行政院農業委員會所屬機關出國報告（出國類別：其他，實驗、研究及田野調查）

果實蠅管理與抗藥性早期偵測

服務機關：行政院農業委員會農業藥物毒物試驗所
姓名職稱：許如君　副研究員
派赴國家：美國夏威夷
出國期間：民國 **95** 年 **11** 月 **13** 至 **96** 年 **2** 月 **11** 日
報告日期：**96** 年 **4** 月 **20** 日

摘要：

執行農委會 95 年科發基金中高科技人才培育計畫核定之「果實蠅管理與抗藥性早期偵測」項目，至美國夏威夷州進行田間東方果實蠅對有機磷分子抗藥性調查及賜諾殺田間感受性調查，另赴印第安那波里斯參加美國昆蟲年會及和道禮公司討論新產品田間實驗的進行等，行程共 90 天。於夏威夷進行東方果實蠅有機磷分子抗藥性調查，所採集蟲源涵蓋五個島，每島 3 個地區(除大島 2 個地區外)，每個地區各 20 隻蟲進行乙醯膽鹼酯酶抗性基因 I214V、G488S 及 Q643R 三個點突變的檢測，其結果顯示其東方果實蠅對有機磷的抗性僅在歐胡島(Oahu)及快怡島(Kauai)有監測不到 5%的頻度，其餘島未發現抗性基因的存在。另調查田間東方果實蠅對賜諾殺的抗性情形，於快怡、茂宜、歐胡及大島等 4 個島田間採集受害果回實驗室飼養及以誘引器直接採集蟲源，成蟲以餵食方法進行賜諾殺的生物檢測，其結果顯示，田間的感受性抗性程度增加不到 2 倍(和室內品系相比)，賜諾殺抗性情況還未在田間發生。夏威夷對東方果實蠅的防治管理情形值得台灣借鏡。

壹、 目的：

東方果實蠅(圖一)是亞太地區重要的經濟害蟲及世界上的檢疫害蟲，在台灣首次藉由抗藥性的分子檢測技術證實東方果實蠅存在乙醯膽鹼酯酶變異，是對有機磷產生抗性的主因。經由台灣的田間調查證實東方果實蠅存在嚴重的有機磷抗藥性問題，不過因別的國家未曾監測過東方果實蠅的有機磷抗性，無法得知他國是否也存在東方果實蠅有機磷抗性的問題。爲和國內狀況作比對，有必要在具東方果實蠅的境外地區作有機磷抗藥性的監測，來釐清東方果實蠅抗藥性問題是普世嚴重或僅是國內栽培環境特殊所造成的結果，以便解決台灣東方果實抗藥性問題。

夏威夷是世上唯一有三種重要檢疫果實蠅(東方果實蠅、瓜實蠅及地中海果實蠅)存在的境地，其氣候狀況和台灣中南部相當，東方果實蠅及瓜實蠅爲害亦相當嚴重，美國政府亦投入相當多的研究經費作爲研究及管理之需 (詳情可參閱鄭允博

士赴夏威夷考察『東方果實蠅之區域防治研究』之出國報告內容有詳細介紹)，不過，目前夏威夷和其他國家一樣未曾對東方果實蠅做有關抗藥性問題的監控。

本行主要目的爲調查夏威夷州田間東方果實蠅是否會對有機磷產生抗藥性；另因夏威夷爲最早使用賜諾殺共同防治東方果實蠅的地區，是探討東方果實蠅是否已在田間產生對賜諾殺抗性情形的最好地點，故一併調查賜諾殺田間感受性現況。研究期間適逢美國昆蟲年會召開，是美國昆蟲界的盛大會議，其發表之研究內容和與會相關學者亦是全球頂尖，因機會難得，再加上夏威夷 Mau 教授引薦到道禮公司討論新產品上市在全球進行田間實驗，所以中途十天前往印弟安那波里斯出席相關業務。

貳、 過程：

本行進行四項主要工作：一、爲調查夏威夷州田間東方果實蠅是否會對有機磷產生抗藥性；二、調查夏威夷東方果實蠅賜諾殺田間感受性現況；三、出席美國昆蟲學會之年會；四、到道禮公司討論新產品的田間實驗。故以下內容分成四個部分做介紹。

一、東方果實蠅的有機磷分子抗性調查

爲調查夏威夷州田間東方果實蠅的乙醯膽鹼酯酶是否在其 I214V，G488S 及 Q643R 產生變異，於五個主要島嶼，歐胡島、快怡島、摩羅凱島、茂宜島及大島上不同的三個地區(大島僅進行二地區)以含甲基丁香油誘引器誘引雄蟲(圖二)，帶回實驗室浸泡於 95%酒精中，以 5%Chelex 萃取 DNA 後，以專一性的引子增幅乙醯膽鹼酯酶基因(ace)標的部位，再利用限制酶切位辨別是否具有點突變的位置，來判斷是否對有機磷產生抗性。調查結果顯示，僅歐胡島及快怡島存在點突變變異，其餘各島未發現變異存在(表一)。

二、東方果實蠅賜諾殺田間感受性現況

爲調查夏威夷東方果實蠅賜諾殺田間感受性現況，於歐胡島的珍珠城(Peal

city)、馬歐那(Manoa)、衛委那(Waialua)、快怡島（Kauai）、摩羅凱島（Molokai）、茂宜島的熱帶果園(Tropical garden)、大島的普那(Puan)田間採集東方果實蠅爲害之果實帶回實驗室飼養，待成蟲羽化後，以市售賜諾殺測試 3-5 日齡成蟲之感受性。將賜諾殺以糖及酵母粉(20:5)之水溶液作序列稀釋，以每個布丁杯放 20 隻蟲供應 0.2 ml 含毒食餌，觀察東方果實蠅在 24、48 及 72 小時後的反應，有些地方因非水果產季，無法採集足夠落果作實驗，則以甲基丁香油配合誘引器誘抓雄蟲(如茂宜島，採集地點如表二)，所得實驗結果如表三，快怡島及大島的東方果實蠅對賜諾殺的感受性和室內品系相當，而歐胡島及茂宜島對果實蠅的感受性略低於室內品系，最高可達 3 倍。

相關結果已發表於夏威夷昆蟲年會(Hsu, J. C., M. Y. Chou., D. S. Haymer, and R. F. L. Mau. 2007. Survey of the spinosad resistance and the organoposphate resistant mutation genes (ace) of oriental fruit fly, Bactrocera dorsalis (Diptera: Tephritidae) in Hawaii. *In* Current Fruit Fly Reserarch in the Pacific Symposium. Pacific Entomology Conference, Honolulu, HI. February 21-22, 2007.)，摘要如附件一。

三、美國昆蟲學會之年會

美國昆蟲學會自 1953 年第一次舉辦年會，2006 年已屆第 54 屆，本年在 12 月 10 至 13 日於印第安那州的印第安那波里斯召開，年會分成學術性的論文發表、不同單位的歡迎會、工作媒合及商品展示(圖三)等四大類；本次年會共有 1148 篇口頭論文宣讀及 586 篇壁報論文宣讀(議題如附件二)。這些論文分成二大類，一爲學者的學術性論文發表，另一爲研究生的論文比賽。學者的學術性論文發表又分二部分，一爲專門主題由召集人邀請討論的討論會，計有 55 場；另一爲設定主題，自由投稿的十分鐘論文宣讀，共有 26 場。學術性的論文其主題涵蓋昆蟲學的研究趨勢、生物技術、蟎類研究、昆蟲館的設計、分子診斷、植物保護昆蟲學、都市昆蟲學、行爲及生態、生物防治、昆蟲化學訊息、景觀昆蟲學、系統、形態及進化、昆蟲病理、微生物防治、醫用昆蟲及害蟲抗藥性管理等等。

四、赴道禮公司討論新產品的田間實驗

道禮公司的總部設在印第安那波理斯，其旗下的賜諾殺產品爲目前可用在有機栽培防治東方果實蠅的農藥，因其在夏威夷爲共同防治的主要藥劑，台灣亦爲東方果實蠅的爲害發生地，故道禮公司擬邀本所進行相關藥劑的田間實驗，故此行跟隨研究學者前往討論其相關田間實驗的進行。

參、 心得與建議

東方果實蠅的抗藥性管理

在夏威夷的東方果實蠅對有機磷的抗藥性發生並不嚴重，其分子抗性發生屬零星低頻度，相對台灣某些地方皆無感性基因而言，仍屬爲未對有機磷發生抗性問題的地區。東方果實蠅在夏威夷的發生早於台灣，其用有機磷防治的歷史也早於台灣地區，爲何現在仍可維持無抗性呢？可能主要跟兩地的栽培方式及用藥管理有關，台灣果樹屬密植栽培，容易茲生介殼蟲或蚜蟲，農民習慣以藥劑防治害蟲，雖對果實採以套袋的保護，減少殘留農藥及東方果實蠅的爲害，但田間東方果實蠅接觸的藥劑的機會很高，造成抗性篩選的壓力。而夏威夷地區果樹栽培間距很大，可容納車輛進入，東方果實蠅爲最主要的害蟲，其防治採誘殺，農民很少直接噴藥防治果樹的害蟲危害，在栽培有機的作物田，甚至不接受含有農藥的甲基丁香油誘捕器，相對台灣其東方果實蠅接觸到藥劑的機會較少，就算當地果實無套袋保護，其都可維持東方果實蠅的無爲害率。

台灣的東方果實蠅防治用藥有 11 種，計有 6 種有機磷、3 種除蟲菊酯、1 種胺基甲酸鹽及賜諾殺等；其中屬食物誘餌劑型有 7 種用藥，5 種可直接噴佈。東方果實蠅以實驗室接觸藥劑評估會產生抗藥性的難易程度，以賜諾殺最甚，除蟲菊酯類次之，有機磷及胺基甲酸鹽類較不易產生。不過，目前台灣田間有很高頻度的有機磷抗性，對除蟲菊酯的抗藥性程度亦高，賜諾殺尚未有明顯抗性。賜諾殺在田間和室內兩者抗性的差異主要是因防治方法的不同，如賜諾殺會藉由接觸的

篩選壓力而極易產生抗性，但藉由食餌篩選產生的抗性則較緩慢(未發表數據)，故以目前配合食餌誘殺東方果實蠅，在夏威夷雖有 5 年的歷史，仍未有明顯抗性產生；不過台灣有小菜蛾、薊馬及紅火蟻採用賜諾殺防治，雖防治作物屬蔬菜非果樹，果實蠅接觸的機會低，但因台灣地小植密，再加上乃力松及馬拉松抗性蟲會對賜諾殺產生交互抗性，需密切注意台灣東方果實蠅對賜諾殺的抗藥性問題。

有機磷在台灣使用的歷史已達 40 年，除蟲菊酯最多不到 10 年，但東方果實蠅對二者產生的抗性程度相當，目前因僅有針對有機磷抗性基因作分子的檢測的技術，故知道田間果實蠅對有機磷的抗性頻度高，而並沒有針對除蟲菊酯標的基因作抗性檢測的技術，無法偵測其分子抗性，而非沒有抗藥性的問題。在台灣各地東方果實蠅普遍存在對有機磷及除蟲菊酯高抗性問題，而且是標的作用的變異所造成，我認爲目前不適宜讓農民使用直接噴佈藥劑防治東方果實蠅(有機磷或胺基甲酸鹽或除蟲菊酯)，而應採用誘殺的方法來降低果實蠅的密度，果實再配合套袋再保護防止雌蟲的叮咬，這樣有效降低藥劑的篩選壓力，使抗性基因的頻度降低，減少抗藥性的問題。

美國昆蟲學會年會心得及建議

美國昆蟲年會和台灣的昆蟲年會不同的地方在於，有很多的互相交流的機會，如各校會藉由歡迎會來和其他學校或國家學者作交流，亦有學校會擺設攤位來介紹敝校的特色增加招生的機會。而這次美國昆蟲學會的年會來自台灣的學者或研究生共有 10 多篇論文與會，除在美求學的學生及學者外，僅二人來自台灣，和中國大陸尚有一場中國昆蟲的討論會及歡迎會，台灣在國際會議的能見度可再加強。

另一特色是有工作的媒合，因昆蟲屬冷門且高技術的學科，人才和工作不易配對，年會便可提供這樣的服務和機會，讓有需要的人藉此高效率的媒合，這個部分亦可供國內借鏡。美國政府亦擺設攤位，農部藉由機會介紹他們的檢疫害蟲讓參觀者可以知道那些蟲是具檢疫重要性，要通報政府，亦藉由此介紹農部的工

作狀況，吸引優秀學者進入農部服務；國防部則是藉機招募兵力。在台灣的年會中擺設攤位的多是具商業利益的公司，而非政府機構，這部分我們學習亦可參考。

另外，在針對分子檢測應用的部分，目前的開發多是針對檢疫害蟲，其中只要談到蘋果蠹蛾的論文，都會提到台灣因此蛾禁止美國蘋果進口，顯示正確檢疫害蟲的重要性。不過美國農部學者對台灣針對美國檢疫出蘋果蠹蛾發表的論文中的核酸序列有疑慮，他認爲那個序列非屬檢疫害蟲的蘋果蠹蛾，而屬另一類似種，他懷疑我們鑑定的蟲源可能是不正確，這部分是值得我們研究單位深入探討。

圖一、東方果實蠅卵、幼蟲、蛹、成蟲及正在產卵的雌蟲。

圖二、田間利用甲基丁香油誘引東方果實蠅的不同型式誘引器

圖三、美國昆蟲學會年會展示會會場

表一、於夏威夷州各島所採集蟲源的進行乙醯膽鹼酯酶有機磷抗性頻度檢測

島嶼	採集地點	抗性頻度（%）		
		I214V	G488S	Q643R
歐胡島（Ohau）	Waimanalo; Peal city; Waialua	0.8	3.3	0
快怡島（Kauai）	Nakamura; Nedwhitrlock; Kilauea	0	5	0.8
摩羅凱島（Molokai）	Moomomi; Hoolehua; Kalawao	0	0	0
茂宜島（Maui）	Waihee Valley; Maui Tropical Ag Park	0	0	0
大島（Big Island）	Puna; Cona	0	0	0

表二、茂宜島以誘引器採集東方果實蠅的採集地點及衛星定位座標

地點	北緯	東經	誘引器數目
Waihee bridge Tropical	2318911	756676	4
Waihee Valley Road	2317645	752775	4
Piihana road	2313248	760342	3
Maui tropical garden	2307863	759555	7
Luana garden park	2310221	762659	4
Ag Park	2301678	774879	4

表三、採自不同地區的東方果實蠅對賜諾殺的感受性

地點[a]	感受性 LC_{50} (µg / ml)			抗性比
	24 h	48 h	72 h	24 h
室內品系	10.4	3.87	3.22	1.0
歐胡島				
珍珠城	32.2	23.5	14.85	3.1
馬歐那[a]	18.3	4.94	3.64	1.8
衛委那[a]	15.3	8.20	6.83	1.5
快怡島	9.99	4.95	8.05	0.96
茂宜島[a]	16.9	3.86	2.68	1.6
大島	9.51	6.76	6.76	0.91

[a]以甲基丁香油誘引器直接誘抓雄蟲作實驗。

附件一、論文摘要

Survey the spinosad resistance and the organophosphate-resistant mutation genes (*ace*) of Oriental Fruit Fly (*Bactrocera dorsalis*) in Hawaii

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ABSTRACT

Control of oriental fruit fly, *Bactrocera dorsalis* (Hendel), in Hawaii has been based mostly on cover sprays with organophosphate insecticides (usually malathion or naled) for about 40 years. In 2002, resistance of organophosphate in field *B. dorsalis* population was documented in Taiwan. To determine the potential for wild *B. dorsalis* populations in Hawaii to develop resistance, diagnostic tests using PCR-RFLP based methods were used to detect the presence of these mutations in individual flies from various populationsi. Spinosad protein bait spray was the latest adapted control tactic in Hawaii Area-Wide Fruit Fly Management Program. In order to monitor the potential resistance development to spinosad in the control areas in Hawaii, a dietary supplementation, feeding assay, was developed with a laboratory population. The values of LC_{50} (including 95% confidential limit, μg/mL) was 10.4 (6.00-29.7), 3.87 (3.07-4.76), and 3.22 (2.53-3.96) during 24, 48 and 72-h post period, respectively. Flies collected from infested fruits and methyl eugenol trap were tested to determine the potential for wild *B. dorsalis* populations to develop spinosad resistance by using the diagnostic dose, LC_{99} (72-h post period) or by the LC_{50} value.
Samples were surveyed from different locations on the islands of Oahu, Kauai, Molokai, Maui and the island of Hawaii. These results could reveal the potential of these populations to rapidly become resistant to these insecticides.

Keywords: Spinosad, point mutation, feeding assay, insecticide resistance, *Bactrocera dorsalis*

附件二、美國昆蟲學會 54 屆年會的論文發表議題

Sunday, 10 December 2006

Program Symposium: Entomological Developments in the 20-21st Century, a Look Back at the Accomplishments: Part 1

Section C Symposium: All Movement Great & Small: Honoring the Career of Michael E. Irwin

Symposium: Biotechnology: What Will It Give Back to Us?

Symposium: Current Advances in Acarology: Genomic and Proteomic Research

Symposium: Insectary Design Concepts and Case Studies

Symposium: Regulatory Uses of Molecular Diagnostics

Ten-Minute Papers, Section F. Crop Protection Entomology, Fb. Urban Entomology, E. Extension and Regulatory Entomology

Ten-Minute Papers, Section Cd. Behavior and Ecology

Ten-Minute Papers, Section Ca. Biological Control

Section B Symposium: Insect Chemical Communication: From Intraspecific to Tritrophic Interactions

Program Symposium: Entomological Developments in the 20-21st Century, a Look Back at the Accomplishments : Part 2

Section D Symposium: Biology & Control of Sand Flies and Leishmaniasis

Section E Symposium: Integrated Approaches for the Prevention and Management of Invasive Pests of Ornamentals and Turf

Section F Symposium: Current State and Future of Non-conventional Pest Management Methods in Urban
Environments

Symposium: A Multinational Examination of the Strategies Used and the Factors that Influence the Fight against
the Southern Cattle Tick, *Boophilus microplus*

Symposium: Current Advances in Acarology 2006

Symposium: Focus on Compliance: Corn, Cotton and Soybean Workshop

Symposium: Lessons Learned from Long Term Insecticide Resistance Management Programs

Symposium: SOLA Scarab Workers

Symposium: Tropical Arthropod Diversity from Sea-level to Cloud Forest: Project ALAS results from the Barva
Transect

Ten-Minute Papers, Section A. Systematics, Morphology, and Evolution

Ten-Minute Papers, Section F. Crop Protection Entomology, E. Extension and Regulatory Entomology

Monday, 11 December 2006

Student Competition for the President's Prize Display Presentations, Section A1. Systematics, Morphology, and Evolution

Student Competition for the President's Prize Display Presentations, Section B1. Physiology, Biochemistry, Toxicology and Molecular Biology

Student Competition for the President's Prize Display Presentations, Section Ca1. Biological Control

Student Competition for the President's Prize Display Presentations, Section Ca2. Biological Control

Student Competition for the President's Prize Display Presentations, Section Cb. Apiculture and Social Insects

Student Competition for the President's Prize Display Presentations, Section Cc. and Ce. Insect Vectors in Relation to Plant Diseases and Insect Pathology and Microbial Control

Student Competition for the President's Prize Display Presentations, Section Cd and Cf. Behavior and Ecology and Quantitative Ecology

Student Competition for the President's Prize Display Presentations, Section Cd1. Behavior and Ecology

Student Competition for the President's Prize Display Presentations, Section D. Medical and Veterinary Entomology

Student Competition for the President's Prize Display Presentations, Section F1. Crop Protection Entomology

Student Competition for the President's Prize Display Presentations, Section F2 and Fb. Crop Protection Entomology and Urban Entomology

Student Competition for the President's Prize Display Presentations, Section Fa. Host Plant Resistance

Student Competition for the President's Prize, Section A1. Systematics, Morphology, and Evolution

Student Competition for the President's Prize, Section A2. Systematics, Morphology, and Evolution

Student Competition for the President's Prize, Section A3. Systematics, Morphology, and Evolution

Student Competition for the President's Prize, Section A4. Systematics, Morphology, and Evolution

Student Competition for the President's Prize, Section B1. Physiology, Biochemistry, Toxicology, and Molecular Biology

Student Competition for the President's Prize, Section B2. Physiology, Biochemistry, Toxicology, and Molecular Biology

Student Competition for the President's Prize, Section Ca1. Biological Control

Student Competition for the President's Prize, Section Ca2. Biological Control

Student Competition for the President's Prize, Section Cb and Cc. Apiculture, Social Insects, and Insect Vectors in Relation to Plant Disease

Student Competition for the President's Prize, Section Cb. Apiculture and Social Insects

Student Competition for the President's Prize, Section Cd1. Behavior and Ecology

Student Competition for the President's Prize, Section Ce and Cf. Insect Pathology and Microbial Control, Quantitative Ecology

Student Competition for the President's Prize, Section D1. Medical and Veterinary Entomology

Student Competition for the President's Prize, Section F1. Crop Protection Entomology

Student Competition for the President's Prize, Section Fa. Host Plant Resistance

Student Competition for the President's Prize, Section Fb. Urban Entomology

Ten-Minute Papers, Section Cc. Insect Vectors in Relation to Plant Disease

Program Symposium: Students Giving Back: Using Entomology to Benefit Society

Section A Symposium: Assembling the Tree of Life for Insects and Their Relatives: Emerging Results in the Pursuit of Large-scale Phylogenies

Section C Symposium: Semiochemicals Mediating Behavior of Cerambycid Beetles

Section D Symposium: Biological Control of Muscoid Diptera

Section E Symposium: Implementation of Pest Management in Greenhouses: Challenges, Consequences, and Opportunities

Section E Symposium: Tapping the Power of the Land-grant System through Cooperative Extension: eXtension (http://intranet.extension.org)

Section F Symposium: The Larry L. Larson Symposium: Advances in New Chemical Insect Control Solutions

Symposium: Effects of Spatial Distribution, Population Dynamics, and Dispersal Behavior on Stored Product Insect Pest Management

Symposium: From Entomological Plagues to Biodiversity: Unfinished Business in Africa. A Tribute

to the Life of Professor Thomas R. Odhiambo (1931-2003).

Symposium: Molecular Insect Science : Student Sponsored Symposium

Symposium: Women Shaping History in Entomology: Roles and Challenges They Face

Ten-Minute Papers, Section Cd. Behavior and Ecology

Ten-Minute Papers, Section B. Physiology, Biochemistry, Toxicology, and Molecular Biology

Ten-Minute Papers, Section Fa. Host Plant Resistance

Tuesday, 12 December 2006

Display Presentations, Section A. Systematics, Morphology, and Evolution

Display Presentations, Section B. Physiology, Biochemistry, Toxicology, and Molecular Biology

Display Presentations, Section Ca. Biological Control

Display Presentations, Section Cd. Behavior and Ecology

Display Presentations, Section D. Medical and Veterinary Entomology

Display Presentations, Section E. Extension and Regulatory Entomology

Display Presentations, Section F. Crop Protection Entomology

Display Presentations, Section Fa. Host Plant Resistance

Display Presentations, Section Fb. Urban Entomology

Symposium: International Affairs Committee Poster Symposium

Program Symposium: Contribution of Social Insect Studies to Science and Society

Section A Symposium: Different Ways to Hitch a Ride: Phylogenetic Perspectives on Ectoparasitism: Part I

Section A Symposium: Notes from the Field: Biodiversity of Coleoptera. A Symposium Honoring the Memory and Contributions of Steve Ashe, Part I

Section B Symposium: Impact of Hormone Research on Science and Economy: A Symposium to Honor Contributions of Professor Lynn Riddiford

Section C Symposium: Genomic Approaches to Understanding Insect Sociality

Section E Symposium: Invasive Species: Real Threats to the Homeland

Symposium: Board Certified Entomologists' Symposium: Applied Realities of Pheromone Chemistry

Symposium: Multidisciplinary National Monitoring, Diagnostics, and Networking Programs for Pest Detection: Bridging Communication Gaps for the Benefit of Growers

Ten-Minute Papers, Section Ca. Biological Control

Ten-Minute Papers, Section Cd. Behavior and Ecology

Ten-Minute Papers, Section D. Medical and Veterinary Entomology

Ten-Minute Papers, Section F. Crop Protection Entomology

Ten-Minute Papers, Section Fb. Urban Entomology

Program Symposium: Emeritus Business Meeting and Ten Minute Papers

Program Symposium: Applied Insect Chemical Ecology: Lessons from the past Are Giving Back Solutions for the Future

Section A Symposium: Different Ways to Hitch a Ride: Phylogenetic Perspectives on Ectoparasitism: Part II

Section A Symposium: Notes From the Field: Biodiversity of Coleoptera. A Symposium Honoring the Memory and Contributions of Steve Ashe, Part II

Section B Symposium: Impact of Hormone Research on Science and Economy: A Symposium to Honor Contributions of Professor Lynn Riddiford Part II

Section F Symposium: Ecology and Management of Insect Vectors of Plant Pathogens in Vegetable Crops

Symposium: Digital Entomological Resources (Teaching Symposium)

Symposium: Forest Entomology Symposium – A Tribute to the Career of C. Wayne Berisford and His Influence on Our Science

Symposium: Systematics and Ecology of Basal Hexapods, Applications and Future Needs

Ten-Minute Papers, Section Cd. Behavior and Ecology

Ten-Minute Papers, Section D. Medical and Veterinary Entomology

Ten-Minute Papers, Section F. Crop Protection Entomology, E. Extension and Regulatory Entomology

Ten-Minute Papers, Section Fb. Urban Entomology

Symposium: Overseas Chinese Entomologists Association-Collaboration, Competition and Creation

Symposium: Annual Business Meeting of the North American Section of the International Union for the Study of Social Insects

Symposium: Coleopterists Society

Symposium: Heteropterists Conference

Symposium: International Society of Hymenopterists Informal Conference and Business Meeting

Symposium: North American Dipterists Society

Symposium: Symposium - Korean Young Entomologists (KYE)

Wednesday, 13 December 2006

Display Presentations, Section A. Systematics, Morphology, and Evolution

Display Presentations, Section B. Physiology, Biochemistry, Toxicology, and Molecular Biology

Display Presentations, Section Ca. Biological Control

Display Presentations, Section Cd. Behavior and Ecology

Display Presentations, Section D. Medical and Veterinary Entomology

Display Presentations, Section E. Extension and Regulatory Entomology

Display Presentations, Section F. Crop Protection Entomology

Display Presentations, Section Fa. Host Plant Resistance

Display Presentations, Section Fb. Urban Entomology

Program Symposium: Bugs Did It First: Insect-Inspired Technology

Section E Symposium: When Giving Something Back Is Not An Option: Management Strategies For Invasive Woodborers.

Symposium: Arthropod Mass Rearing, Research that Keeps on Giving

Symposium: Bt Crop Sustainability

Symposium: Darklings into Light: A Celebration of Tenebrionid Beetle Diversity

Symposium: Department of Defense Entomology: To Serve and Protect

Symposium: Genitalic Homology Challenges in the Lepidopteran Tree Of Life

Symposium: Psylly Psyllids - Lerps and Jumping Lice

Ten-Minute Papers, Section A. Systematics, Morphology, and Evolution

Ten-Minute Papers, Section B. Physiology, Biochemistry, Toxicology, and Molecular Biology

Ten-Minute Papers, Section Cd. Behavior and Ecology, Cf. Quantitative Ecology

Ten-Minute Papers, Section F. Crop Protection Entomology, Fb. Urban Entomology, E. Extension and Regulatory Entomology

Ten-Minute Papers, Section Cb. Apiculture and Social Insects

Symposium: New Developments for IPM in Public Housing

Section C Symposium: Integration of Entomopathogen Biology and Trophic Interactions When Developing Pest Management Programs

Section D Symposium: Highlights of Medical and Veterinary Entomology

Ten-Minute Papers, Section Cb. Apiculture and Social Insects

Ten-Minute Papers, Section A. Systematics, Morphology, and Evolution

Ten-Minute Papers, Section Ce. Insect Pathology and Microbial Control