜蚜是十字花科主要的害蟲之一，在台灣多在十一月至次年四月發生，對全年都能種植的小白菜與油菜的為害並不清楚。因而想進行其生活史之探討。自嘉義大學農場種植的黃金白菜與油菜上，各自兩種作物上採回蟲源，帶回實驗室，放入25°C恆溫生長箱內飼養一代後，再進行15、20、25和30°C四個溫度的實驗。自蟲源逢機選取初產下之一日齡若蟲分別進行不同溫度之實驗。以一隻為一重複，每個溫度有50重複。每天觀察記錄其發育與成蟲生殖之狀況。利用 Chi (2015)年齡齡期之兩性生命表進行數據分析。

結果/結論/應用啟示

當取食黃金白菜時，在上述 15-30°C 四個溫度的世代長依溫度由低到高分別為 14.9、15.2、14.2、12.5 天。就生活史參數而言，依溫度由低到高， r 值為 0.1208、0.2096、0.3403、0.3479/天； R_0 為 5.6、15.13、32.73、23.12 子代/雌蟲； λ 為 1.1284、1.2331、1.4054、1.4161； T 為 14.25、12.96、10.25、9.03 天。當取食油菜時，在上述四個溫度的世代長依溫度由低到高分別為 13.7、15.8、15.8、13.1 天。就生活史參數而言，依溫度由低到高， r 值為 0.1097、0.1475、0.3805、0.3249/天； R_0 為 4.85、9.81、42.13、22.3 子代/雌蟲； λ 為 1.1159、1.1589、1.4631、1.3838； T 為 14.40、15.48、9.83、9.56 天。上述結果顯示，偽菜蚜在台灣低海拔全年皆可種植之油菜與黃金白菜上會隨著溫度的升高，完成一個世代的時間也縮短；但 r 值、 λ 值及 R_0 會增加。

關鍵詞 (Key words)：偽菜蚜(*Lipaphis erysimi*)、生活史(life cycle)、油菜(*Brassica napus*)、小白菜(*Brassica rapa chinensis*)

臺灣茶樹粉蝨類害蟲之分布與族群動態調查
Distribution and population dynamics of the whiteflies in tea fields
in Taiwan

寧方俞^{1*}、廖治榮²、許飛霜¹、廖珠吟¹、柯俊成²

Fang-Yu Ning, Jhih-Rong Liao, Fei-Shuang Xu, Chu-Yin Liao, Chiun-Cheng Ko

¹ 行政院農業委員會茶業改良場 Tea Research and Extension Station

² 國立臺灣大學昆蟲學系 Department of Entomology, National Taiwan University

背景/研究問題/材料方法

臺灣茶區之粉蝨類害蟲包含茶柑橘刺粉蝨 (*Aleurocanthus spiniferus*)、茶刺粉蝨 (*Aleurocanthus* sp.) 及茶摺粉蝨 (*Aleurotrachelus camelliae*) 三種。此類害蟲好發於生長茂密且不通風之茶園，刺吸危害葉片並分泌蜜露誘發煤煙病，造成樹勢衰弱及茶農的經濟損失。本研究為了解茶樹粉蝨類害蟲於臺灣茶區之分布與族群動態，自 2015 年起陸續採集全臺灣各茶區共 62 個樣點之粉蝨樣本，攜回實驗室鏡檢鑑定。並從 2016 年起於楊梅 (臺茶 20 號，無施用農藥)、龍潭 (青心大有，慣行管理)、名間 (臺茶 12 號，慣行管理) 及魚池 (臺茶 12 號，無施用農藥) 茶園，以黃色黏紙進行成蟲密度監測，以期了解相同生態棲位下，何者為茶園中的優勢蟲種。

結果/結論/應用啟示

試驗調查結果顯示，茶摺粉蝨多發生於中低海拔茶區，包含坪林茶區、石碇茶區、三峽茶區、龍潭茶區、楊梅茶區、大溪茶區、新埔茶區、關西茶區、日月潭茶區、名間茶區、鹿谷茶區、古坑茶區及鹿野茶區。拉拉山茶區、阿里山茶區、梅山茶區、東眼山茶區及翠峰茶區等高海拔茶區，則僅有茶刺粉蝨的蹤跡。成蟲族群監測結果顯示，楊梅及龍潭茶區監測點以茶摺粉蝨為優勢蟲種，名間茶區監測點以茶刺粉蝨為優勢蟲種，魚池茶區監測點的茶刺粉蝨及茶摺粉蝨則呈明顯動態消長。粉蝨族群間的消長可能受茶樹品種、栽培管理方式、環境微氣候及用藥習慣等多因子影響，僅從成蟲族群監測較難判斷原因。無論是隨機採集或是黃色黏紙監測均未發現茶柑橘刺粉蝨，間接證實了臺灣茶樹上的刺粉蝨長期被誤認為是柑橘刺粉蝨的事實。

關鍵字 (Key words)：茶樹 (tea tree)、粉蝨 (whitefly)、族群動態 (population dynamics)

施用己酸 (Hexanoic acid) 對小黃瓜上棉蚜 (*Aphis gossypii* Glover)
族群增長之影響

Effects of Hexanoic Acid on the Population Development of Cotton
Aphid (*Aphis gossypii* Glover) on Cucumber

許北辰、董耀仁

Bei-Chen Hsiu, Yaw-Jen Dong

農業試驗所應用動物組 Applied Zoology Division, Agricultural Research Institute

背景/研究問題/材料方法

綜合遺傳、基因組學及生物化學研究顯示，植物遭受半翅目昆蟲取食危害時所引起的防禦反應與遭受微生物病原入侵時類似。己酸 (Hexanoic acid) 是一種單羧酸，已知存在於野草莓 (*Fragaria vesca* L.) 及楊梅 (*Arbutus unedo* Linnaeus) 中，為一種天然化合物。前人研究顯示己酸可誘發不同植物對不同病原微生物之防禦反應，是一種廣效性天然誘導物。至目前為止並無己酸對小黃瓜棉蚜影響之研究結果。因此，本試驗以小黃瓜盆栽於室內探討己酸不同方式施用於小黃瓜是否對棉蚜族群成長造成影響，藉由此研究我們希望未來能發展一安全、有效的棉蚜非農藥防治方法。

結果/結論/應用啟示

根據小黃瓜室內盆栽試驗結果，於本試驗條件下己酸以種子浸泡或澆灌方式處理，小黃瓜上的棉蚜族群成長顯著低於對照組且效果隨著使用濃度增加提升；小黃瓜噴施0.04%及0.08%己酸較對照組小黃瓜顯著影響棉蚜族群成長；己酸以揮發方式處理小黃瓜除0.08%處理組外，對棉蚜族群成長影響與對照組無差異。綜合上述試驗結果，以己酸處理小黃瓜可降低小黃瓜上棉蚜族群成長，但效果受己酸處理方式及使用濃度影響。本試驗結果證實誘導抗病物質己酸施用於小黃瓜可對棉蚜族群發展造成影響，此類誘導抗病物質於半翅目植食性害蟲防治上之應用值得進一步投入研究。

關鍵詞 (Key words)：己酸 (Hexanoic acid)、小黃瓜 (Cucumber)、棉蚜 (*Aphis gossypii*)、誘導防禦 (Induced resistance)

基徵草蛉微膠囊人工飼料新製程
An New Encapsulation Process of Microcapsule Diet for Rearing *Mallada basalis* (Walker) (Neuroptera: Chrysopidae)

許北辰、余志儒

Pei-Chen Hsu, Jih-Zu Yu

行政院農業試驗所應用動物組 Taiwan Agricultural Research Institute, Applied
Zoology Division

背景/研究問題/材料方法

利用微膠囊人工飼料作為食物為基徵草蛉量產之關鍵技術。目前草蛉的人工飼料大多使用石蠟膜擠出或熱封來做為飼料包埋的方法，本研究目的為精進既有之微膠囊化製程，將製程中飼料之推進動力由高壓空氣改以馬達直驅動力，並將飼料全程密閉於矽膠管內，收穫微膠囊時之冷卻系統亦改為密閉式，以減少汙染及簡化操作流程。

結果/結論/應用啟示

新的微膠囊人工飼料製作技術在製程設計與整體空間需求、機具重量上有明顯的改進。整體空間需求與機具重量，則分別縮減為舊製程的 1/12 與 1/5。此製程可節省操作人力、減少器械成本、降低耗能器械，且由於微膠囊於密閉空間中冷卻收穫，因此利於試驗人員搜集成品。此外，由於原料的驅動方式改變，因此輸送的過程中不易受到器械汙染，並可由少量原料進行製備生產，適合低量試驗操作。

關鍵詞 (Key words)：基徵草蛉 (*Mallada basalis* (Walker))、微膠囊飼料 (Microcapsule diet)、微膠囊化製程 (Encapsulation Process)、核殼結構 (Core-Shell Structure)

草蛉飼養技術的回顧與改進

Review and improvement of mass rearing of the green lacewing

趙語矜、陳泓如、盧美君

Yu-Chin Chao, Hung-Ju Chen, Mei-Chun Lu

行政院農委會苗栗區農業改良場 Miaoli District Agricultural Research and
Extension Station, Council of Agriculture, Executive Yuan

背景/研究問題/材料方法

草蛉作為許多小型害蟲的天敵，許多歐美國家早已成功商品化行銷全球，而台灣由農試所開發的本土種—基徵草蛉(*Mallada basalis* (Walker))飼育技術所產出的草蛉商品，仍因成本過高，至今尚未能成為成熟的產業。本研究回顧了過往國外關鍵技術，試圖改善現有技術的缺失，利用本場長期飼養的基徵草蛉，(一)針對幼蟲飼育空間，改以獨居方式飼養；(二)以次氯酸鈉集卵法，比較不同濃度、時間處理後，草蛉卵柄溶解效率及孵化率；(三)以粉斑螟蛾(*Cadra cautella* (Walker))卵做為替代飼料。

結果/結論/應用啟示

(一)幼蟲以獨居方式飼養僅需不到傳統 1/5 的飼育空間，並藉由避免同類自相殘殺現象(cannibalism)，進而提升結繭率與羽化率；(二)以 0.6%次氯酸鈉水溶液浸泡 4 分鐘，綜合卵柄溶解率及孵化率有最佳效果，並與對照組無顯著差異；(三)比起傳統餵食外米綴蛾(*Corcyra cephalonica* (Stainton))卵，在同樣餵食過量飼料的情形下，餵食粉斑螟蛾卵的結繭率、羽化率及公母比上並無顯著差異。本研究採用獨居飼養法以提升飼養效率，次氯酸鈉集卵法則能降低獨居飼養接種步驟額外的人力需求，此外，使用粉斑螟蛾卵作為替代飼料成本較低廉，並能適時補上目前外米綴蛾卵產能的不足的問題。未來若能在飼養過程耗費較多成本的部分，如接種、飼料、餵食、集卵等步驟配合自動化機械的投入，相信草蛉商品化的目標能在近年內達成。

關鍵詞 (Key words)：基徵草蛉(*Mallada basalis* (Walker))、獨居飼養法(partition rearing method)、次氯酸鈉集卵法(sodium hypochlorite based-egg harvesting method)、粉斑螟蛾(*Cadra cautella* (Walker))

福化利結合養蜂管理方式應用於台灣蜂蟹蟎防治之評估
Evaluation of the combination of fluvalinate and beekeeping methods for
the control of *Varroa destructor* in Taiwan

徐培修¹、陳昶璋²、吳姿嫻¹、盧美君¹

Pei-Shou Hsu, Chang-Chang Chen, Tzu-Hsien Wu, Mei-Chun Lu

¹ 行政院農業委員會苗栗區農業改良場 Miaoli District Agricultural Research and
Extension Station, Council of Agriculture, Executive Yuan

² 衛生福利部國家中醫藥研究所 National Research Institute of Chinese Medicine,
Ministry of Health and Welfare

背景/研究問題/材料方法

蜂蟹蟎(*Varroa destructor*)為西洋蜜蜂(*Apis mellifera*)體外寄生蟲，以吸食蜜蜂體液維生，是台灣養蜂產業主要敵害。福化利是我國唯一登記用於蜂箱之蜂蟹蟎防治藥劑，若能搭配其他養蜂管理方式控制蜂群內蜂蟹蟎族群，可降低蜂蟹蟎產生抗藥性之風險。蜂蟹蟎繁殖過程在封蓋蜜蜂幼蟲房中進行，雄蜂幼蟲封蓋期長，可繁殖出更多具生殖能力之雌成蟎。割除雄蜂房及更換新蜂王都是常見的養蜂管理方式，可控制雄蜂幼蟲數量及造成蜜蜂幼蟲斷層。本研究利用福化利進行蜂蟹蟎防治，並配合雄蜂房移除及關王一週以模擬換王造成的幼蟲斷層，於田間實驗進行3週藥效評估，包含對照組在內之各處理皆為4重複。

結果/結論/應用啟示

防治效果利用隔蟎蜂箱收集底盤落蟎數量進行評估，隔蟎蜂箱也具物理防治效果。對照組蜂群部分減群，剩餘蜂群平均防治率為62.4% (n=2)，福化利處理為71.9%，福化利搭配雄蜂房割除為81.8%，福化利搭配雄蜂房割除處理且關王處理為85.2%，顯著高於僅以福化利防治之效果。福化利藥劑僅能防治寄生於成蜂之蜂蟹蟎，尚有蜂蟹蟎陸續隨蜜蜂羽化出房，而蜂王羽化至產卵期間會產生幼蟲斷層；另雄蜂幼蟲房又會提高蜂蟹蟎擴增速度，此時已不需要雄蜂幼蟲。試驗結果顯示，於換王期間以福化利進行蜂蟹蟎防治，並配合雄蜂房割除，可提高蜂蟹蟎防治效率。

關鍵詞 (Key words)：蜂蟹蟎 (*Varroa destructor*)、西洋蜜蜂 (*Apis mellifera*)、福化利 (fluvalinate)、養蜂管理 (beekeeping methods)

高雄地區埃及斑蚊幼蟲對殺蟲劑敏感性測試
Insecticide susceptibility of *Aedes aegypti* in Kaohsiung area

李亞哲¹、丁柔心¹、黃旌集^{1,2} 杜武俊^{1,3}

Ya-Zhe Lee¹, Jou-Hsin Ting¹, Chin-Gi Huang^{1,2}, Wu-Chun Tu^{1,3}

¹ 國家蚊媒傳染病防治研究中心 National Mosquito-borne Disease Control Research Center, National Health Research Institute

² 臺北市立大學地球環境暨生物資源學系 Department of Earth and Life Science, University of Taipei

³ 國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

台灣南部地區經常性的使用殺蟲劑防治登革熱病媒蚊，導致埃及斑蚊對殺蟲藥劑抗藥性的產生，是登革熱防疫面臨的一大難題。本實驗以 2017 年高雄市使用的第佳寧乳劑、煞蟲乳劑和富力旺乳劑等殺蟲藥劑進行前鎮、苓雅、三民、與鳳山地區埃及斑蚊幼蟲的藥劑敏感性測試，並以實驗室敏感品系為對照，計算半數致死濃度(LC₅₀)、99%致死濃度(LC₉₉)、抗性比值(RR₅₀ 和 RR₉₉)等，以評估埃及斑蚊幼蟲的抗藥性。

結果/結論/應用啟示

測試結果，對於各野外品系埃及斑蚊幼蟲之感受性，皆明顯低於敏感品系；顯示田間埃及斑蚊已經具有抗藥性。以各抗性分級定義下，第佳寧乳劑對於前鎮地區之埃及斑蚊已產生「低抗性」，對於苓雅、三民、與鳳山地區已產生「中抗性」；煞蟲乳劑於前鎮、苓雅、與三民地區已產生「低抗性」，對於鳳山地區已產生「中抗性」；富力旺乳劑對於所有測試地區之埃及斑蚊皆產生「中抗性」，三種藥劑中以富力旺乳劑產生較高的抗性，

關鍵詞(Key words)：埃及斑蚊(*Aedes aegypti*)、抗藥性(Insecticide resistance)、抗性比值(Resistance ratio)

埃及斑蚊對糖類的偏好試驗

Sugar preference in the Mosquito *Aedes aegypti*(Diptera : Culicidae)

邱于恩¹、林子甄¹、黃旌集^{1,2}、杜武俊^{1,3}

Yu-En Chiu¹, Tzu-Chen Lin¹, Chin-Gi Huang^{1,2}, Wu-Chun Tu³

¹國家衛生研究院蚊媒傳染病防治研究中心 National Mosquito-borne Diseases Control Research Center, National Health Research

²臺北市立大學地球資源暨生物科學系 Department of Earth and Life Science, University of Taipei

³國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing University

在自然環境中，蚊子無論雌雄，都會從露水、花蜜或其他地方攝取糖分以獲取能量；因此利用帶有糖份甜味的毒餌誘引蚊蟲前來吸食，可發展毒糖餌法(attractive toxic sugar bait, ATSB)防治病媒蚊。本試驗在於尋找埃及斑蚊雌蚊偏好取食的糖類，並在其中加入毒餌，以助成蚊之誘殺。本試驗選用葡萄糖、蔗糖、麥芽糖、木糖等蚊蟲會吸食的糖液，以兩兩選擇方式進行偏好選擇試驗。試驗結果在95%信心水準下進行2 Sample Poission Rates比較分析，結果顯示埃及斑蚊雌蚊對糖液的選擇偏好依序為蔗糖>葡萄糖>麥芽糖>木糖。

關鍵詞(key word)： *Aedes aegypti*、ATSB、Sugar

埃及斑蚊室內產卵偏好及防治應用
Indoor Oviposition Preference of *Aedes aegypti* (Diptera: Culicidae) and
the Control Application

王冠智¹、張家源¹、吳逸鈞¹、黃旌集^{1,2}、杜武俊^{1,3}

Kuan-Chih Wang¹, Chia-Yuan Chang¹, Yi-Jun Wu¹, Chin-Gi Huang^{1,2}, Wu-Chun Tu^{1,3}

¹ 國家蚊媒傳染病防治研究中心 National Mosquito-Borne Diseases Control
Research Center, National Health Research Institute

² 臺北市立大學地球資源暨生物資源學系 Department of Earth and Life Science,
University of Taipei

³ 國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing
University

背景/研究問題/材料方法

埃及斑蚊為台灣登革熱主要傳播媒介，喜好生活於社區、室內居家等地方，因此瞭解其室內習性對其防治十分重要。本研究利用台南市區 12 間大小位置相似的公寓房間，每間各擺設 20 個誘卵桶 (Ovitrap)，每間置入一隻懷卵雌蚊，探討埃及斑蚊在室內產卵之偏好。

結果/結論/應用啟示

實驗結果顯示 92.0% 的斑蚊偏好在牆邊產卵，且陰暗處誘卵桶的陽性事件發生率顯著大於其它組。同時發現斑蚊分散產卵平均為 2.3 個陽性桶 (SD=2.0)，其中有 63.6% 並無分散產卵行為。另外，以誘殺桶和誘卵桶進行誘蚊產卵比較，發現蚊蟲並無顯著偏好，故未來在室內防治上，可將誘卵桶及誘殺桶擺置室內非陽光直射之牆邊陰暗處，提升防治成效。

關鍵詞 (key words): 埃及斑蚊 (*Aedes aegypti*)、產卵偏好 (Oviposition Preference)

大型斑蚊誘殺裝置之開發與應用

The Development and Application of the Large-Sized Gravitrap

李宜勳¹、李侖遠¹、吳逸鈞¹、黃旌集^{2,3}、杜武俊^{1,3}Yi-Shiun Lee¹, Lun-Yuan Li¹, Yi-Jun Wu¹, Chin-Gi Huang^{2,3}, Wu-Chun Tu^{1,3}¹ 國家蚊媒傳染病防治研究中心 National Mosquito-Borne Diseases Control Research Center, National Health Research² 臺北市立大學地球資源暨生物資源學系 Department of Earth and Life Science, University of Taipei³ 國立中興大學昆蟲學系 Department of Entomology, National Chung Hsing University

背景/研究問題/材料方法

病媒蚊誘殺、誘引器為常用的病媒蚊監測方法，多數市售誘引器都需額外連接電源以正常運作，不利於放置田間使用。大型誘殺裝置具操作簡易、不需外接電力等優點，容易製作且維護簡單，可放置於公共空間進行捕殺，以達長期監測與降低病媒蚊數量之功用。本研究製作了兩種不同類型的大型誘殺裝置，地下室型於室外大型網籠內進行測試，社區型則於在2017年第11週至第38週在社區放置六個進行測試，並於附近放置市售誘卵桶Ovitrap進行比較。

結果/結論/應用啟示

本研究分三個部分，第一部分將社區型誘殺裝置放置於台南的三個里，一里兩個，三里平均每週引誘斑蚊產卵數分別為130、62、185顆，上蓋打洞後誘卵數增加，而其他改良無明顯差別，而市售Ovitrap各里平均誘引斑蚊產卵數為33、15、116顆，顯示大型誘殺桶誘卵數皆高於Ovitrap。第二部分將地下室型誘殺裝置放置於室外大型網籠，結果對埃及斑蚊成蚊的累積誘殺率可達52%。第三部分將地下室型誘殺裝置與自製小型誘殺進行比較，大型誘殺裝置累積誘殺率達24%，小型裝置達36%；惟累積誘卵數方面，大型裝置可達1,625顆，小型裝置僅為140顆。比較間隙分別為1 cm與4 cm之浮筏產卵數，間隙1 cm浮筏於間隙中卵數為28顆，間隙4 cm浮筏則可達427顆。總結以上試驗，大型誘殺裝置可發揮誘集更多蚊卵、以及捕殺成蚊的功效，具有很大的田間防治登革熱病媒蚊潛力。

關鍵詞 (Key words)：埃及斑蚊 (*Aedes aegypti*)、白線斑蚊 (*Aedes albopictus*)、誘蚊產卵誘殺桶 (Gravitrap)

Study on the Effects of Bioactive Compounds against German cockroach (*Blattella germanica*) under Laboratory Conditions

Sama Sapakuka¹, Donisio Shol², *Lekhnath Kafle¹

Department of Tropical Agriculture and International Cooperation, National Pingtung University of Science and Technology, Pingtung 912, Taiwan

*Corresponding Author: kafle@mail.npust.edu.com

Background/Question/Methods

Cockroaches are among the most common pests in many homes and other buildings. They are considered one of the most successful groups of animals because they are so adaptable, and successfully adjusted to living with humans. German cockroach *Blattella germanica* is known as the one that has the most troublesome, which prefers indoor locations. Bioactive compounds are excellent alternatives to traditional insecticides because of its low toxicity to wildlife and environment friendly. Compared with other bioactive compounds, the active ingredients of many essential oils are reasonably priced because they are commonly used as flavors and fragrances. This is another reason why bioactive compounds are excellent alternative to traditional insecticides. Although, there are more effective application to control *B. germanica*, recent studies have focus on developing alternative methods to reduce negative impact caused by using chemical insecticides that certain to affect human health and the environment. Here we experimentally test the respond of adult male and female *B. germanica* against few compounds with four concentrations (0.25, 0.5, 1, 2, and 4 ml/cm²).

Results/Conclusions

However, results shows that Sandalwood was found to be the most effective compound with 100% killed at 24h observation. Eugenol acetate and Eugenol otherwise were also found effective where both compound tended 100% killed at 120h observation. Therefore, results conclude that the three tested compound were all effective against the adult stage of *B. germanica* through all the five concentration. Also, they show that the high the concentration the higher the number of *B. germanica* died. Bioactive compound can be the best alternative replacement to some of the chemical insecticides against *B. germanica*.

Key words: Bioactive compounds, *Blattella germanica*, insecticides

Evaluation of the House Fly Bait under Laboratory Condition

Jose Olman Santeliz Gonzales¹, Lee Lu-Lin¹, Lekhanth Kafle¹

¹Department of Tropical Agriculture and International Cooperation, National Pingtung University of Science and Technology, Pingtung 912, Taiwan

Background/Question/Methods

The housefly, *Musca domestica* L. (Diptera: Muscidae), is one of the most distributed insect pests. Domestic flies are an important pest that particularly affects human health and creates significant threats to the food, agriculture, livestock and poultry industries. Domestic flies contaminate products and transmit a variety of pathogens, making them mechanical vectors of disease. Different control techniques are being used globally, but they develop resistance against the number of insecticides in a short period of time, and became one of the most difficult to control pests. The proposed research is designed to develop a new bait fly, using a attractive color and an active ingredient. Different attractants and active ingredients from previous research have been reviewed. A series of laboratory tests will be conducted with different formulations of new bait to evaluate bait efficiency, including preference and mortality tests against flies under laboratory conditions.

Results/Conclusions

In this study, tests were performed to evaluate the efficacy of the new fly baits with different colors against the house fly. The result obtained after a series of studies indicated that color blue bait was most preferred followed by white bait. The result shows that the less attractive bait was green bait followed by purple bait. Further research on bait studies are needed to make white and blue baits of color more efficient against house fly, more need studies to be done.

Keywords: housefly, color bait, preference test

根蟎人工飼料開發及其效益評估
Development of artificial diet for bulb mites and evaluation of their
benefits

林政寬、陳文華

Zheng-kuan Lin, Wen-Hua Chen

國立屏東科技大學植物醫學系 Department of Plant Medicine, National
Pingtung University of Science and Technology

背景/研究問題/材料方法

根蟎(Bulb mites)屬蟎蟬亞綱(Acari)真蟎目(Acariformes)無氣門亞目(Astigmata)粉蟎科(Acaridae)根蟎屬(*Rhizoglyphus*)為世界性球根作物重要害蟎。學者們以天然食物研究其生活史，均可完成生長與發育。但作物不易控制生長及品質、且不耐儲存、腐爛速度快，易影響蟎類之生長及發育。因此開發人工飼料成功飼育根蟎並研究根蟎之生活史有極佳之成效。本研究測試自行開發人工飼料A、人工飼料B、人工飼料C、人工飼料D、人工飼料E、人工飼料F、人工飼料G等7種新人工飼料與Chen(1990)改良人工飼料飼育羅賓根蟎(*R. robini*)之效益，分別進行5重複，計數成蟎數量及性比，並分析飼料配製時間、成本。

結果/結論/應用啟示

本研究測試7種人工飼料四玉羅賓根蟎，結果顯示，在第16及21天計數，以人工飼料A、人工飼料G飼育之成蟎數量最為顯著，分別為30.62、29.64及44.2、45.76隻成蟎；而人工飼料B、Chen(1990)改良人工飼料、人工飼料D及人工飼料F間無顯著性差異。人工飼料G、人工飼料A、人工飼料B、Chen(1990)改良人工飼料、人工飼料D、人工飼料F、人工飼料C、人工飼料E等各飼料飼育出根蟎之雌雄性比，其雌成蟎數量幾乎高於雄成蟎。配製Chen(1990)改良人工飼料與新人工飼料所需花費之時間，分別為31分17秒與10分33秒，以新人工飼料配製所需時間較短。各飼料之成本比較，以Chen(1990)改良人工飼料之成本最為昂貴，每份高達951.32元，而人工飼料A、人工飼料G成本分別僅需277.98及186.87元，換言之，人工飼料A、人工飼料G成本分別只有Chen(1990)改良人工飼料的29%及20%。綜上所述，人工飼料G、人工飼料A與Chen(1990)改良人工飼料進行比較，其飼育效果更佳、成本低及配製時間短；人工飼料B、人工飼料D及人工飼料F等人工飼料與Chen(1990)改良人工飼料進行比較，其飼育效果相近，但成本更低及配製時間短。

關鍵詞 (Key words)：羅賓根蟎 (*Rhizoglyphus robini*)、人工飼料(artificial diet)、性比(sex ratio)、配製時間(Preparation time)、成本(Cost)

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