

2017 Annual Report

Taiwan Forestry Research Institute

行政院農業委員會林業試驗所

一〇六年度年報



序

近年來在全球氣候變遷及環境快速發展的壓力下，環境資源議題越來越受到世界各國重視，但 2017 年仍有些令人遺憾的消息傳出，3 月美國夏威夷茂納羅亞觀測站記錄到 CO₂ 濃度突破 410ppm 創 200 年來新高、6 月美國川普總統宣布退出巴黎協定，加上 10 月美國加州發生持續不斷的森林火災，此皆對環境保護工作造成不小的衝擊。所幸的是在 2017 年韓國首爾展開的第四屆 APEC 林業部長會議，確立了未來積極增加亞太地區森林覆蓋率須符合 APEC 2020 的目標；以及在聯合國氣候變化綱要公約的第 23 屆締約國大會、京都議定書締約方會議與巴黎協定會議等重要環境會議中，依舊有 195 個締約國願意在碳減排上持續做最大的努力，並訂定出未來新的永續發展目標。

臺灣地理面積雖小，森林覆蓋度卻高達全島六成以上，隨地形起伏變化，擁有熱帶到溫帶、海岸到高山草原高歧異度的植被樣貌及豐富的生物多樣性；隨著自然環境保育意識興起，與合理永續經營森林並合理利用的觀念同時並重，當我們積極維繫臺灣森林資源的同時，也應思考如何提高我國人工林的利用率，並在國際間日益重視森林資源與世代公平的趨勢下，如何妥善保護天然林及永續經營人工林的議題，更加彰顯林業研究工作的重要性。

本所蓮華池試驗林地從 2016 年取得臺灣地區國有林第一張國際森林管理系統驗證 (FSC™ FM) 合格證書之後，2017 年本所再接再厲，通過林產品產銷監管鏈驗證 (FSC™ COC) 取得證書，建立了公部門國有林管理單位從原木生產到林產品的產銷，均能符合國際森林驗證系統標準，證實了本所森林經營已符合國際水準，更證明臺灣的國有林經營已成為於環境保護、經濟可行及對社會有益的負責任的森林經營者，符合社會大眾對於林業的期待；此外，國家林木種原庫正式於 2017 年 12 月啟用，除了持續推動本土植物種原資源的保存利用外，未來更將全力發展各項林木生物技術，希望可以有效率的培育臺灣優良林木，建造更健康優質的臺灣人工林。

回顧過去一年來臺灣的林業研究在所內同仁共同努力下，於集水區經營、造林撫育、木材利用、林地復育、保種技術、資源調查、環境監測、林下經濟研究、疫病防治等諸多研究成果上都足有斬獲；同時也致力於環境推廣教育、林園療癒等活動，有助提升社會大眾對於森林多面向的瞭解與親近；此外，亦在網路上設置多方平台推廣所內資訊、研究成果及環境即時監測，還有出版許多森林相關刊物及技術影片等影音資料發表，方便關心林業研究發展的民眾及技術合作廠商查詢。

本刊為 2017 年所內研究成果的彙總，在同仁的共同努力下期望能使林業研究更進一步，落實永續發展，也敬請各方不吝賜教。

行政院農業委員會林業試驗所

所長  謹誌

2018年5月



Preface

In recent years, global climate change and pressure of rapid environmental development are causing countries of the world to pay more and more attention. However, in 2017, there were still certain disheartening news occurring, such as in March, the Mauna Loa Observatory at Hawaii measured atmospheric carbon dioxide concentration reached 410 ppm, a 200-year high; in June, President Trump of USA announced withdrawal from Paris Agreement; and in October, pernicious forest fires persistently broke out in California USA. All these events adversely impacted environmental protection efforts. Fortunately, there were positive developments as well. The 2017 Fourth APEC Forestry Ministers Meeting held in Seoul, Korea had ascertained that in the future, forest cover in the Asian Pacific Region shall reach the goal of APEC 2020 with active afforestation; and in the realm of climate moderation, there were still 195 signatory countries ever to do their best in reducing carbon emission and setting new sustainable developmental goals following a series of important environmental meetings including UN framework convention on climate change 23th conference of the parties (COP23), Kyoto Protocol signatory nations, and Paris Agreement etc.

Despite of its small geographic area, Taiwan has degree of forest cover more than 60 percent. Along with the undulating topography, there are terrains of highly diverse vegetation types and rich biodiversity ranging from tropic to temperate climates, and from coastal to montane grassland. With the rise of environmental conservation consciousness, the concepts of both reasonable sustainable management of forests and reasonable utilization of forest resources shall be stressed. As we are striving to maintain the forest resources of Taiwan, we shall also ponder how to increase our utilization rate of the plantation forests. Under an atmosphere of worldwide emphasis of forest resources and generational equality, the issues of how to effectively and properly protect our natural forests and sustainably manage our plantation forests are manifesting the importance of forestry research work.

The Lienhuachih Experimental Forest of Taiwan Forestry Research Institute (TFRI) received the first qualifying certificate of international forest management issued by the Forest Stewardship Council (FSCTM FM) in 2016. Following the exemplary achievement, in 2017, the TFRI again passed muster of forest product chain of custody certification (FSCTM COC) which established that from log harvesting to production and sales of forest products of the national forest management organization in the public sector are all complying with the standards of an international forest certification system; and thus certified that forest management rendered by the TFRI had reached an international recognized level. Furthermore, these also prove that national forest management in Taiwan has become a forest manager that protect the environment, is economically viable, and is responsible to the society. Thus we are complying with the public expectation of forestry to the general public. In addition, National Tree Germplasm Bank started operation in December of 2017. The bank, in addition to dedicate to the preservation and utilization of endemic plant germplasm resources, shall in the future engage fully in tree biotechnology in hope of culturing superior forest trees and establishing healthier and better forests for Taiwan.

In retrospect, the past year saw that all staff of TFRI mutually endeavored to achieve good results in the aspects of watershed management, silviculture and tending, wood utilization, forestland restoration, germplasm conservation technology, resources surveying, environmental monitoring, understory economy study, tree pest and disease prevention etc. Much efforts were also devoted to activities of environmental promotional education, forestscape therapy etc. These are useful to elevate the public perception and understanding to the many facets of forestry. In addition, with respect to establishment of many platforms on the websites to promote information about TFRI, research achievements and real time environmental monitoring scenes, coupled with publication of many forestry-related journals, pamphlets and film clips are also facilitate the access to people who care about forestry research development and businesses interested in seeking technical cooperation.

This annual report is the compilation of the research achievements of TFRI transpired in 2017. With the summary efforts of all staff members, we hope that forestry research will be advanced further and the objective of sustainable development will be affirmed. We are also looking forward to have comments and feedbacks from the readers.

Director General, Taiwan Forestry Research Institute, Council of Agriculture, Executive Yuan
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Bin Chang

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2017 Annual Report



前言

Introduction



前言

林業試驗所106年度編制員額為136人，歲入預算數8,778千元，較上年度增列23千元，歲出預算數531,678千元，較上年度減列105,390千元。為利各界瞭解本所106年度施政概況，本刊援例以計畫領域為編纂軸心，刊載已結案之計畫成果42項，分作三類呈現：一、林業科技試驗研究計畫19項(45%)。二、所外委辦計畫12項(29%)。三、科技部補助專題研究計畫11項(26%)。除完成各類計畫外，106年度亦推動多項施政簡述如次：

一、林業資源生產技術研究方面：藉由枝葉產量與精油分析等研究，完成牛樟5品系選拔，完成技術移轉1件；完成牛樟與冇樟之遺傳與化學成分標誌檢定；建立青脆枝毛狀根培養體系；開發瓊崖海棠種子油脂的護膚抗UV產品；山葵健康苗栽培與接種松露在青剛櫟苗之林下經濟研究，完成技術移轉各1件；建立小果種油茶生產示範區4處；採獲長尾柯5,500粒、森氏櫟6,500粒、象牙柿9,200粒，並進行發芽條件及儲藏性質之研究。土肉桂伽羅木醇型降憂鬱產品開發產學合作，開發4種舒壓產品；選拔護膚品系紅豆杉，建立繁殖栽培與枝葉採收技術，完成技術移轉3件。

二、樹木健康管理及樹木保護研究方面：提供「林木疫情鑑定與資訊中心」疫情通報案件診斷及防治諮詢服務共1,026件，更新及建立林木疫情資料庫1,026筆。在臺北、恆春、中埔、六龜及福山植物園或樹木園區持續辦理林木病蟲害與褐根腐菌害之巡檢；以及辦理潛在危木之風險監測；危木風險評估教育訓練1次；樹藝教育實習學員總計176人次；製作森林昆蟲標本2,780份，標本資訊輸入新增3,725份，以及新增標本影像2,009份。

三、試驗林生態系示範經營方面：辦理與環保、生態、生物多樣性、里山倡議等相關解說教育之服務達146,858人次；協助屏東縣滿州鄉鄉村聚落發展導覽式觀光生態旅遊1件；協助高雄壽山、臺中港、臺東金崙地方社區或政府單位執行生態復育造林3件；促進高雄六龜木材利用相關產業供需活化1件；於烏來、蓮華池、扇平推廣林園療癒產業16件；巡護國有林地達958次。苗木培育於恆春1,500株、太麻里2,000株、四湖10,000株、蓮華池3,000株。福山志工培訓6場185人，解說服務124,598人次。蓮華池志工培訓4場165人，解說服務5,468人次。中埔志工教育訓練6場320人次，解說服務128場5,742人次。六龜扇平志工專業訓練4次，解說服務計34個團體1,025人次。恆春志工培訓5場230人，解說服務10,045人次。

四、植物園建設方面：完成台北植物園「台北植物園腊葉館整體修復再利用工程」，並重新修復台北植物園內逸失的早田文藏紀念碑及佛里銅像；完成「台北植物園行車步道改善工程」及「植物分類園改善工程」。另本所植物標本館之植物標本資料庫中添加植物物候欄位資料，本年度共完成1,200筆，並經過標準資料集格式發布65幅(種)物候圖層。

五、植樹造林試驗監測方面：完成花蓮、雲林與屏東100個樣區監測調查，提供10個重要造林樹種生長趨勢與存活率變化，20種生長資訊、病蟲防治、生物多樣性監測及混農林業效益試驗研究資料蒐集與評估之成果報告1式。辦理「106年度傾聽人民心聲—平地造林撫育作業講習與座談」及「平地造林中後期撫育工作坊」活動，培訓105人。造林木資材利用藝品開發2種。

選育2種桉樹優良品系，技轉或推廣造林之用。轉化科學監測資料為科普資訊出版成果宣導品，提供企業主與農民及相關造林單位所需之造林撫育技術、收穫與利用資訊，以提昇農民營林所需之基礎知識，開發平地造林木之文創產品及商品化成果，提高收益，達到富民經濟及樂活生態環境之效益。

此外，本刊亦檢附106年度之重要記事、專題演講、出版品、技術移轉案件、發表報告、財務預決算、人力資源等訊息，謹供各界檢視本所當年度之整體施政成效。

Introduction

In 2017, the Taiwan Forestry Research Institute (TFRI) had an official staff of 136 persons. The annual income budget was 8.778 million NT dollars, which was an increase of 23 thousand dollars from a year ago. The annual expenditure budget was 531.687 million dollars, which was a reduction of 105.390 million dollar from a year ago. In order for readers to understand the administrative status of TFRI in 2017, this annual report follows previous examples and was edited according to project domains and complied 42 items of completed project results, which were grouped into three categories: 1) nineteen items of forestry science and technology experimental research projects (accounted for 45% of the total); 2) twelve items of external entrusted projects (accounted for 29% of the total), and 3) eleven items of Ministry of Science and Technology supported project (accounted for 26% of the total). In addition to the completed projects, in 2017 a variety of other administrative achievements are briefly described as follows:

- I. On forestry resources production technological research aspect: We've completed selection of 5 strains of stout camphor tree (*Cinnamomum kanehirai*) with leaf mass and essential oil content analyses, which was technological transferred in one case; completed genetic and chemical compositionn markers determinations of *C. kanehirai* and *C. micranthum*; established a hairy-root cultivation system for foetid nothapodytes (*Nothapodytes foetida*); developed skin-care and UV resistant crème products based on *Calophyllum inophyllum* seed oil; understory economy of cultivating healthy wasabi (*Eutrema japonica*) seedlings and inoculate truffle spores to saplings of ring-cupped oak (*Cyclobalanopsis glauca*), for which one each case of technical transfer were transpired; established 4 sites of demonstrative fields of small-seed oil-tea (*Camellia brevistyla*); harvested 5,500 seeds of caudate-leaved chinkapin (*Castanopsis carlesii*), 6,500 seeds of Mori oak (*Cyclobalanopsis morri*), 9,200 seeds of Philippine ebony persiimmon (*Maba buxifolia*), conducted germination and storage conditions studies; a linalool-rich strain of indigenous cinnamon tree (*Cinnamomum osmophloeum*) was used to develop anti-depressant products in an academic-industrial cooperative project, for which 4 kinds of stress-releasing products were realized; selected skin-care Taiwan yew (*Taxus mairei*) strains, and established their cultivation and leaf harvesting techniques, for which 3 cases of technical transfer was completed.
- II. On tree health management and tree protection aspect: We've provided a total of 1,026 cases of tree pests and diseases diagnoses, prevention and interdiction inquiry services to the "Forest Disease Information Center," renewed and established 1,026 case-studies to the database of the center. We've persistently undertaken cruises and inspections at Taipei, Hengchun, Chungpu, Liouguei, and Fushan botanical gardens or arboreta for forest tree insect and brown root rot, held risk monitoring of potentially dangerous trees, and operated one such risk assessment training course. We've also sponsored arboriculture course with a total of 176 person-times attendance; prepared 2,780 forest insect specimens, fed 3,725 items of new specimen information, and increased 2,009 specimen images.

- III. On demonstrative management of experimental forest ecosystem aspect: We've undertaken pertinent interpretive educational services of subjects such as environmental protection, ecology, biodiversity, Satoyama initiative etc. reaching a total of 146,858 person-times; assisted one case of developing guided ecotourism for Manchiu Township, Pingtung County's village community; assisted in three cases of ecologic reforestation for Shoushan of Kaohsiung city, Taichung Harbor, and Jinglung regional community of Taitung County; promoted one case of supply and demand activating wood utilization-related industry at Liouguei, Kaohsiung. We've also promoted 16 cases of forestscape therapy industry at Wulai, Lienhuachih, and Shanping; cruised and guarded national forestland for 958 times. As for seedlings, there were 1,500 raised at Hengchun, 2,000 at Taimalee, 10,000 at Szechu, 3,000 at Lienhuachih. There were 6 training courses with 185 persons attending at Fushan volunteers' corps, provided 124,598 person-times interpretive services; for volunteers of Lienhuachih, there were 4 courses and 165 persons, and 5,468 person-times received interpretive service; for volunteers of Chungpu, there were 6 courses and 320 persons attended with 128 rounds of interpretive services and 5,742 person-times served; for Liouguei volunteers, 4 professional training were given and 34 groups, 1,025 person-times received interpretive service; for volunteers of Hengchun, 5 training courses with 230 person attended, in turn they gave 10,045 person-times of interpretive services.
- IV. On construction of national botanical gardens aspect: We've restored a long lost statue of Pere Faurie and a stele in memory of Bunzo Hayata; completed a "Taipei botanical garden car paths improvement work" and "plant taxonomic garden improvement work." To the herbarium plant specimen database, columns of plant phenologic observations were included. The year saw a total of 1,200 entries. After a standard information compilation there were 65 items added to the plant specimen database.
- V. On tree planting and afforestation monitoring aspect: We've completed monitoring surveys of 100 plots at Hualien, Yunlin and Pingtung Counties; provided 10 important afforestation tree species growth trend and survival rate change information; one items of achievement report entailing a total of twenty cases of growth information, pests and diseases prevention, biodiversity monitoring and eco-efficiency of agroforestry evaluations. We've held activities of "2017 listening to the people—plain afforestation tending operational training courses and lectures" and "mid- and late-stage tending workshop for plain afforestation," for which, 105 persons had been trained. We've also engaged in developing 2 kinds plantation wood resources craftworks; selectively bred 2 eucalyptus superior strains, which were technical transferred or promoted for afforestation. In addition, we've transformed scientific monitoring data into popular science information and published promotional publications to provide businesses, farmers and pertinent afforestation units with tending techniques, harvesting and utilization information, thus providing the basic knowledge to afforestation farmers, developing cultural innovation craft

items and commercial products based on wood from plain afforestation so as to enrich people's economy and foster an eco-efficient environmental benefits of lohas.

In addition, in this annual report we've recorded the chronicles of important events, special lectures,, publications, technical transfer cases, paper published, budget and financial accounts, and human resources information transpired in 2017, so that the administrative achievements of TFRI in the year can be presented in total for the readers to peruse.



2017 Annual Report

貳

研究計畫推動及成果

Development and Results of Research Projects





經濟樹種品種改良與栽培繁殖技術之開發

陳舜英、張淑華、鄧書麟

林業試驗所與日本森林總合研究所合作研究瓊崖海棠 (*Calophyllum inophyllum*)，以瞭解分佈於臺灣與日本石垣島和西表島等地區之瓊崖海棠各種原間之生長性狀差異。本計畫為選拔瓊崖海棠優良母樹，並進行採種、育苗及野外栽種試驗，共調查蒐集臺灣地區包括恆春(21家系)、花蓮(4家系)及臺東(12家系)精英母樹共37家系，已培育1,323株健壯苗木；日本地區共採集20家系母樹，已培育480株健壯苗木。在屏東恆春、宜蘭壯圍、雲林四湖及嘉義澧水等地區分別設置瓊崖海棠適應性生長試驗地共四處，並完成臺灣32家系、日本19家系，共1,331株苗木之後裔栽種工作。今年持續進行屏東恆春及宜蘭壯圍試驗地2次試驗地苗木生長調查，以及除草除蔓等撫育工作。另外，完成雲林四湖及嘉義澧水試驗地之設置及初步生長適應情形調查工作。

完成10個牛樟營養系各部位精油與木酚素成分分析，品系與組織間含量差異很大。調查長嶺苗圃牛樟組培苗之抽芽與性狀，在105年10月在1 m高截幹後之日月潭苗圃58個牛樟營養系，經1年生長後有98%牛樟萌芽且樹平均高達2.9 m。調查竹崎、六龜與孝義苗圃牛樟生長，成活率在六龜與孝義為74%、77%，竹崎的苗木成活率54.5%最差，乃由於竹崎栽植地會積水造成。評估106年日月潭苗圃平均每株牛樟可產生54支穗條，最佳營養系為N12與F5，可產生91-92支穗條。建立組織培養繁殖適合樟芝生長及具優良材質之優良品系牛樟。利用繼代培養與低溫保存樟芝菌種。樟芝接種於不同牛樟營養系以菌種B，營養系1、3、4、8及大於1.1 kg的段木比較適合樟芝生長，完成採集段木子實體進行成分分析。

不同牛樟營養系之品系、段木重量與樟芝菌絲生長的關係。

The growth of mycelium of *Androdia cinnamomea* strains on different weight of logs among *Cinnamomum kanehirae* clones.

營養系 (Clones)	菌種A(Strain A)				菌種B(Strain B)				菌種C(Strain C)			
	段木重(log weight kg)				段木重(log weight kg)				段木重(log weight kg)			
	0.8-1.0	1.0-2.0	2.1-2.5	>2.5	0.8-1.0	1.0-2.0	2.1-2.5	>2.5	0.8-1.0	1.0-2.0	2.1-2.5	>2.5
1	+	*	+	+	+	+++	++	++	-	++	+	+
2	-	-	+	+	-	+	+	+	-	+	+	+
3	+	++	++	++	++	+++	++	+++	-	++	+	+
4	+	+	+	++	++	+	++	+++	-	+	+	+
5	-	-	+	+	-	+	+	+	-	-	+	+
6	-	-	-	+	+	-	+	+	-	-	+	+
7	-	-	+	+	-	+	++	++	-	+	+	+
8	+	++	++	++	++	+++	+++	+++	+	++	++	++
9	-	+	+	+	+	+	++	+	-	+	+	+
10	-	+	-	-	-	-	++	+	-	-	+	-

*-, +, ++, +++ 代表菌絲生長程度為無、少許、中等、大量。

*-, +, ++, +++ represented as the mycelium grown in logs: non, few, middle, and a lot.

Improvement of Economically Tree Varieties and Technical Development of Cultivation and Propagation

Shun-Ying Chen, Shu-Hwa Chang, Shu-Lin Deng

A collaborative research in *Calophyllum inophyllum*, a coastal tree species, was carried out between Taiwan Forestry Research Institute (TFRI) and Forestry and Forest Products Research Institute (FFPRI) in Japan. The objective is to select wind resistant seed trees among Taiwan, Iriomote Island, and Ishigaki Island, and to collect seeds and cultivate seedlings. These seedlings were planted at coastal areas, and their survival and growth were investigated. Thirty-seven *Calophyllum inophyllum* plus trees were investigated in Taiwan, including 21 trees at Hengchun, 4 trees at Hualien, and 12 trees at Taitung. A total of 1,323 seedlings were obtained. Twenty plus trees were investigated in Okinawa, and 480 seedlings were obtained. In 2017, 1331 seedlings from 32 Taiwan plus trees and 19 Japan plus trees, respectively, were planted at Hengchun, Illan, Yunlin, and Chiayi sites for adaptability test. The growth of these seedlings was surveyed.

Chemical analysis of different plant parts of 10 *Cinnamomum kanehirae* clones was investigated. Composition of essential oil and lignans showed great differences. Leaf characters at dif-

ferent stages among clonal plants derived from tissue cultures were investigated at Changlin Nursery, Ilan County. On year following stem cutting of 58 clones at stump height of 1 m at Sun-moon-lake nursery, Nanto County in October 2016, 98% plants successfully resprouted with an average height of 2.9 m. The survival rates at 3 scion gardens, located at Zhuqi of Chiayi County, Liouguei of Kaohsiung City, and Xiaoyi of New Taipei City, were 54.5%, 74% and 77%, respectively. Due to poor drainage, plants at Zhuqi had the lowest survival rate. The average cuttings per tree at Sun-moon lake was 54. However, clone #N12 and #F5 produced as high as 91 and 92 cuttings each. Clones suitable for culturing *Androdia cinnamomea* and for producing good wood quality were propagated via tissue cultures. *A. cinnamomea* strains were preserved by using serial subculture and storing at low temperature. Testing different strains inoculated on 1 kg logs of different *C. kanehirae* clones, fruiting bodies successful developed from logs of clones #1, #3, #4, and #8 with strain B. Fruiting bodies were collected and their chemical compositions were analyzed.



不同生育地造林技術之研究

陳芬蕙、黃俊元

混農林業可兼顧農民收益與自然保育，因此我們需要了解國內混農林業永續經營之效益並累積更多相關知識以利推廣。本計畫針對山坡地混農林業試區進行栽植林作物之生長與農作物之生產的長期觀察。觀察發現混植牛樟栽植6年後之成活率介於43-76%之間，其中魚池牛樟生長情形各處理中以檳榔全砍最佳。低密度栽植於廬山茶園之臺灣肖楠栽植20年後生長強健快速，其碳吸存之效益大，今年二氧化碳累積量已達166噸/公頃。觀察坪林茶園所產鮮葉重量，混植的牛樟長大後茶葉產量銳減。混植林木之環境可提供比單純農地更多樣化之棲地，以提高生態功能及維持生物多樣性，也較能緩和環境之劇烈變化，將可減少氣象災害之發生。因此，混農林業可提供保育淺山地區的農林永續策略。

臺灣常因颱風引發洪水及山崩，造成下游河川礫石含量高而貧瘠，屬於造林困難處。太麻里海岸試驗林因2009年遭受莫拉克風災危害造成土壤劣化，本試驗於河川下游洪氾區進行造林試驗，希望篩選生長快速及適應佳之造林樹種，並藉由造林技術增進造林木的生長表現。結果發現對於石礫含量高的貧瘠地，可藉由適當的施肥，促進造林木生長及適應逆境能力；未施肥處理以木麻黃、相思樹、黃槿、水黃皮及欖仁的生長表現較佳，可成為洪氾區造林之適生樹種。以篩土整地處理造林木的生長表現優於未篩土整地處理，並以粗篩及土壤改良處理之造林木生長表現最佳，顯示洪氾區內林地運用篩土整地及植穴土壤改良處理可改善生育地土壤，利於林木生長。



低密度栽植於廬山茶園之臺灣肖楠栽植20年後生長強健快速，增加農地的碳吸存效應。

These low-density 20-year-old Taiwan Incense Cedar, *Calocedrus formosana*, in a Lushan tea plantation grow quickly. Interplanting trees on tea plantations will increase the carbon sequestration capacity of agricultural lands.

Study on Forestation Technologies in Varied Habitats

Fen-Hui Chen, Chun-Yaun Huang

Agroforestry management system can be a solution of balancing agriculture for livelihood with sustainability in upland villages. However, related researches in agroforestry in these areas are not enough and out of date. To disseminate agroforestry, more update of technologies and consensus among different parties are urgent. In this project, we will monitor the growth of interplanted trees and agricultural productions at agroforestry study sites. Six years after planting, the average survival rates of interplanted *Cinnamomum kanehirai* were between 43%-76%. Among all treatments of Yuchi study site, the best performance of *Cinnamomum kanehirai* was those at betal nut clearcut plots. At Lushan study site, 20-year-old interplanted Taiwan incense cedar (*Calocedrus formosana*) are now over 9 meters in height and in good conditions. The estimate CO₂ sequestration of these *Calocedrus formosana* is over 166 ton/ha CO₂. Due to the shade effect from interplanted *Cinnamomum kanehirai* at Pinglin study site, tea production was decreasing gradually. Environments with interplanting trees provide more various habitats than agricultural lands, and in turn increase their ecological function and biodiversity. Moreover, in agroforestry systems, mitigating environmental changes will reduce weather disasters. Agroforestry strategies provide conservation insights into sustainable management of lowland farmland.

Heavy rains during typhoon season are main factors that cause flood and landslide in Taiwan. Barren floodplains filled with gravel are unsuitable for afforestation. In this project, we chose a degraded land on floodplains that was flooded by Morrakot typhoon in 2009 in Taitung Taimalee. We conducted a research about how to improve afforestation techniques and understand what kind of trees which grew better and quicker in degraded land. According to the results after seedlings were planted for 2.5 years, seedlings had better growth performance and adaptation ability with fertilization than without fertilization. The growth performance of *Casuarina equisetifolia*, *Acacia confuse*, *Hibiscus tiliaceus*, *Millettia pinnata*, and *Terminalia catappa* seedling on non-fertilization treatment were greater than others. Therefore, these species are recommended on untreated floodplains. The results also showed that using excavators for soil preparation before planting improved the growth performance of seedlings. Appropriate soil preparation and fertilization are able to promote growth and adaptability of afforestation on barren lands.



人工林之多目標經營模式研究

邱志明

處在21世紀，生態環境和天然林之保護為當前之趨勢，因此，天然林將繼續禁伐，在此環境下，永續與集約經營人工林，透過多元化育林或撫育等策略，變成為重要課題。長伐期林業經營目標是將人工林延長伐期，即由目標樹之選育，並透過一系列多元化育林撫育措施(如選擇疏伐、塊狀伐採、天然更新和人工促進天然更新及撫育等)，同時將人為的干擾降低到最小，並且不影響森林的結構和景觀，使同齡純林逐步接近天然的複層異齡混交林，即近自然林，並且要求林地上持續地有林冠覆蓋，且不斷的有木材收穫，培育大徑高品質及高價目

標樹，做為終伐收穫之標的。因此，此永續經營之森林將達到社會、文化、生態和經濟需求之平衡。本計畫已完成六龜試驗林45年生之香杉、臺灣杉，及蓮華池57年生臺灣肖楠人工林長伐期目標樹、干擾樹、生態樹、一般樹之標訂，及干擾樹之砍伐，並和傳統之下層疏伐及未疏伐之對照區進行比較分析。結果顯示。林下地被植物在疏伐作業過後並未顯現明顯影響，喬木天然更新方面，疏伐作業初期確實對於林下天然更新的小樹造成破壞，但疏伐後新增加之空間產生了極大量的天然更新小樹，數量遠大於疏伐作業所造成的小樹之損害。



肖楠干擾樹疏伐(藍繩)，目標樹留存(紅繩)之林相。

The symbol of blue rope were thinned and the symbol of red rope were retained for 57-year-old *Taiwania incense-cedar* plantations at Lienhuachih research center.

Studies on the Models of Sustainable Management for Plantations

Chih-Ming Chiu

To reach 21st century, the protection of ecological environments and conservation of natural forests are the current trend on the earth. Therefore, the ban of natural forest cut is still a continuing tendency. Under the circumstance, it is important that sustainable and intensifying management of man-made forests through a breeding desired trees and a series of alternative silvicultural tending strategies (such as dispersed thinning, tree selection, aggregated (gap or cluster) cutting, natural regeneration and planting or tending) to approach the long-term rotation plantation management that is to establish multi-stories and uneven aged, mixed-species plantations to reach sustainable forestry. In the meantime, reduces the disturbed manipulations to minimum, furthermore, uneffect the forest structure and landscapes. And pure even-aged plantations were gradually transformed into natural multi-stories and uneven aged mixed-species forest i.e. close to natural forest. Those forests are claimed to maintain that can produce wood sustainability and continuous cover forestry. Moreover, the breeding target trees can possess big diameter, good quality and high value will be harvested at the extended rotations. Therefore, that sustainable forest could

balance social, cultural, ecological and economic needs. This study was conducted in Luanta-fir (*Cunninghamia konishii* Hayata), Taiwania (*Taiwania cryptomerioides* Hayata), 45-yr-old and Taiwan Incense-cedar (*Calocedrus formosana*), 57-yr-old plantations located at the Liouguei and Lienhuachih research centers in southern and central Taiwan, respectively. The stands have finished marking 4 parts, such as, target trees, disturbed trees, ecologic trees and general trees, The long-term target trees area, the general thinning from below area, and unthinned area (control) were established to compare and analyze the difference among growth, structure and diversity. The results showed that there were no significant effect ground-layer vegetation after thinned area. The natural regeneration trees, which were damaged by thinned operations at first, but promote large amount of natural regenerated trees because of increasing spaces after thinned. Therefore, the numbers of natural regeneration trees have more than that of mortally by thinned operation. There were no difference between long-term trees area and the general thinning from below area.



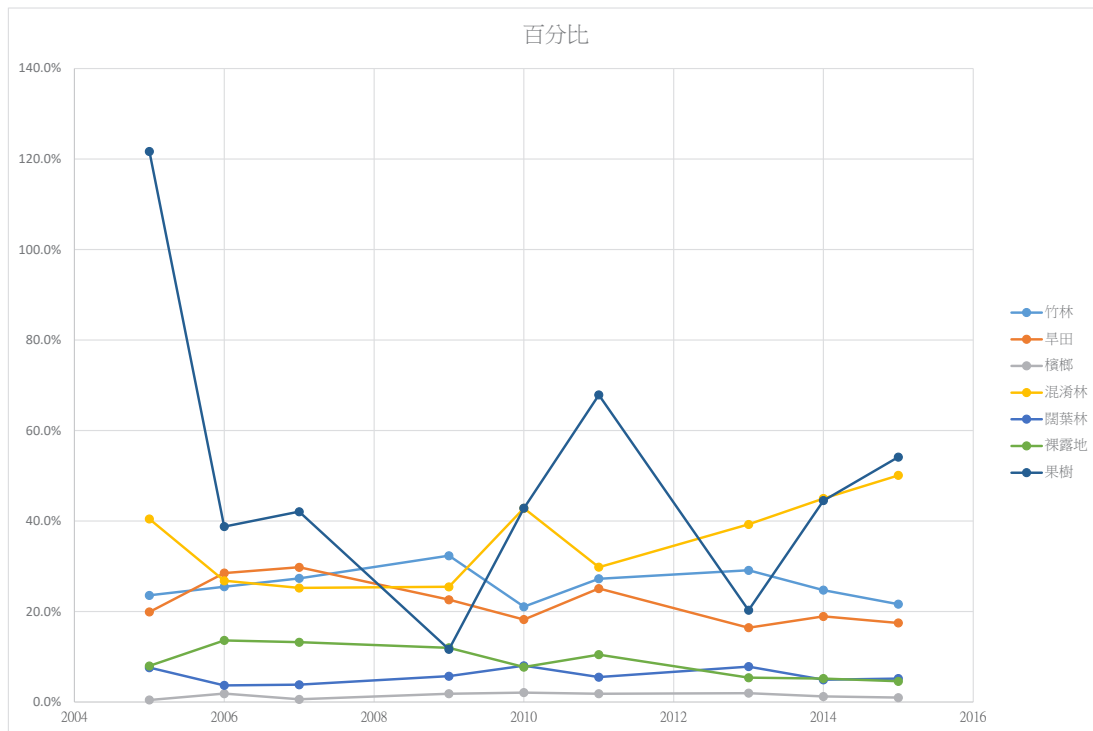
應用多時期福衛二號影像與地景指標於山坡地土地利用影響評估

謝漢欽

本研究以7,810公頃苗栗獅潭地區為研究試區，選用2005年至2015年11年間9個時期無雲的福衛二號衛星影像、應用物件導向平均值移動影像分割法、對各期NDVI影像進行非監督分類，求得9個年期非植生覆蓋區塊的空間分布格局主題圖。選用5個組類層級地景指標，針對非植生區塊與植生覆蓋區塊兩個組類，進行組類分布結構化分析，結果顯示本試驗區的非植生區塊有逐漸增加、聚集、彼此之間的距離逐漸減少、區塊形狀日趨簡單。非植生覆蓋基底區塊數逐漸增加、總面積減少、連接度減少、形狀複雜度增加，因而植生覆蓋的地景有逐年呈現破碎化趨勢。在整個地景層級方面選用4個地景指標，進行地景組類結構化分析，結果呈現本試區的地景區塊有逐漸年增加、面積變小聚集程度變小，分散增加，因而被非植生區塊分割後的整體地景破碎化程度有逐年增加的趨勢。

再針對9個年期坡度大於16度以上之超限非植生區塊分布主題圖，依據區塊在16種不同土地利用型發生比率進行比較，分析結果顯示超限非植生區塊發生比例依序於果樹、混淆林、竹林與旱田的面積比較大。發生於混淆林的面積比有逐年增加趨勢，發生於旱田與竹林比率維持在20%上下波動。發生於本區的果樹面積比在各年其中比例普遍都很高平均維持在50%，但波動幅度較大。

此外應用Local G-statistic空間統計指標，分析由9年期超限利用非植生區塊空間分布圖，結果顯示主要熱點區位，位在研究區的東南下方大湖鄉大南村與泰安鄉大興村交接處，本區有許多休閒農場與露營地分布。研究成果可提供山坡地土地利用地管理的空間決策參考資訊。



介於9個年期超限利用區塊在與坡地利用有關的竹林、旱田、果樹、檳榔、混淆林、闊葉林及裸露地7類土地利用型發生面積比例趨勢圖。Trend lines showing the ratios of overuse area occurred in the 7 main slope land-use types: bamboo, dry field, fruit tree, betel nut, mixed forest, broadleaf forest and bare ground, during 9 time periods.

Using Multi-temporal Formosat-2 Satellite Images and Landscape Metrics to Evaluate the Impacts of Land Use Types

Han-Ching Hsieh

In this study, a total of 7,810 hectares of Shihtan area in Miaoli were selected as the study area. 9 cloud-free images of FORMOSAT 2 satellite were selected during the 11 years from 2005 to 2015, and the object-oriented mean shift image segmentation was used to extract non-vegetative patches from NDVI images through unsupervised classification procedure to obtain non-vegetative patches thematic map for each date. 5 class level landscape metrics were selected for the analysis of non-vegetative class and vegetative class. The results showed that the non-vegetative patches in the experimental area increased gradually and aggregated, the distance between each other gradually decreased, and the shapes of the patches became simpler. The number of non-vegetative patches gradually increased, the total area of vegetative cover decreased, the degree of connectivity decreased and the shape complexity increased. The entire landscape showed a trend of fragmentation year by year. 4 landscape level landscape metrics were selected for the analysis whole landscape structures. The results showed that the total number of patches increased gradually, the patches area became smaller and the degree of aggregation became smaller and the dispersion increased. Therefore, the degree of fragmentation of the entire landscape after the cutting of no-vegetative patches was increased gradually year by year.

According to the thematic map of overuse patches, non-vegetative patches with a slope of more than 16 degrees, the comparison of the ratios of area of overuse patches which located in 16 different types of land-use was conducted. The analysis showed that the ratios of overuse areas of fruit trees, mixed forest, bamboo forest and dry land area is relatively large in order. The area ratio of mixed forest has been increasing year by year. The ratios occurred in dry field and bamboo remained at 20% fluctuation. The area ratio of fruit trees occurring was generally high at 50% per year, but the fluctuation is relatively large.

In addition, the local G-statistic spatial statistical index was used to analyze the spatial distribution of non-vegetative overused patches during the 9-year for the finding of hot spots. The results showed that the major hot spots are located at the junction of Danan Village, Dahu Township and Daxing Village, Taian Township, at the southeast of the study area. There were many leisure farms and campsites in this area. The research outcomes can provide spatial decision information for slope land use management.



混農林經營型態及應用策略之探討

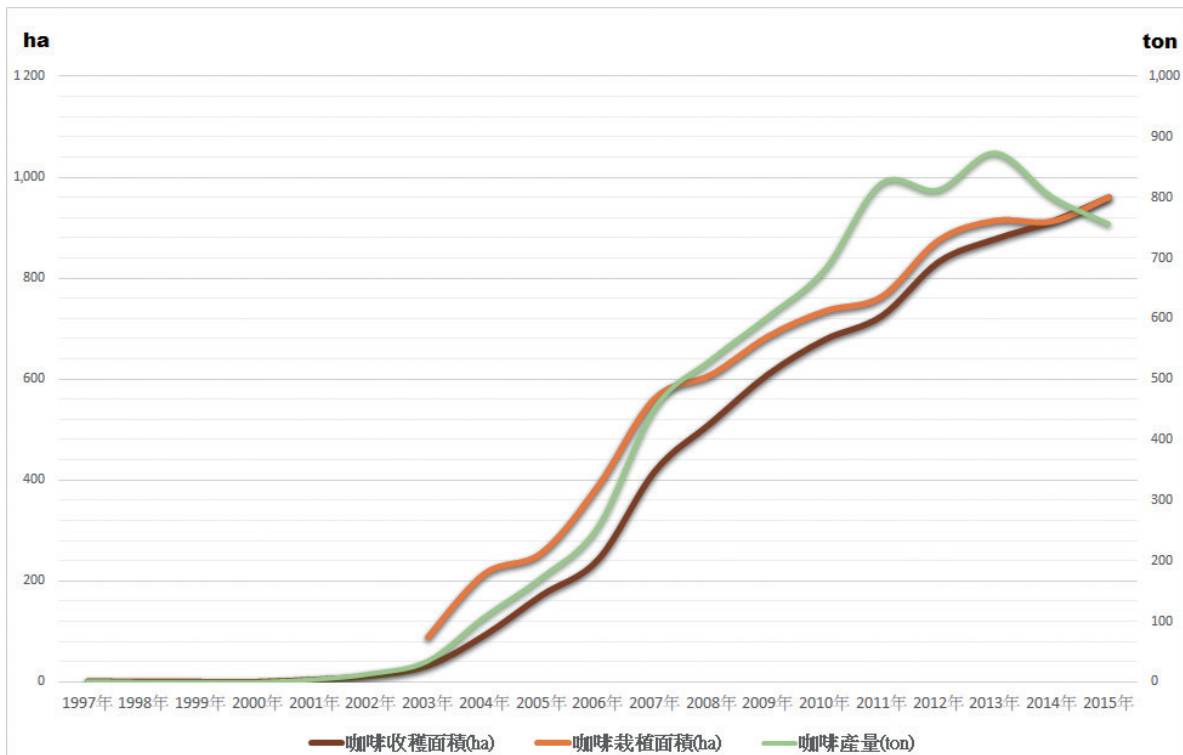
王培蓉

氣候變遷對島嶼國家的風險為害層級不斷升高，對於極端氣候的承受能力相對較低的島嶼，臺灣需要提高不同植被類型做為糧食安全的保障以及增強環境與社會的韌性。咖啡為極佳的林蔭植物，已有大量研究證實林蔭咖啡對生物多樣性、咖啡風味提升與農民的收益保障，均有助益。臺灣咖啡樹引進年代甚早，惟自2001年起咖啡栽植面積有逐年快速增長的趨勢，至2015年已近1,000公頃。本研究針對林蔭咖啡之生態、社會及經濟效益設計訪談項目，並調查林下咖啡栽植之生態優勢，比較3種植被結構在昆蟲多樣性之差異。

從現有咖啡產銷班班員的抽樣調查，近8成的人回答其咖啡園有上木遮蔭。受訪者對有/無上木對咖啡結果量的效果，有12.4%認為沒差異，37.9%認為全光照的結實量多，49.7%認為有上木的結實量較多。在氣候變遷對咖啡經營的影響，則有88.7%同意氣候變遷會降低咖啡

收穫量。因此，未來有48.4%考慮增加咖啡栽植面積，22%會嘗試種一些樹木保護，只有6.3%考慮轉作其他作物。

另外，本研究在雲林縣古坑鄉荷苞山調查不同植被類型咖啡園的生物多樣性，分為純咖啡林、混肖楠林咖啡、咖啡育苗場，以及野生狀態的林蔭咖啡四處，架設掉落式陷阱及空中攔截板，蒐集不同樣點的昆蟲相。總計在掉落式陷阱採集到7目28科41個型態種2,674隻次，攔截板採集到7目36科48形態種287隻次。計數結果，各樣區間差異不大，初級消費者、次級消費者、清除者皆俱，可見生態完整性高。據此推測由於臺灣咖啡栽植多為小面積鑲嵌於中低海拔農林交錯的里山地景間，此類植被過渡帶的生物多樣性較為豐富，縱有小面積純咖啡園對當地生物多樣性即無顯著影響。



臺灣咖啡面積與產量增長趨勢。
Taiwan coffee area and production growth trend.

Discussion on Management Types and Application Strategies of Agroforestry

Pei-Jung Wang

The level of risk that climate change has on island nations is rising. For island nations with relatively low endurance to extreme weather, Taiwan needs to improve the protection of different vegetation types for food security and enhance environmental and social resilience. Coffee is an excellent forest understory plant, a large number of studies have proved that the coffee forest have benefits to biodiversity, coffee flavor enhancement and farmers' income. Coffee trees were introduced to Taiwan during early years, only since 2001, coffee plantation area has been growing rapidly year by year. By 2015, coffee plantation area has reached nearly 1,000 hectares. This study designed an interview for the ecological, social and economic benefits of coffee plantations, investigated the ecological advantages of coffee plantation in the forest, and compared the differences in insect diversity between the three vegetation types.

From a sample survey on the existing coffee production and marketing staff, nearly 80% of the staff answered that there was wood shading in their coffee plantation. As for the effect of shaded wood on coffee seeds, 12.4% of the respondents thinks there are no difference, 37.9% of the respondents believes full light results in more seeds, 49.7% of the respondents believe having shaded wood results in more seeds. On the impact that climate change has on coffee plantation, 88.7% respondents

agree that climate change will reduce coffee harvest. Therefore, there are 48.4% of the respondents considering to expand coffee plantation area, 22% of the respondents will try to upgrade protection by planting more trees, and only 6.3% of the respondents are considering to plant other crops.

Furthermore, this study investigated the biodiversity of coffee plantations with different vegetation types in Hebaoshan, Gukeng Township, Yunlin County, by setting fall-traps and air interception board in pure coffee plantation, coffee forest mixed with *Calocedrus formosana*, coffee cultivation and wild coffee forest, collecting different samples of insects. Collected 7 orders 28 families 41 species 2,674 times in the fall trap, and collected 7 orders 36 families and 48 morphological species 287 times on the interception board. As result, there are only little differences between the various sample sections; primary consumer, secondary consumer and removers were all included, which shows high ecological integrity. Therefore, it is speculated that due to Taiwan's coffee planting are mostly in small area inlaid in low-altitude agricultural and forestry interlaced mountain area, the biological diversity of such vegetation transitional zone is more abundant, even a small area of pure coffee plantation on the local biodiversity won't be significantly affected.



友善環境之木竹材採運作業與小型林業機械應用之研發

湯適謙、邱志明

為了提升森林作業的效率及作業的安全性，世界各林業先進國家都在積極發展高性能之林業機械，臺灣之森林作業亦面臨採運技術人員老化、人力不足之問題，因此林業試驗所嘗試研製引進高性能林業機械，該型機械以履帶式挖掘機為基礎，透過快速換斗器，可進行包含鏟斗、自動伐木造材機及夾具之更換；亦加裝雙絞盤可進行半懸式或全懸式集材，以降低對環境之衝擊。

上述之行動式多功能木材收穫機於林業試驗所蓮華池研究中心60年生山坡地臺灣肖楠人工林及台灣糖業公司雲嘉區處15年生平地杜英人工林進行疏伐集材作業之測試，所得結果如次：山地疏伐作業部分，平均每日集材材積為16.1 m³，每人每日作業量為3.2 m³，作業成本為

3,167元/m³，小於木材市價；平地疏伐作業部分，由於作業地為平地之農地，因此收穫機可如農用機械駛入林地進行作業，充分發揮機械自動化、機動性及大動力輸出之特性。經調查平均每日集材材積為79.8 m³，每人每日作業量則為26.4 m³，機械疏伐成本為632元/噸，人工疏伐為854元/噸，所以機械作業之成本較低，亦均小於該批收穫段木之售價。

另為了解人工林疏伐作業後對林地植被及地表之影響，本研究亦進行林務局新竹林管處柳杉人工林疏伐樣區監測，所得結果如次：主伐帶在伐採後一年，逐漸接近伐採前之植被歧異度，橫向及下層疏伐則對歧異度影響不大。另沖蝕深度與林地受干擾程度有關。



應用行動式多功能木材收穫機之自動伐木造材機進行造材作業。

The automatic feller-processor installed on mobile versatile harvester was applied for wood processing.

Application of Smaller Machinery and Environmentally Friendly Logging Operations for Wood and Bamboo

Shyh-Chian Tang, Chih-Ming Chiu

In order to improve the efficiency and safety of forest operations, the advanced countries of the world are developing high performance forestry machineries actively. The forest operations in Taiwan face the problems of skilled men aging and manpower shortage. So Taiwan Forestry Research Institute try to introduce the high performance forestry machinery. For the need of research, the machinery was based on the excavator, and the bucket, automatic feller-processor and grapple could be changed by quick hitches. The double winches were installed also to implement the semi and whole suspending cable yarding to reduce environmental impact.

The above mobile versatile wood harvester was applied on the thinning logging of mountainous sixty years old Taiwan incense cedar (*Calocedrus formosana*) plantation and plain fifteen years old common elaeocarpus (*Elaeocarpus sylvestris*) plantation. The results were as follows. For the mountainous thinning, the daily skidding output was 16.1 m³ and 3.2 m³ for per worker per

day. The operational cost was 3,167 NTD/m³, which was less than market price.

For the plain thinning, because the site was for agriculture, so the harvester could be drove into the land as general farm machinery. The properties of automation, mobility and high power of machinery could be bring into full capacity. The daily output was 79.8 m³ and 26.4 m³ for per worker per day. The operational costs were 632 and 854 NTD/ton for mechanical and manual operations respectively and they were all less than the sale price of the logs.

For the eco-monitoring of Japanese cedar (*Cryptomeria japonica*) thinning located in Hsinchu Forest District, Forestry Bureau, the biodiversity of main logging zone was close to the value before logging. The changes of horizontal and lower thinning were not significant after one year. On the other hand, the erosion depth had relevance to interference degree.



木、竹廢料之生質燃料應用與儲存技術研發

林裕仁

氣候變遷持續性地威脅全球生態環境，諸多學者紛紛提出各項指標來檢視自己國家的安全程度，其中「糧食安全」與「能源安全」為多年來備受關注之議題；反觀我國不論是糧食或能源皆需高度依賴國外進口，欠缺自主性，因而高成本地投資建置風力及太陽光電等各項再生能源，卻忽略了我國亦為林木資源極豐富的海島型國家，全島蒼鬱林木每年所剩餘之廢棄餘材，在國外早已發展成高效率效能的木質燃料，以替補昂貴、易汙染且終將竭盡的化石能源。

本計畫係乃應用「能源安全」與「糧食安全」之觀念結合其已發展之相關理論，針對木、竹廢料不同型式生質燃料應用與其儲存技術進行分析研究，同時評估對能源供給之經濟效益，目的在期研究結果可提供能源政策主管機關在制訂生質能源發展政策時參考。因此，研究結

合「糧食安全」與「能源安全」之戰略概念，藉以評估我國在戰備時期能源遭限制性進口，導致能源供給短缺，為維持烹煮糧食需求的情況下，使用木質能源替補供氣燃料之量能。經情境模擬敏感度分析結果顯示，利用全國廢棄樹枝年產量轉製木質顆粒，在回收利用率100%情況下，替補於液化天然氣糧食燃料失衡時，使用天數約為41-68天；替補於液化石油氣糧食燃料失衡時，使用天數約5-8天。對此，說明木質能源雖未能完全替代進口供氣燃料，卻可即時因應緊急所需，再加上若能有效規劃已達收穫期之人工造林定期定量轉能機制，勢必更具其價值。未來應研擬相關木質能源發展策略，以提供多元化再生低碳燃料之運用，並期研究結果可提供能源政策主管機關在制訂生質能源發展政策時參考之用。



木質加工廢棄資材型態：(A)木屑；(B)邊皮；(C)下腳料；(D)小切片；(E)木薄片。

Types of woody wastes. (A) sawdust; (B) bark wastes; (C) sawn timber; (D) woodchips; (E) wood leftovers.

Research and Develop on Biofuel Application and Storage Technology from Woody and Bamboo Wastes

Yu-Jen Lin

Climate change has threatened the global ecological environment. Many researchers have proposed various indicators to examine the level of security in their countries. Among the indicators, both food security and energy security have been highly concerned for many years. Food and energy in Taiwan are heavily reliant on foreign imports that lack of autonomy. Thus, Taiwan stimulates high investment cost in developing renewable energy such as wind power, solar energy and others, but overlooks the abundant forest resources. The wood residues from luxuriant forests each year have long been developed highly efficient and effective wood fuels in foreign countries in order to replace the expensive, high pollution and ultimately depleted fossil fuels.

This study adopted the concepts of energy security and food security to analyze the application of different biofuel from woody and bamboo wastes and its relative storage technologies. To develop feasible storage and transport technologies for above-mentioned biofuels, what could be comparable with the current technologies of fossil fuels, was simultaneously expected. The economic benefit to general energy supply was assessed in this study as well. The purpose of this study was to provide the results as a reference for the authorities, what they are making the country energy development strategies in the future. This

research combined the strategic concepts of food security and energy security to assess utilization of wood energy that substitutes capacity of gas fuels during the war preparation ,in order to maintain the demand for cooking food that energy would face in restricting import ,which led to an energy supply shortage in Taiwan. The results of sensitivity analysis that simulated situations showed that utilization of national waste twigs annual yield generated wood pellets, under the condition of recovery and utilization rate was 100%, the service days was around 41-68 days that wood pellets substituted liquefied natural gas as food fuels unbalanced, and the service days was around 5-8 days when wood pellets substituted liquefied petroleum gas as food fuels unbalanced. Wood energy could not completely replace imported gas fuels, but it could immediately to cope with emergency real time. In addition, if artificial afforestation that has reached harvesting season can be planned effectively by an energy transformation mechanism quantitatively and regularly, wood energy would be more valuable. Development strategy of woody energy should be surveyed and drawn up in the future that providing not only utilization of diversified low carbon fuels, but also findings as a reference for developing bioenergy policies to competent authority of energy strategy.



木、竹材生產之合法性驗證制度研究

林俊成

臺灣99%以上的實木產品需求來自進口，因此對於進口木材及其製品的合法性相當敏感，建立我國木材合法性制度，將有助於提升我國木材或林產品於國際市場的地位。另外美國雷斯法案修正案(Lacey Act Amendment)、歐盟木材法案(European Union Timber Regulation, EUTR)及澳大利亞禁止非法伐採法案(Illegal Logging Prohibition Act, ILPA)，皆要求市場上木材及其製品之生產商和進口商，在首次進入該國國內市場時，都必須透過盡職調查體系(Due Diligence System, DDS)或盡責調查(Due

Care)來進行風險管理，其目的在於降低及避免非法木材及其製品進入國內市場，進而確保所有進入國內市場的木材及其製品屬合法伐採與貿易的。因此建議國內林產業者應實施盡職調查、森林驗證或制定產業自律規範，以降低使用可疑非法來源的風險，相關木材合法文件及程序的制訂，需先舉辦說明會(公聽會)或相關專家會議，由相關公會、工會或商會，以及各進口相關單位(農委會、經濟部國貿局、財政部關務署等)以求得一致共識。



面對木材合法性要求，臺灣要如何因應？
How to deal with the legality of timber in Taiwan?

Legality Certification System of Wood and Bamboo Product

Jiunn-Cheng Lin

More than 99% of Taiwan's demand for wood products comes from imports, therefore, the legality of imported timber and its products is sensitive, the establishment of Taiwan's timber legitimacy system will help enhance the status of our timber or forest products in the international market. In addition, the Lacey Act Amendment of the United States, the European Union Timber Regulation (EUTR) and the Australian Illegal Logging Prohibition Act (ILPA) require that producers and importers of timber and its products to carry out risk management through Due Diligence System (DDS) or Due Care on their first entry into the country's market, their purpose is to reduce and prevent the entry of illegal timber and its products into the market and

to ensure that all timber and its products entering the market are legally harvested and traded. Therefore, in order to reduce the risk of suspicious illegal source, it is suggested that domestic forest industry should conduct due diligence, forest certification or self-regulation. A briefing session (public hearing) or related expert meetings, the relevant guilds, trade unions or chambers of commerce, as well as the import of relevant units (Council of Agriculture, Ministry of Economic Affairs Bureau of Foreign Trade, Ministry of Finance Services Department, etc.) in order to reach a consensus is needed for the related timber legal documents and procedures for the formulation.



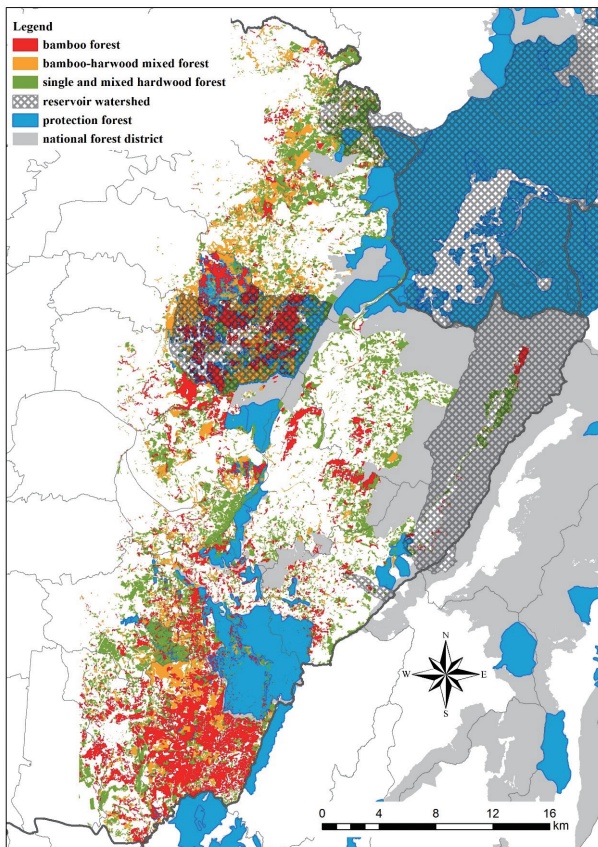
動態清查公私有林木、竹材資源之技術研發

林奐宇

竹林是生長快速、利用歷史悠久且加工技術成熟的森林資源。臺灣第一次對全臺竹林資源的完整調查，始於1956年中國農村復興聯合委員會特刊發表之「臺灣之森林資源」調查報告，記錄臺灣全島竹林面積113,900 ha。後經歷年森林資源調查更新，概可瞭解全臺灣竹林面積約介於113,900至183,330 ha間。然而，除1956年「臺灣之森林資源」報告以外，對於全臺各經濟竹種的面積與分布資料始終缺如，無法提供準確數據做為經營管理參據。

本研究針對國有林事業區外土地，包含山坡地及部分平地為範圍，建立整合林務局第四次全國森林資源調查及水土保持局山坡地利用調查及山坡地可利用限度查定成果圖資之流程，再經現地調查與航攝影像補充判釋，針對竹林資源充沛之縣市(新北市、桃園市、新竹縣、苗栗縣、南投縣、臺南縣)，建立全區木竹資源分布及土

地利用現況圖。此外，特別針對竹林進行竹種組成判釋，瞭解竹林與竹種分布現況，並透過樣區調查，瞭解各縣市竹材資源之蓄積情形。研究結果顯示，以面積而言，竹苗地區竹林面積最廣，達17,000公頃；其次則為桃園及新北地區，面積達12,000公頃。主要地點為苗栗獅潭、泰安、大湖、新竹尖石、桃園復興及新北八里等行政區，組成竹種以桂竹為主，八里地區則以綠竹為大宗。然而，經調查竹林伐採現場之地形與交通參數，進一步於地理資訊系統進行套疊分析，顯示臺南地區與桃園新北地區竹林分布環境之地勢緩平，交通可及性較高，從資源利用角度而言，其伐採利用成本較低。本所已完成前述研究成果之地理資訊系統資料庫建置，可提供各界後續使用。



以臺南為例，本研究獲得區域內森林(含竹林)之分布狀況，並於GIS系統內與水庫集水區及保護留區等圖資套疊，分析不同地點的經營管理策略。

Fig. 1. An overlap of bamboo and hardwood distribution ranges with the watershed of reservoirs and the protected forests to reveal the adaptive strategies for management by locality.

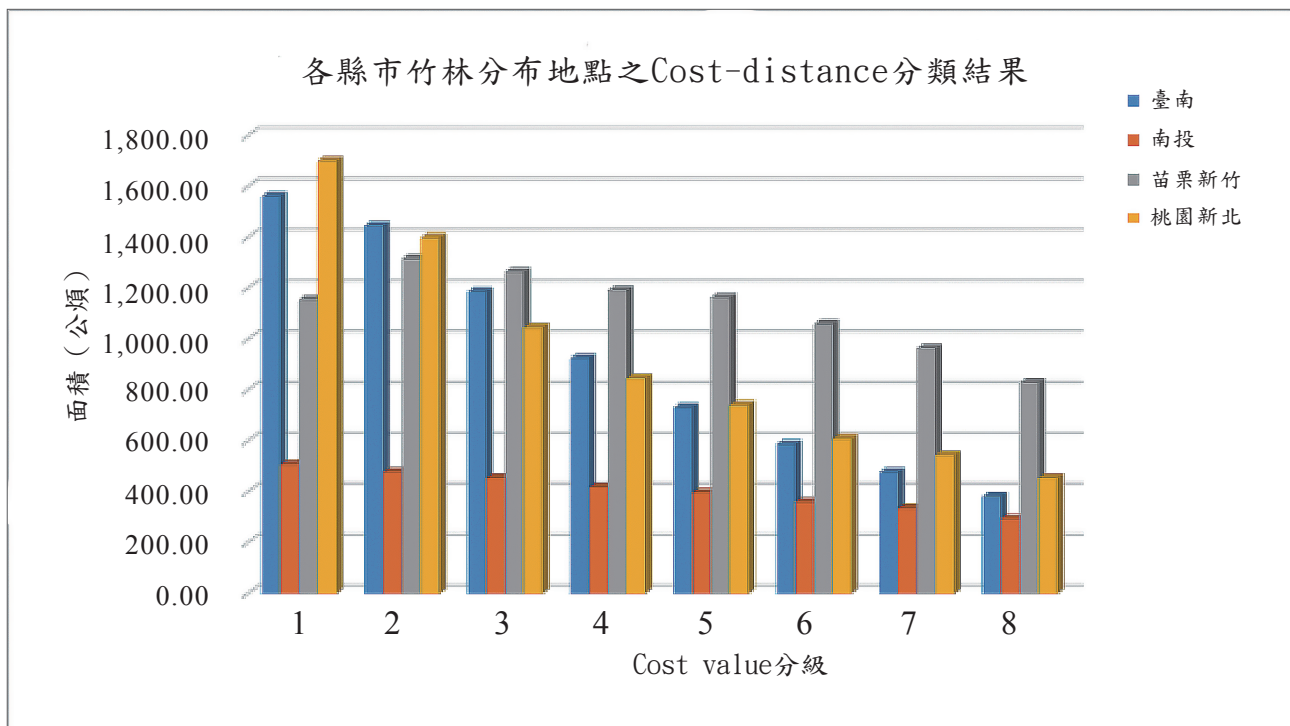
Application of Aerial Images and GIS Techniques in Forest Resources Estimation

Huan-Yu Lin

Bamboo, a widely distributed plant species and has been utilized for a long history in Asia, is one of the most plentiful forest resources of Taiwan. The first report was published in 1956 to reveal the statics of six economical bamboo species with a total area of 113,900 ha. Taiwan Forestry Bureau has kept on updating the distribution of forest resource via several censuses during recent decades, it demonstrated that the exact area of bamboo forest in Taiwan ranges from 113,900-183,330 ha. However, few of studies focused on the distribution of single economical bamboo species so that led to a scarcity of information for bamboo forest resource management and utilization.

In this study, we established a workflow to integrate land cover maps from the 4th forest resources inventory and slopeland utilization inventory project. Based on the latest aerial images, we also implemented field work and set up forest plots to reidentify distributions and stocks of bamboo species in several administrative districts which were regarded as bamboo-domi-

nant regions of Taiwan. Finally, a GIS database of land use and distribution of bamboo species was constructed which covered six districts including New Taipei, Taoyuan, Hsinchu, Miaoli, Nantou and Tainan. The result demonstrated that Hsinchu and Miaoli have the most abundant bamboo forest resources with an area up to 17,000 ha, which was dominantly consisted by Makino Bamboo (*Phyllostachys makinoi*). New Taipei and Taoyuan were also rich in bamboo resource with an area of 12,000 ha but dominant by two species (*Phyllostachys makinoi* and *Bambusa oldhamii*) in different localities. The cost of bamboo harvesting was influenced by several factors such as topography, harvest methods and traffic accessibility. We used a GIS tool called Cost-Distance analysis to incorporate these parameters to evaluate the relative cost of bamboo production among districts. It demonstrated that New Taipei, Taoyuan and Tainan could be ideal and accessible regions for large-scale management and bamboo timber production.



利用Cost-Distance分析方法，以地形、作業法及交通可及性為參數，比較不同區域竹林伐採成本的相對值。

The result of Cost-Distance analysis to illustrate the relative cost of bamboo production among localities, several parameters such as topography, harvest methods, traffic accessibility were taken into consideration.



經濟竹類產業振興之研究

陳財輝、汪大雄、李宗宜

本研究針對臺灣經濟竹類包括孟宗竹、綠竹、麻竹等進行調查，調查項目包括林分結構、竹稈生長特性、地上部生物量累積狀況及產筍量等，此外，也針對不同竹產業生產區域結構和運銷通路進行調查與分析。孟宗竹產筍林不同齡級之株數頻度分布，主要集中在1、2年生竹，4年生及以上者頻度極低，顯示明顯有擇伐4年生以上成熟老竹之施業，此外，孟宗竹林分如未經營，新生竹胸徑在第3年後會顯著下降，老竹的株數密度及地上部生物量會大幅度的增加，進而壓縮新生竹的發展空間。綠竹筍產銷運作上，北部近郊地區常以現代零售供應鏈的方式產銷，而南部地區則傾向以運銷合作社及農會供應鏈。竹園更新後第一年綠竹筍產量 5.6 ton ha^{-1} ，第二年增加至 10.8 ton ha^{-1} ；而未更新產筍林綠竹筍產量

則為 8.9 ton ha^{-1} ，顯示更新後第一年產筍量雖會較少，但第二年開始即有顯著增加，並且會超過未更新之綠竹園產筍量。綠竹粉經青貯後之營養大為改善，在乳牛飼糧添加竹粉青貯對於乾物質採食量之影響試驗中，乾物質採食量對照組為 18.2 kg ，竹粉青貯組 19.3 kg ，顯示竹粉青貯可增加乳牛之採食量。麻竹園更新後第一年分株苗生長速度較高壓苗快，第二年開始兩種更新法新生竹生長皆有顯著增加，麻竹筍產量於7月最多，5月最少，分株法更新麻竹林竹筍年採收量可達 25.5 ton ha^{-1} 較高壓法 16.2 ton ha^{-1} 高。大多數竹農認為竹筍產銷上面臨最大困難為人力不足，次為銷售通路待拓展，最需輔導和協助項目為災害補助，其次為穩定的灌溉水源和病蟲害防治等。

乳牛飼糧添加竹粉青貯對於產乳量及乳品質之影響。

The influence of milk quality and quantity by adding bamboo powders to dairy cattle silage.

	對照組 no bamboo powders	竹粉青貯組 adding bamboo powders
產乳量 milk yield (kg)	23.05	23.03
乳脂肪 milk fat percentage (%)	3.47	3.74
乳蛋白 milk protein percentage (%)	3.58	3.60
乳糖 milk lactose percentage (%)	5.11	5.07
無脂固形物 milk solids-not-fat percentage (%)	9.39	9.37
總固形物 milk total solid percentage (%)	11.81	12.37
尿素氮 blood urea nitrogen (mg/dL)	13.61	15.36
檸檬酸 citric acid (mg/dL)	137.12	137.08

Study on Revitalization of Economic Bamboo Industry

Tsai-Huei Chen, Dar-Hsiung Wang, Zong-Yi Li

In this study we investigated the stand structure, stand growth, biomass, bamboo shoots production, and market for different economic bamboo species in Taiwan, including Moso bamboo (*Phyllostachys pubescens*), Green bamboo (*Bambusa oldhamii*), and Ma bamboo (*Dendrocalamus latiflorus*) etc. The results of stand structure showed that the highest percentage of distribution frequency in different ages were both of age 1 and 2 at 37.2% and 35.8%, individually, in Moso bamboo shoot plantation, while the lowest percentage was above age 4 at 1.8%. For unmanaged Moso Bamboo stands, the diameter of new culms decreased after 3 years since being unmanaged, but the biomass of old culms with age older than 5 years increased. On the market for green bamboo shoots, in the suburb of northern Taiwan, bamboo shoots were supplied by retailers; however, in the southern areas, bamboo shoots were supplied by farmers' association or cooperatives. The first year of green bamboo shoots production were 5.6 ton ha⁻¹, and were 10.8 ton ha⁻¹ in second year after regenerated green bamboo shoot plantations.

The bamboo shoot production in the regenerated plantation was higher than which in not regenerated plantation since the second year. Bamboo powders for dairy cattle silage experiments showed that the feeding amount for bamboo powder silage was 19.3 kg/cattle which were greater than that for non-bamboo powder silage (18.2 kg/cattle), indicating the preference of dairy cattle for bamboo powder in silage. The growth of Ma bamboo by offset planting propagation was better than by air layering propagation in the first year. However, the growth significant increased in both regeneration methods in second year. The most and least annual production of Ma bamboo shoots was in July (25.5 ton ha⁻¹) and in May (16.2 ton ha⁻¹), respectively. The interview survey showed that the most difficulties faced by bamboo farmers were insufficient manpower and expansion of sales channel. The most requirement hoped to get assistance from the government was subsidy for damage loss, followed by stable supply of water resources and pest control.



都市林效益數量化評估研究

莊鈴木、陸聲山、劉則言、林朝欽、周富三、吳孟玲

都市林的生態服務功能對改善城市環境品質具有重要作用，都市樹木可以清除大量的空氣污染物，提高城市的空氣品質，光合作用吸收固定大氣中的CO₂，並提供建築物節能效益。但如何使都市林發揮最大效益的一個重要前提，便是量化這些生態服務功能，甚至以貨幣價值量化。本計畫參考美國農業部林務署發展的i-Tree軟體工具，進行都市林效益的評估與分析。雖然國際上已廣泛的應用此i-Tree軟體，但國內卻是首次嘗試應用此工具，評估都市林的生態效益與價值。本研究在北部的臺北大安森林公園、臺北青年公園及南部的高雄都會公園進行先驅試驗，經由森林的結構決定功能，功能決定其經濟效益。為對都市林的經濟效益進行準確的評估，調查三個公園的基本結構，包括物種組成、樹木密度、徑級分佈、冠幅等，進而換算得出葉面積、生物量等其他

結構。此外，蒐集與彙整臺北與高雄環保署每小時空氣汙染物濃度與中央氣象局的氣象資料(溫度、濕度等)，並選取美國氣候環境與臺北及高雄兩城市相似的城市作為參照模型的基礎，以推算出三個都會公園的生態系服務經濟價值，包括移除六項汙染物(CO、O₃、NO₂、PM₁₀、SO₂、PM_{2.5})與逕流避免(avoided runoff)的經濟效益。同時為了符合美國林務署的i-Tree Eco模組的運算需求，收集環保署與氣象局的空氣汙染及氣象資料，建置成符合運算模組所需之格式，經由i-Tree線上資料庫傳送至美國林務署，匯入遠端資料庫系統內，作為後續發展符合國內運算的基礎資料使用。未來應加強蒐集本土資訊，用以校正i-Tree URFOE model的參數，使i-Tree系統在進行都市林生態系統服務效益量化評估時，所估算的貨幣價值能更接近臺灣實際的狀況。



空污日益嚴重的今日更顯都市林的重要。
The more important role of urban forest in the highly air pollutant cities.

Research on the Ecological Benefits Assessment of the Urban Forests

Ling-Mu Jaung, Sheng-Shan Lu, Tse-Yen Liu, Chau-Chin Lin, Fu-Shan Chou, Meng-Ling Wu

The ecological service function of urban forests plays an important role in improving urban environmental quality. Urban trees can remove a large amount of air pollutants and improve the air quality of the city. Trees can also absorb and fix CO₂ in the fixed atmosphere by photosynthesis. They also contribute the energy-saving benefits for buildings. However, an important prerequisite for how to maximize the benefits of urban forests is to quantify these ecological service functions and even quantify them with monetary values. This project adopts the i-Tree Eco tool developed by the USDA Forest Service to evaluate and analyze the benefits of urban forests. Although i-Tree Eco has been widely used internationally, it is the first time that this tool has been applied in Taiwan to evaluate the ecological benefits and value of urban forests. In this study, pilot experiments were conducted in Taipei Daan Forest Park, Taipei Youth Park and Kaohsiung Metropolitan Park. The structure and function of the forest determine its economic benefits. In order to accurately evaluate the economic benefits of urban forests, the basic structure of the three parks, including species composition, tree density, diameter distribution and crown width, was investi-

gated and other structures such as leaf area and biomass were converted. In addition, collecting and aggregating the hourly air pollutant concentrations of Taipei and Kaohsiung from Environmental Protection Administration (EPA) and the meteorological data (temperature, humidity, etc.) from the Central Weather Bureau (CWB) were conducted. The cities with similar climate to Taipei and Kaohsiung cities were also selected as the reference. The economic values of the ecosystem services of the three metropolitan parks are estimated by accounting that includes the economic benefits of removing six pollutants (CO, O₃, NO₂, PM₁₀, SO₂, PM_{2.5}) and avoid runoff. At the same time, in order to meet the computing needs of the US Forest Service's i-Tree Eco module, air pollution and meteorological data collected by the EPA and the CWB were collected and compiled into the format required by the computing module. In the future, local information should be intensively collected to correct the parameters of the i-Tree URFOE model. Based on this, the monetary value quantifying the benefits of urban forest ecosystem services will be closer to the actual situation in Taiwan.



樹木保護資訊與智慧型醫療服務系統之開發研究

陸聲山、施欣慧、劉則言、林朝欽

樹木植物病蟲害的防治方法與治療技術，需兼具科學性與技術性。目前所採用的方法與技術，因缺少有效的科學驗證而顯得理論基礎薄弱。相信唯有不斷累積長期的防治植物病蟲害施作方式的資料後，進行科學數據的分析與資訊萃取，才能增進此專業領域上的知識，修正並改進現有的施作方式，而提高樹木醫療服務的品質。林業試驗所林木疫情鑑定與資訊中心多年的運作，已經積累了大量的林木有害生物防治基礎資料。在此基礎上，進一步構想樹木保護資訊與智慧型醫療服務系統的開發研究，基本原則與服務功能，將採取類似現有醫院的病歷管理功能，加強對施做過的病株追蹤紀錄，建立起技術性工作的科學基礎，如此不僅能經得起科學檢驗，也能提升樹木醫療服務的品質。透過樹木保護基礎資料的建立，逐年不斷地更新和完善，將可提升未來防治與施作等基礎工作的科學性。智慧的樹木醫療服務系統，要有健全的資料，以及更快速且更詳細的分析，藉此來改

善現有研究、診斷與治療的服務流程。達成上述目標的前提之一，就是資料標準化，醫療與防治資訊必須有公認且開放的資料標準，本計畫之主要目的，在透過林試所已建立的生態資訊平台，結合林木疫情病例與實驗資料庫，發展具備實際診療及實證基礎的決策系統，讓樹木醫學中心人員可以即時獲得詳盡的診斷與治療參考方式，達到智慧化樹木醫療資訊服務。在樹木醫療服務需求日增之際，同時可協助簡化樹木保護醫療流程、優化資源分配，促進智慧醫療服務。樹木保護醫療服務系統架構規劃，網站系統架設基礎為開放原始碼的內容管理平台—Drupal，且以現行最穩定的7.0版本為主，網站版面基礎為響應式設計，網站功能為提供調查者於調查與追蹤病樹時，便於輸入調查資料，並以此建立病樹的病歷系統，而且連結林木疫情中心網站的樹木病蟲害資料，提供調查者診斷之參考；針對一般瀏覽者，也提供瀏覽與查詢病樹基本資料之功能。



台北植物園2011年褐根病施作至今超過六年的黃果垂榕。

Continuous tracking of brown root disease for more than six years of *Ficus benjamina* L. since 2011 in the Taipei Botanical Garden.

The Development and Research on Tree Protection Information and Intelligent Health Service System

Sheng-Shan Lu, Hsin-Hui Shih, Tse-Yen Liu, Chau-Chin Lin

Prevention and treatment methods and techniques for trees are both scientific and technical work. However, the methods and techniques used in prevention and control can not be valid due to the basic theory of application treatments is deficient. It is believed that continuous accumulation of long-term data on the ways in which plant pests and diseases can be applied can lead to the enhancement of knowledge in this area of expertise, the revision and improvement of existing methods of application and the improvement of tree health services. The Forest Disease Information Center of TFRI operation for many years has accumulated a large number of forest disease and pest information. Based on this information, further development of tree protection information and intelligent medical service system can be studied and developed. The basic principles and service functions will be similar to the existing hospital case history management capabilities. The scientific basis of work can not only stand the test of science, but also improve the quality of tree medical services. Through the establishment of the basic information on tree protection, it will be updated and improved year by year, which will enhance the scientific basic work on treatment in the future. The smart tree medical service system requires faster and more detailed analysis to improve the existing research, diagnosis and treatment service processes. One of the prerequisites for achieving the above objectives is that data standardization, medical and prevention information must

have accepted and open data standards. The main purpose of this project is to development with practical and evidence-based decision-treatment system through the well establishment of the ecological information platform, powerful computing and real-time analysis capabilities, combined with the database of forest disease cases that allows the investigators easy access to diagnosis reference and treatment methods to achieve intelligent trees medical information services. As tree health services are in increasing demand, they can also help to simplify tree protection of medical procedures, optimize resource allocation and promote smart medical services. Long-term record of the existing tree treatments on pests and diseases control, digitization of the diagnosis and treatment cases, tree protection information management system are crucial for the tree health management as well as the future development of tree protection and intelligent health services. Tree protection service system platform based on the open source content management - Drupal, and the current most stable version 7.0 based, site layout based responsive design, the site features to provide investigators in the survey and follow-up of the tree is easy to enter the survey data, and in order to establish the treatment records system of the tree, and link the forest disease information center, provide investigators diagnostic reference. Otherwise, general visitors can also browse and query the basic information function.



南鳳山臺灣山茶不同品系主要化學成份及抗氧化活性之分析

陳盈如、周富三

本試驗分別以六龜試驗林生產之臺灣山茶綠茶(扇平地區綠心芽、紅心芽品系)及紅茶(扇平地區、南鳳山地區綠心芽品系)與市售之茗品綠茶、紅茶進行抗氧化活性比較，分析總酚類化合物與總黃酮類化合物含量，並評估其清除DPPH自由基之活性，同時以高效能液相層析儀對各種茶葉之兒茶素成分進行定量分析。試驗結果顯示，六龜試驗林所生產之臺灣山茶綠茶，無論紅心芽(GR)或綠心芽(GG)品系皆具有極佳的抗氧化活性，其清除DPPH自由基能力($IC_{50} = 3.29 \pm 0.03 \mu\text{g/mL}$ (GR)； $3.43 \pm 0.09 \mu\text{g/mL}$ (GG))與總抗氧化活性($5.34 \pm 0.18 \text{ mM of Trolox}$ (GR)； $5.36 \pm 0.06 \text{ mM of Trolox}$ (GG))皆顯著優於市售綠茶。紅心芽與綠心芽綠茶之總酚類含量分別為 $390.58 \pm 1.78 \text{ mg/g}$ 與 $390.04 \pm 1.53 \text{ mg/g}$ ，顯著高於其他市售綠茶；至於紅茶則以南鳳山地區生產之紅茶抗氧化

活性較佳，但其清除DPPH自由基能力($IC_{50} = 7.17 \pm 0.08 \mu\text{g/mL}$)、總抗氧化活性($1.97 \pm 0.05 \text{ mM of Trolox}$)與總酚類含量 $251.66 \pm 1.24 \text{ mg/g}$ 仍略遜於市售紅茶。此外，根據HPLC成分分析結果顯示，臺灣山茶綠茶之主要化學成分包括EGCG($298.2 \pm 1.8 - 306.5 \pm 0.6 \text{ mg/g of tea}$)、Caffeine ($82.6 \pm 2.2 - 93.0 \pm 1.8 \text{ mg/g of tea}$)以及ECG ($26.4 \pm 1.3 - 27.4 \pm 0.7 \text{ mg/g of tea}$)三種成分含量最高；而紅茶則以Caffeine ($170.8 \pm 7.8 - 242.1 \pm 2.1 \text{ mg/g of tea}$)及EGCG ($109.0 \pm 0.2 - 110.7 \pm 1.0 \text{ mg/g of tea}$)為其主要成分。其中，綠茶之EGCG、GCG以及ECG等三種兒茶素含量皆顯著高於其他市售茶類，顯示六龜地區臺灣山茶優異的抗氧化活性乃來自於其含有豐富的兒茶素成分且極具市場競爭優勢。



臺灣山茶。
Camellia formosensis.

Analysis on Main Chemical Component Content and Antioxidant Activity of Different *Camellia formosensis* (Theaceae) from Nan-Fong Mountain

Ying-Ju Chen, Fu-Shan Chou

The objective of this study is to evaluate the antioxidant activity and total phenolic contents of different provenance of *Camellia formosensis* from Liouguei Research Center (Shanping and Nan-Fong Mountain), 10 kinds of commercial tea were also compared. The catechin contents of hot water extracts from various tea specimens, including (-)-epigallocatechin gallate (EGCG), epicatechin, gallic acid gallate (GCG), (-)-epicatechin gallate (ECG), and caffeine were quantified by using high performance liquid chromatography (HPLC). Results revealed that the total phenolic content of hot-water extract from green tea of *C. formosensis* (390 mg of GAE/g) were higher than those in commercial teas (259.8 – 297.8 mg of GAE/g), while the total phenolic content from black tea of *C. formosensis* were 200.04 – 251.66 mg of GAE/g. Both the green and red sprout

strain of green tea made from *C. formosensis* which have the greatest effectiveness in scavenging DPPH free radical, and the DPPH free radical scavenging activity of black tea were equivalent to the average of commercial teas. As to the results from HPLC analyses showed that EGCG (298.2 ± 1.8 - 306.5 ± 0.6 mg/g of tea) was the dominant component of hot-water extracts from green teas of *C. formosensis*, and Caffeine (170.8 ± 7.8 - 242.1 ± 2.1 mg/g of tea) and EGCG (109.0 ± 0.2 - 110.7 ± 1.0 mg/g of tea) comprised the major component of hot-water extracts from black teas of *C. formosensis*. Moreover, in addition to had an excellent antioxidant activity, the total catechin in hot-water extracts of green teas from *C. formosensis* were found to be significantly higher than commercial teas, and they could be more competitive than commercial products.

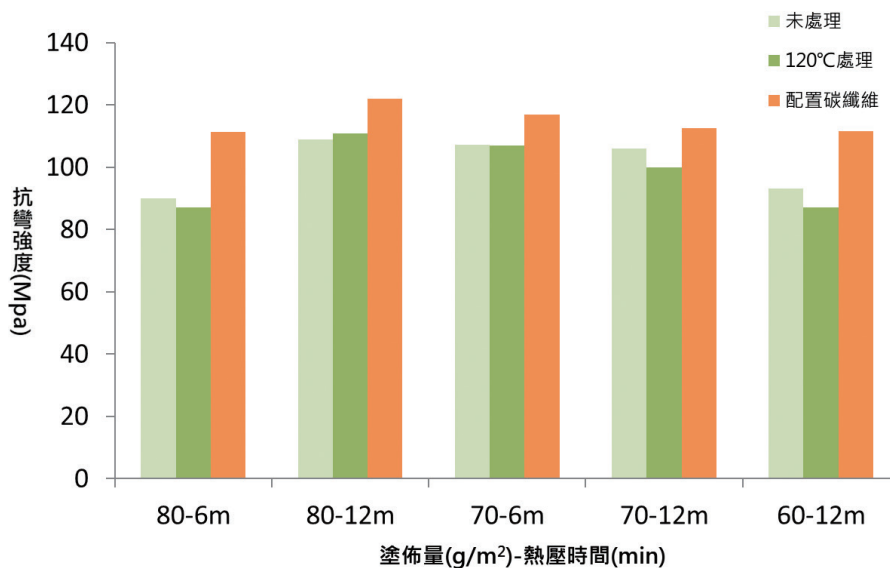


木質複合材料之研發及耐久性研究

塗三賢

本研究已完成分別由2種不同孟宗竹單板積層數與2種不同碳纖維積層數之複合材的含水率、膠合性能、抗彎強度等性質檢測。試驗結果顯示，由2層或3層孟宗竹單板與碳纖維材膠合之複合材含水率的差異並不明顯，2層孟宗竹單板與碳纖維材膠合之複合材的含水率平均約為4.87%，3層孟宗竹單板與碳纖維材膠合之複合材的含水率平均則約為5.03%，由3層孟宗竹單板與碳纖維材膠合之複合材抗彎強度會比2層孟宗竹單板的複合材為佳。就佈膠量或熱壓時間觀之，可以發現在相同層數孟宗竹單板與碳纖維材膠合之複合材，佈膠量或熱壓時間的不同對其在機械性質上的差異並不明顯。不同碳纖維積層數之孟宗竹材—碳纖維材複合材含水率的差異也並不明顯，其中單層碳纖維材複合材的含水率平均約為5.01%，而2層碳纖維材複合材的含水率平均約為

5.03%。由2層孟宗竹單板與1層碳纖維材膠合之複合材抗彎強度(MOR)在縱向部分平均約為98.77MPa，MOE在縱向部分平均則約為7.96GPa，而由2層孟宗竹單板與2層碳纖維材膠合之複合材抗彎強度(MOR)縱向部分平均約為110.23MPa，彈性係數(MOE)在縱向部分平均則約為8.45GPa，試驗結果顯示，由2層碳纖維材膠合之複合材抗彎強度會比1層碳纖維材的複合材為佳，顯示碳纖維材可有效提昇複合材的抗彎強度。由膠合性能的檢測結果則顯示碳纖維強化複合材在酚—甲醛樹脂佈膠量在60g/m²，熱壓壓力10kgf/cm²，熱壓時間12min，熱壓溫度在135°C的加工條件下，可通過 CNS 1349 TypeI 的標準。120°C蒸氣處理合板於部分條件中，重量損失率對於未處理合板有增加的趨勢，推測為蒸氣處理及熱壓時間造成表面劣化，進而降低其磨耗性質。



由2層孟宗竹單板與1層碳纖維材膠合之複合材抗彎強度(MOR)檢測結果可以看出，孟宗竹單板不管表面未處理或經過120°C蒸氣處理，在縱向部分的抗彎強度都差不多，與碳纖維材膠合之複合材的抗彎強度則均有增加，顯示碳纖維材可提昇複合材的抗彎強度。

Results of the bending strength (MOR) test shows that there is no difference between un-treated and 120°C vapor-treated composite panels, while laminated by 2 layers of Moso bamboo veneer with 1 layer of carbon fiber, MOR of the composite has been increased, showing that carbon fiber material can enhance the bending strength of the composite panel.

Development and Durability Study of Wood Composite Materials

San-Hsien Tu

The study has been completed tests of properties of different types of Moso bamboo veneer laminated with carbon fiber. The results show that the moisture content of composite laminates with two or three layers of Moso bamboo veneer with carbon fiber is insignificant, and the average moisture content of the composite laminates with 2 layers of Moso bamboo veneer and 1 carbon fiber is about 4.87%. 3 layers Moso bamboo veneer and 1 carbon fiber composite materials with an average moisture content of about 5.03%. Three layers of Moso bamboo-carbon fiber composite material bending strength better than the two layers of Moso bamboo veneer composites.

The difference of amount of glue or hot pressing time on the mechanical properties of the composites is not obvious in the same laminate layers of the Moso bamboo-carbon fiber composite materials. The differences of moisture content of Moso bamboo-carbon fiber composite materials with different carbon fiber layers are also not obvious. The average moisture content of single-layer carbon fiber composite is about 5.01%, while the average moisture content of the two-layer carbon fiber composite is about 5.03%. The flexural strength (modulus of rupture, MOR) of composites laminated by 2 layers of Moso bamboo

veneer and 1 layer of carbon fiber material is about 98.77MPa in the longitudinal part and about 7.96GPa in the longitudinal part of the MOE, while the MOR of the 2 layers Moso bamboo veneer with 2 layers carbon fiber composite material was about 110.23MPa in the longitudinal part and about 8.45GPa in the longitudinal part of the modulus of elasticity (MOE). The test results showed that the MOR of the composite material with two layers of carbon fiber material would be better than single layer of carbon fiber composite material, showing that carbon fiber material can effectively enhance the composite bending strength. The test results of the adhesive properties show that the carbon fiber reinforced composite material can be processed under the conditions of a phenol-formaldehyde resin coating $60\text{g}/\text{m}^2$, hot-pressing pressure of $10\text{kgf}/\text{cm}^2$, hot-pressing time of 12min and an autoclave temperature of 135°C to meet the CNS 1349 Type I standard. In some conditions, the weight loss rate of the 120°C steam-treated Moso bamboo veneer is higher than untreated Moso bamboo veneer. It is presumed that the surface degradation is caused by the steam treatment and the pressing time.



強化農業創新育成多元服務與建構行銷能量平台

柯淑惠、劉婉妤、陳燕章

本計畫透過農業委員會所屬創新育成中心及農科院育成中心朝向聯盟形式發展，共同推動創業育成。年度每季定期召開工作小組會議，促進各項工作的進行，並於林業試驗所、農業試驗所、畜產試驗所設立廠商服務定點諮詢中心，內容包含專利智財、財務、技術移轉、市場行銷、經營管理及人才媒介等服務，今年度更新增電商平台及國際展覽說明會，建立完整的北中南區全育成諮詢服務網絡，讓業者能在地即時獲得整合性資源輔導，達成前育成至後育成一條龍式之完整育成服務。透過北中南三場聯合招商說明會，以及北中南東四場106年度農企業輔導資源聯合說明會，進行聯合招商、宣傳及推

廣活動，藉此說明研發成果加值、產學合作、農業科技專案計畫、育成中心及農企業輔導等方案。

本所本年度新進駐家數2家(保證責任臺中市友善農產加工運銷合作社及蜂神有機養蜂場)，累積輔導7家進駐業者，促進就業人數24人。協助進駐業者申請產學合作計畫通過1件(臺灣利得生物科技股份有限公司/計畫總經費1,296千元)、申請其他政府補助計畫通過4件(宏力生化科技股份有限公司及有限責任屏東縣永在林業生產合作社/計畫總經費1,534千元)。另也協助2家成功參與2017臺灣國際生物科技大展－農業科技館。



2017臺灣國際生物科技大展－農業科技館(參展廠商－伊豆創意開發有限公司)。

The 2017 Bio Taiwan Exhibition, Conferences & Partnering (Exhibitor-IDEA Technology Oasis Innovative Development Company Limited).

Diversity Enhancement of Agricultural Innovation Incubation Service and Platform Construction for Marketing Power Accumulation

Shu-Hui Ko, Pei-Yu Liu, Yen-Chang Chen

The mission of this program is to assist in the development of the diverse service network by constructing a platform for marketing power accumulation in agricultural innovation incubation ecology. The aim of the incubators is to facilitate the survival of such companies and also to nurture these companies for growth and success.

Taiwan's Agriculture small and medium sized enterprises are being threatened by severe manufacturing environment and loss of competitive advantages, thus, it's mandatory that transformation and products innovation are needed to enhance the competitive strength. Council of Agriculture, Executive Yuan has set up Taiwan Agricultural Research Institute, Forestry Research Institute, Fisheries Research Institute and Livestock Research Institute innovation incubation centers to help agricultural enterprises with innovating and commercializing agricultural technologies. The incubation centers provide not only well-appointed space, devices and R&D technologies, but also assist in capital attracting, business service and management. They effectively employ resources, lower the risk of start-ups in research cost, create good cultivation environment, and increase the chance of successfully running business. This project, through the Council of Agriculture by the IIC (Innovation Incubation Center), Innovation Incubation Center and Agricultural Technology Research Institute sciences-bred development, forms the Center Union and jointly promotes the innovation incubation.

Working Group meetings, held regularly every quarter of this year, promote and present modifications, review points, train the management and evaluation points, set points, and make the application process more convenient.

The Agricultural IIC Web Page is built up to breed business and can be real-time accessed to serve integrated resources. Through the northern, central, and southern three joint investment seminars, as well as the North, Central, South, East four 106 annual agribusiness counseling resources joint briefings, joint investment promotion, publicity and promotional activities were accomplished. And, hence, value added to research findings, academia cooperation, agricultural technology development program, breeding centers and agribusiness counseling and other programs were explained.

This year 2 business firms (Agro-Group. LTD and Honey Master's Organic Bee Farm) were added to IIC and the totally 7 stationed industries were advised. Also employment of 24 people was promoted. Our IIC assisted the industries to successfully apply the industry-research cooperation plan for 1 case (Taiwan Leader Biotech Corp), and national grants plans for 4 cases (Yong-Zai Forestry and Grabio-Greentech Corp). We also assisted 2 industries to join the 2017 Bio Taiwan Exhibition, Conferences & Partnering.

樹木疫病檢測套組商品化

吳孟玲、莊鈴木

疫病菌屬(*Phytophthora*)包含100多種疫病菌，是許多主要作物如馬鈴薯、番茄、瓜類及大豆等重要病原菌，也包含柑桔等果樹與都市樹木皆會被感染。診斷疫病菌引起的病害，在傳統上有兩大方法。

一、病徵與病兆鑑定：

依據染病部位之病徵特性，再以顯微鏡觀察病斑上之病原菌特徵，可以幫助病害快速診斷。

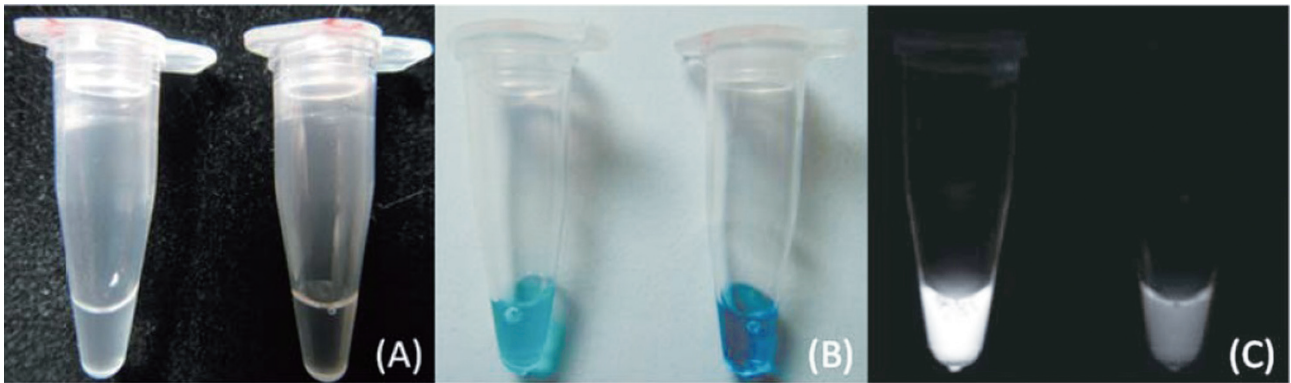
二、病原菌分離：

進行病組織內病原菌之分離與鑑定。

上述傳統方法中，病徵觀察雖然快速且方便應用於田間，但皆需要專業植病人員，搭配儀器進行觀察或操作，需要較多經驗與相關專業知識，也較為費時費力。

近年來，分子生物技術亦用來輔助疫病菌之分類鑑定，例如利用蛋白質或核酸的特性分析。然而上述方法仍有

需要昂貴儀器及專業實驗室的需求，本研究開發之新式且快速靈敏的恆溫環狀擴增法(Loop-mediated isothermal amplification, LAMP)，利用4-6條基因密碼，於60-65°C恆溫條件下，可以在90分鐘內快速辨識疫病菌的存在與否。此方法的優點為可在恆溫及簡易加熱器材下，進行鑑定反應，對於某些田間檢測、偏遠地區實驗室來說，相當簡單實用，所產生的白色沉澱用肉眼或濁度計即可觀察，相當簡便(圖A)。亦可加入亞甲基藍染劑或是加入核酸染劑於紫外光激發下則更有助於觀察(圖B與圖C)。本研究研發的植物疫病快速且靈敏LAMP診斷技術，可廣泛應用於植物疫病診斷及疫情監控。未來技術移轉至生技廠商開發商品化檢測套組，利用淺顯易懂的操作流程與實驗步驟，未來可提供非植病之林業專業人員從事疫病快速診斷工作，亦可應用於進出口植物防檢疫大量篩檢。



LAMP增幅反應產物的觀察。LAMP增幅反應後陽性樣本會產生的白色沉澱，用肉眼或濁度計即可觀察(A左側管為陽性右側為陰性)，亦可加入甲基藍染劑(B左側管)或是加入核酸染劑如EtBr於UV光激發下(C左側管)則更有助於觀察。

Detection of LAMP amplification product. LAMP amplification product can be observed via photometry for turbidity or by naked eyes (A, left tube) or with addition of methylene blue, a color change can be seen without equipment (B, left tube). With addition of EtBr, it will fluoresce when exposed to ultraviolet light (C, left tube).

Loop-mediated Isothermal Amplification Detection Kit of Tree *Phytophthora* diseases

Meng-Ling Wu, Ling-Mu Jaung

The Genus *Phytophthora* contains more than 100 species, and many of them are important plant pathogens on potato, tomato, cucumber, soybean, fruit tree and other tree species. Traditional process for *Phytophthora* identification mostly based on morphology observation of symptom and pathogen isolation. However, these methods are time- and professional labor-consuming. In recent years, molecular technique requires less time, but it usually needs complicated experimental procedures and expensive instruments. For increasing accuracy and efficiency of *Phytophthora* diagnosis, a new method based on the loop-mediated isothermal amplification (LAMP) was developed. With 4-6 primers, the reaction can be done at 90 minutes under constant temperature (60-65°C). The method is useful for remote

laboratory to field test without using expensive equipment and complicated procedures. The positive reaction produces white precipitate product which can be easily observed by naked-eye or turbidimeter (Fig. A). Moreover, to add methylene blue dye or EtBr dye can improve the results certainly (Fig. B and Fig. C). The development of LAMP detection method applies on *Phytophthora* diagnosis and epidemic monitoring. The LAMP detection technique will be transfer to biotechnology company to develop commercial detection kit. The advantages of easy operating of the kit can help non-professional staffs to handle the rapid diagnosis procedure and also apply on *Phytophthora* quarantine and prevention.



不同乾燥程序對小果油茶油品質之研究

楊正釗

本研究目的在比較傳統日曬與新開發室內冷乾法對小果油茶茶籽在乾燥效益及油品質上的差異。將採自14個(104年8個, 105年6個)不同茶園之小果油茶生果以日光曝曬開裂, 且持續曝曬乾燥至種子含水率5~6%, 另以新開發茶籽冷乾法於室內將茶籽乾燥至種子含水率5~6%, 將上述2種不同乾燥處理之茶籽以螺旋冷榨方式榨取茶油後, 立刻測定其酸價、過氧化價、總酚含量、還原力、維他命E、各項脂肪酸、氧化安定性指標(OSI)等, 以判斷2不同乾燥程序處理下油品質之優劣程度。結果顯示在乾燥效益上: (1)雖然傳統日曬法的初期乾燥速度較快, 但若將天候因素納入後, 新冷乾法在完成乾燥所需的全程時間上明

顯低於傳統日曬法, 傳統日曬法完成乾燥所需的全程時間約為新冷乾法的3~6倍。(2)新冷乾法所需的操作工時顯著低於傳統日曬法, 傳統日曬所需的操作工時約為新冷乾法的3.3倍以上。在油品質上: (1)酸價: 傳統日曬者之油酸價有高於室內氣乾之趨勢, 其中11/14為顯著。(2)總酚含量: 室內冷乾法所得油品質之總酚含量有高於傳統日曬法者之趨勢, 其中10/14為顯著。(3)2不同乾燥方法所生產之油品質在過氧化價、還原力、維他命E、各項脂肪酸與氧化安定性指標(OSI)等項目上則無顯著差異。綜上, 新開發茶籽冷乾法在乾燥效益上明顯優於傳統日曬法, 在油品質上也以冷乾法略優, 故本法值得加以開發應用。



傳統日曬茶籽的現場狀況。

The scene of Traditional Solarization Method for dehydration of Camellia seeds.

Research of Different Dehydration Processes on Oil Quality of *Camellia brevistyla* Seeds

Jeng-Chuann Yang

The objective of this study is to compare Traditional Solarization with New Indoor Cool-dry Method in order to understand the dehydration effect and the difference of oil quality in *Camellia brevistyla* seeds. Sun exposure was used to make the fruits of *Camellia brevistyla* split, and those fruits in this study were from the 14 different plantations, among which 8 were collected in 2015 and 6 were in 2016. The duration of solarization continued until the moisture contents of the seeds were dehydrated to 5~6%. On the other hand, New Indoor Cool-dry Method was applied to dry the seeds to 5~6% moisture contents. The dehydrated seeds, in the two different dehydration processes above, were soon cool-compressed by spiral oil press machine. Subsequently, acid value, peroxide value (POV), total phenolic content (TPC), reducing power, vitamin E, fatty acids, and oxidation stability index (OSI) were evaluated. And the evaluation was used to judge the condition, being superior or inferior, of oil quality in the two different dehydration processes. When it comes to the dehydration efficiency, the results are as follows. (1) Although the preliminary dehydration speed of traditional solarization is faster, the whole dehydration time New Indoor Cool-dry Method demands is significantly less than that traditional solarization needs when the weather factor is considered, too. The total dehydration duration traditional so-

larization needs is about 3~6 times as much as that New Indoor Cool-dry Method demands. (2) The working time New Indoor Cool-dry method needs is obviously less than that traditional solarization demands. The working time traditional solarization needs is about more than 3.3 times as much as that New Indoor Cool-dry method demands. When it comes to oil quality, the followings are the results. (1) Regarding acid value, acid values of oil in the process of traditional solarization tend to be higher than those of New Indoor Cool-dry Method. Among 14 samples, there were 11 samples showing significant difference. (2) As for total phenolic content (TPC), the oil TPCs New Indoor Cool-dry Method shows tend to be higher than those traditional solarization demonstrates. Among 14 samples, there were 10 samples showing significant difference in TPC. (3) No significant differences of peroxide value, reducing power, vitamin E, fatty acids, and oxidation stability index are found in oil quality in the two different dehydration processes. To sum up, New Indoor Cool-dry Method shows the better performance of dehydration efficiency than traditional solarization. Furthermore, its oil quality is also slightly superior to traditional solarization. Therefore, New Indoor Cool-dry Method is worth development and application.



苦茶油製程對於油脂葉綠素含量變化與氧化安定性之影響

徐光平、謝靜敏

本試驗選用臺灣特有苦茶品種的小果油茶(*Camellia brevistyla*)以及大陸品種之大果油茶(*Camellia oleifera*)之茶籽，分別以常溫25°C(無焙火)、50°C、70°C、90°C、110°C、130°C、150°C、170°C、190°C進行焙火，之後榨油，初榨油以4°C冷藏備用以進行後續檢測。

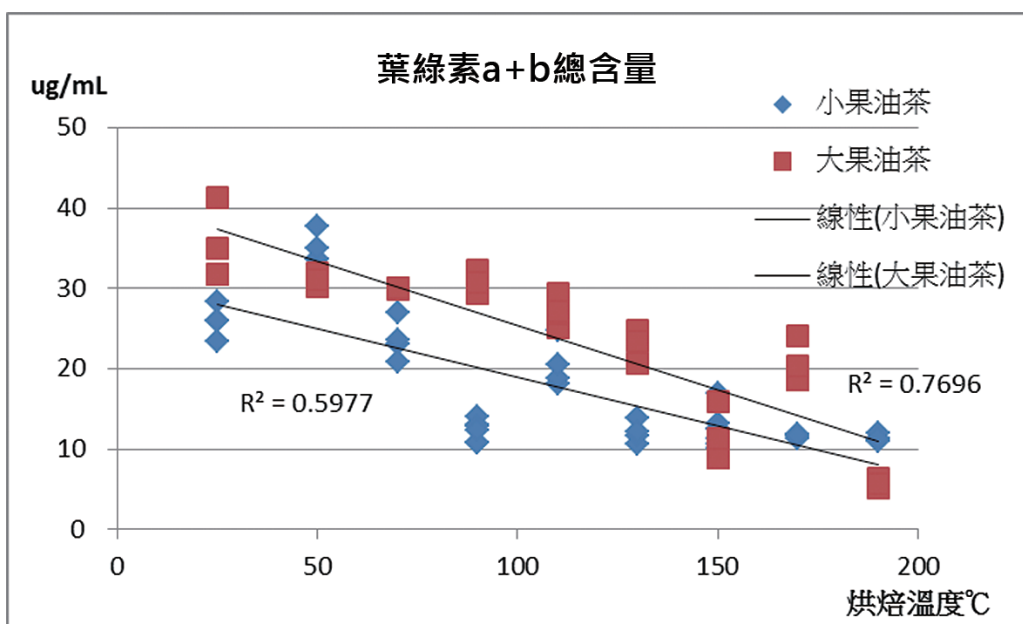
茶籽經過烘焙後，無焙火茶籽的含水率約在4.5 ± 5%左右，隨著焙火的溫度升高，茶籽的含水率會逐漸下降。而得油率在本試驗中，小果油茶之平均得油率為24.48%，大果油茶之平均得油率為34.84%，不同焙火條件處理後之得油率差異並不明顯。

茶籽經由不同焙火條件後，所榨出的油品，焙火溫度越

高，氧化安定性越高所以油品的保存期限也較長。

不同烘焙溫度之油茶籽所得到之苦茶油其葉綠素含量，無論是葉綠素a還是葉綠素b，皆有隨著烘焙溫度的增加而降低的趨勢。油品中葉綠素的含量隨著茶籽烘焙溫度的增加，而有降低的趨勢，因此茶籽烘焙溫度越高所榨出來的油品，氧化安定性越高，葉綠素含量越低的情形，所以推估葉綠素可能是影響油品氧化安定性的原因之一。但經由統計分析結果，葉綠素的影響並不大。

經由油品的加速光劣化試驗分析葉綠素含量隨著照光時間增加而有顯著下降的趨勢，崩解快速。所以油品的保存需要避光，減少光劣化的發生。



葉綠素含量隨著焙火溫度的增加而降低。

The contents of total chlorophyll were decreased with the increase of baking temperature.

Effects of Camellia Tea Oil Preparation Processes on the Chlorophyll Content in the Oil and Its Antioxidant Property

Kuang-Ping Hsu, Ching-Ming Hsieh

In this study, we planned to observe any differences among camellia tea fruits planted from Chinese Mainland (*Camellia oleifera*) and Taiwan (*Camellia brevistyla*), roasted at different temperatures (room temperature (without roasting), 50°C, 70°C, 90°C, 110°C, 130°C, 150°C, 170°C, 190°C), produced oil by pressing tea fruits, and frozen at 4°C for further examination.

The moisture content of tea seed is about $4.5 \pm 5\%$ after roasting, and the moisture content of tea seed decreases gradually with the temperature rising. In the experiment, the average oil yield of *Camellia brevistyla* is 24.48%, and the average oil yield of *Camellia oleifera* is 34.84%. The difference of oil yield after treatment with different firing conditions is not obvious.

Camellia tea fruits were roasted at different conditions in the

testing. The higher temperature applied when roasting, the more oxidation stability has been observed. Thus, the longer days such oil can be preserved.

The contents of chlorophyll, chlorophyll a and chlorophyll b were decreased with the increase of baking temperature. Hence, it had seemed chlorophyll could have been one of the reasons to enhance oxidation stability. However, the statistical analysis demonstrated that chlorophyll was not one of the most critical factors.

After utilizing the accelerated degradation testing, chlorophyll decreased with longer irradiation time. In conclusion, staying away from light is essential for the oil preservation to prevent photodegradation.



油茶生產之碳足跡及經濟分析

Carbon Footprint and Economic Analysis of Oiltea Camellia Production

吳孟珊、林俊成

Meng-Shan Wu, Jiunn-Cheng Lin

近年來由於食安問題引發民眾對食用油品質之重視，發展油茶產業生產苦茶油不但可以提供國人健康安全的在地食用油，此外，油茶根系深且廣，具有保水作用，因此在調整耕作制度活化農地計畫和檳榔廢園轉作計畫，均將油茶列為獎勵栽植樹種。本研究利用訪談方式調查小果油茶的生產成本與收益，應用淨現值、內部報酬率與敏感度分析方法，研究油茶投資的效益。結果顯示盛產期茶籽年產量 $1,500 \text{ kg ha}^{-1}$ 以上，40年期滿的淨現值達533,922元以上，投資的內部報酬率高於9.6%以上，均屬可行的經營方案。但年產量 $1,500 \text{ kg ha}^{-1}$ 的回收期長達20年，恐降低農民的經營意願，敏感度分析結果顯示年產量若能提高至 $2,500 \text{ kg ha}^{-1}$ 以上，不但可提早於第13年開始有正收益，且受到成本、豐欠年及含油率等外在環境變動的影響較小，即便欠年產量減少70%時淨現值仍呈現正值。建議為達到穩定的經濟收益，未來應以品種改良為優先措施，於舊有茶林施行嫁接豐產品系、新植茶園選擇豐產品種。此外，研究發現含油率變動對淨現值的影響最大，可加強教育農民合理施肥、撫育、改善油茶生長狀態，提升整體的產油量，以提高油茶生產的效益。

In recent years, food security issues have called public awareness on edible oil. By boosting the oil-tea Camellia industry, the production of Camellia seed oil will provide healthy, safe, locally-made edible oil. In addition, as Camellias grow, they form deep roots for anchorage. The wide-spreading fibrous root system of Camellias has outstanding water retention capacity. Therefore, subsidies are paid to promote the planting of oil-tea Camellia in both the project of adjusting farming systems and activating agricultural land use, and that of altered farm practices after betel-nut plantation abandonment. This study conducted interview surveys on the production cost and profit of *Camellia brevistyla*. The benefits of investing in oil-tea camellia were measured by net present value (NPV), internal rate of return (IRR), and sensitivity analysis. The results indicated that in peak harvest, the annual production of oil-tea Camellia seeds reached $1,500 \text{ kg ha}^{-1}$ and above. Forty years of planting yielded an NPV of as much as NT\$533,922 in total. The IRR of the investment was as high as 9.6%. Hence, the investment proved to be a feasible management project. Although the 20-year payoff period for an output of $1,500 \text{ kg ha}^{-1}$ might lower farmers' willingness to participate in the project, the result of the sensitivity analysis showed that positive returns would be yielded as early as the 13th year of cultivation if the annual output could be increased to more than $2,500 \text{ kg ha}^{-1}$. In case of a crop lean year with a drop in the annual output by 70%, the NPV can still be positive because the changes in the external environment such as cost, a bumper crop year or crop lean year, or oil content have little impact on NPV. It is advised to place Camellia variety improvement as the priority in order to gain stable economic profits: grafting of high-yielding breeds in older tea grove plantations and cultivating high-yielding breeds in new tea grove plantations. Moreover, the study has discovered that the NPV is affected most by volatility of oil content. To cope with that, education should be enhanced for farmers on applying adequate fertilizers, tending, and ameliorating conditions for oil-tea Camellia cultivation. With the total volume of oil production will be boosted, the production of oil-tea Camellia can effectively yield high benefits.

不同產量油茶經營的收益。

生產量 Yield (kg)	NPV (NT\$)	IRR (%)	回收期 Payoff period (yr)	第12年淨收益 NPV of the 12 th year (NT\$)
1,500	533,992	9.6	20	122,903
2,500	1,828,606	16.33	13	251,278
3,500	3,123,220	21.19	11	379,653
4,000	3,770,527	23.4	10	443,840

東眼山森林遊樂區樹木危險性風險之檢查及評估

Study on the Detection and Diagnosis of Tree Hazard in Dongyanshan Forest Recreation Area

李志璇、林柏亨、林振榮

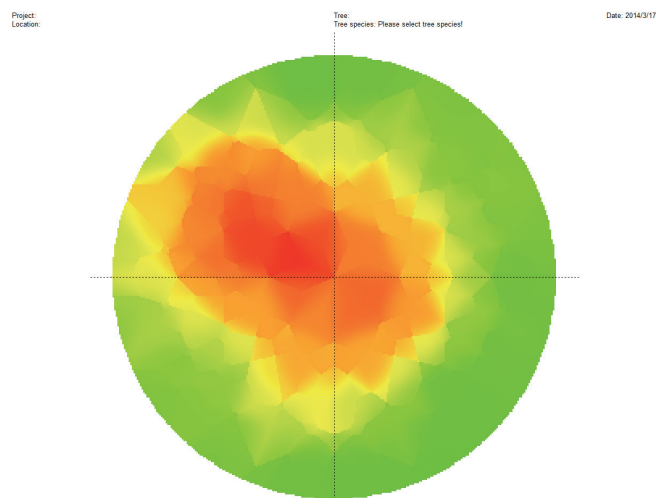
Chih-Hsuan Lee, Po-Heng Lin, Cheng-Jung Lin

使用目視樹木評估法(VTA)及應力波影像非破壞性技術(NDT)，採取無損壞評估法(NDE)檢查及檢測樹木共50株，已完成本計畫目標的項目及數量。針對樹木已遭受風害而斷頭的樹木，因為後續生長受限，不是造林期待的木材生產，建議逐步移除作業，改植檜木、肖楠、臺灣檫等本土樹種，接近林道、開闢地、建物等，可增加栽植觀賞樹木，如櫻花樹等。樹木危險程度區分為四個等級。

A total of 50 trees were examined and visualized using the Visual Tree Assessment (VTA) and Stress Wave Imaging Nondestructive Technology (NDT). The number of projects and the number of targets of the project have been completed. Trees have been subjected to wind damage and broken trees, follow-up growth is limited, it is recommended to gradually remove the operation, planting native trees. Close to the forest road, open land, building materials, etc., can increase the ornamental trees, such as cherry trees. The degree of risk of hazard trees is divided into four levels.



目視樹木評估法檢查柳杉樹木。
The detection of Japanese cedar tree body by visual tree assessment.



橫向應力波速度905-1365-1826 m/sec。
Transversal acoustic velocity 905-1365-1826 m/sec.

柳杉樹幹斷面橫向應力波速度2D影像。
The 2D image of transversal acoustic velocities in Japanese cedar trunk by stress wave method.

溪頭地標紅檜神木的樹幹木材解析及樹齡評估

Tree Age Assessment and Wood Analysis of Landmark Red Cypress Tree at Xitou Nature Education Area

李志璇、林柏亨、林振榮

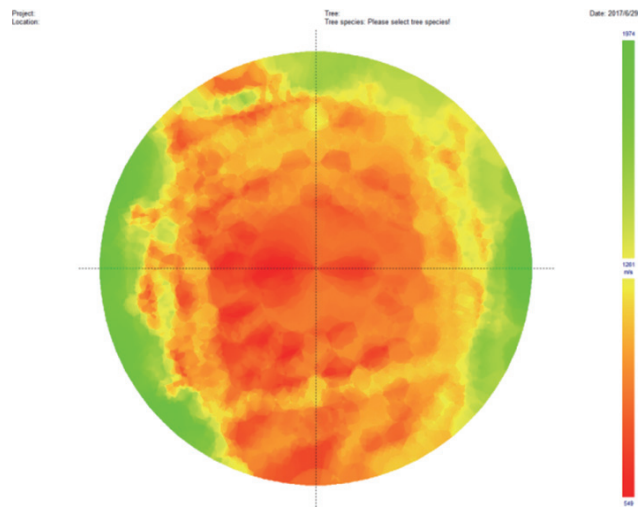
Chih-Hsuan Lee, Po-Heng Lin, Cheng-Jung Lin

本計畫使用簡易儀器非破壞性診斷技術，檢測及評估紅檜神木樹幹內部的健全性，並部份取樣試材以進行微破壞試驗數值，樹幹內部腐朽可以使用應力波2D非破壞性技術進行研究，作為危險風險性的評估準則。目前已完成神木傾倒的結構性問題，以外觀樹木檢查法、非破壞性診斷法及部份取樣微破壞法，判斷神木傾倒風險問題，結果樹幹愈接近樹木下方及內部中央，樹木腐朽劣化愈來愈嚴重。檢測神木樹輪及評估樹齡，以x-ray樹輪密度圖譜，使用四個平均年輪寬度是1.0175 mm，樹圍13.6公尺，本研究計算樹木年齡應為2,127年，文獻記載區內紅檜神木樹齡已2,800年，後來推估檢定應為1,836歲。使用C14檢測法檢測樹木內部木材死細胞，探討研究年齡的機制，可能受諸多因素影響，C14檢測法研究評估樹齡的研究方法需再進一步確認及努力。以X-ray繞射法瞭解木材纖維素結晶度，發現樹幹內部木材的結晶度是比樹幹外部周圍的木材有較低的結晶度。溪頭地標紅檜神木具有指標性意義，提供神木樹幹木材解析及樹齡評估，可提供教育解說資訊，宣傳保護老樹的宗旨，以上結果可提供臺大實驗林管理單位作為樹木教育及管理的資料。

The wood quality of trunk was detected by 2D stress wave nondestructive technique (NDT) for tree hazard assessment in this study. Bottom of the tree and the inner center, decay of trees was more serious deterioration by visual tree assessment and NDT. The average annual width of the four rings is 1.0175 mm and the circumference of the tree is 13.6 meters by X-ray scanning method. The tree age calculated in this study should be 2,127 years old. The age of the recorded red juniper trees has been 2,800 years, and the subsequent estimation should be 1,836 years old. The use of the C14 test to detect dead wood in trees cannot be assessed for age and may be affected by many factors. X-ray diffraction method to understand the degree of crystallinity of wood cellulose, wood was found within the trunk of the trunk than the wood around the outside of the lower crystallinity. Xitou landmark red juniper giant tree has an indicative significance to provide Shenmu trunk wood analysis and age assessment can provide educational commentary information, propaganda and protection of the old tree's purpose, the above results can provide NTU forest management unit as a tree education and management information.



目視樹木評估法檢查樹木。
The detection of tree body by visual tree assessment.



橫向應力波速度549-1261-1974 m/sec。
Transversal acoustic velocity 549-1261-1974 m/sec.

紅檜樹幹斷面橫向應力波速度2D影像。
The 2D image of transversal acoustic velocities in red cypress trunk by stress wave method.

建築物轄區樹木危險性風險檢測及診斷之研究(臺中市)

Study on the Detection and Diagnosis of Tree Hazard in Buildings Area (Taichung City)

李志璇、林柏亨、林振榮

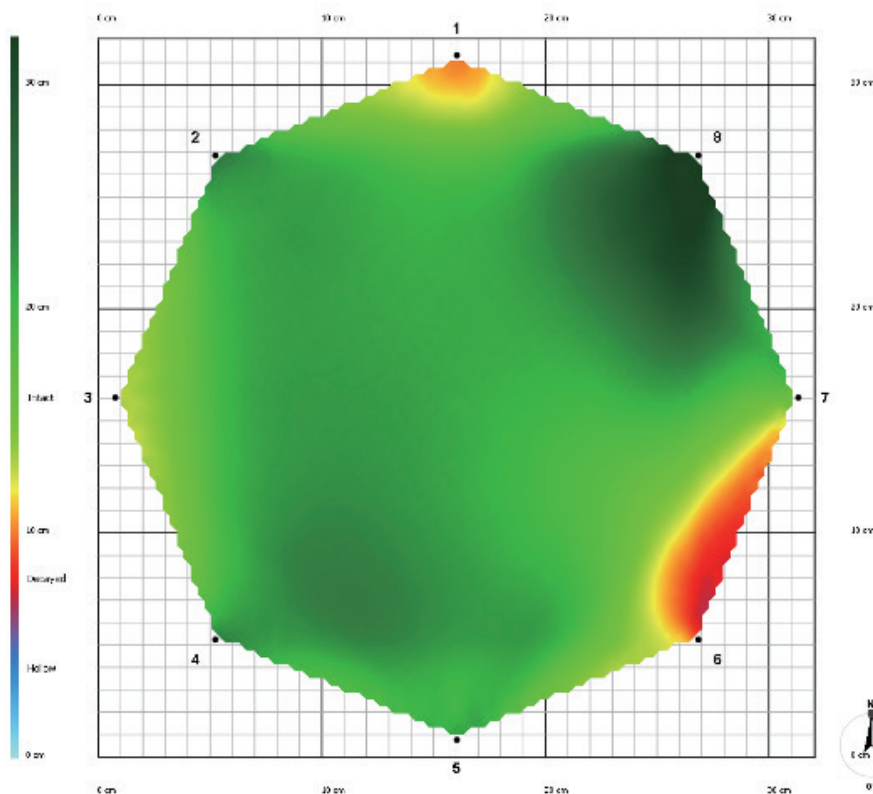
Chih-Hsuan Lee, Po-Heng Lin, Cheng-Jung Lin

本計畫檢查臺中市3株榕樹1株龍眼樹木，依據目視樹木評估法及非破壞性技術檢查樹木危險性，樹幹內部檢查結果為正常狀況，大枝條彎曲及長徑比較長，建議陸續監測。目視樹木評估及應力波2D檢測數值之橫向應力波速度等資料，將列入樹種資料庫，以提供後續追蹤檢查及評估參考。

A total of 3 *Ficus microcarpa* and 1 *Dimocarpus longan* trees were examined and visualized using the Visual Tree Assessment (VTA) and stress wave imaging nondestructive technology (NDT). The result of internal inspection of the trunk is normal reaction, and large branches curved and branch length to diameter is higher. Therefore, it is recommended that trees should be monitored subsequently. Visual tree assessment and stress wave 2D detection values of transverse stress wave velocity and other data will be included in the tree species database to provide follow-up inspection and assessment of reference.



目視樹木評估法檢查樹木。
The detection of tree body by visual tree assessment.



橫向應力波速度1197-1565 m/sec (榕樹)。
Transversal acoustic velocity 1197-1565 m/sec (*Ficus microcarpa*).



樹幹斷面橫向應力波速度2D影像。
The 2D image of transversal acoustic velocities in trunk by stress wave method.

建築物轄區樹木危險性風險檢測及診斷之研究(臺北市)

Study on the Detection and Diagnosis of Tree Hazard in Buildings Area (Taipei City)

李志璇、林柏亨、林振榮

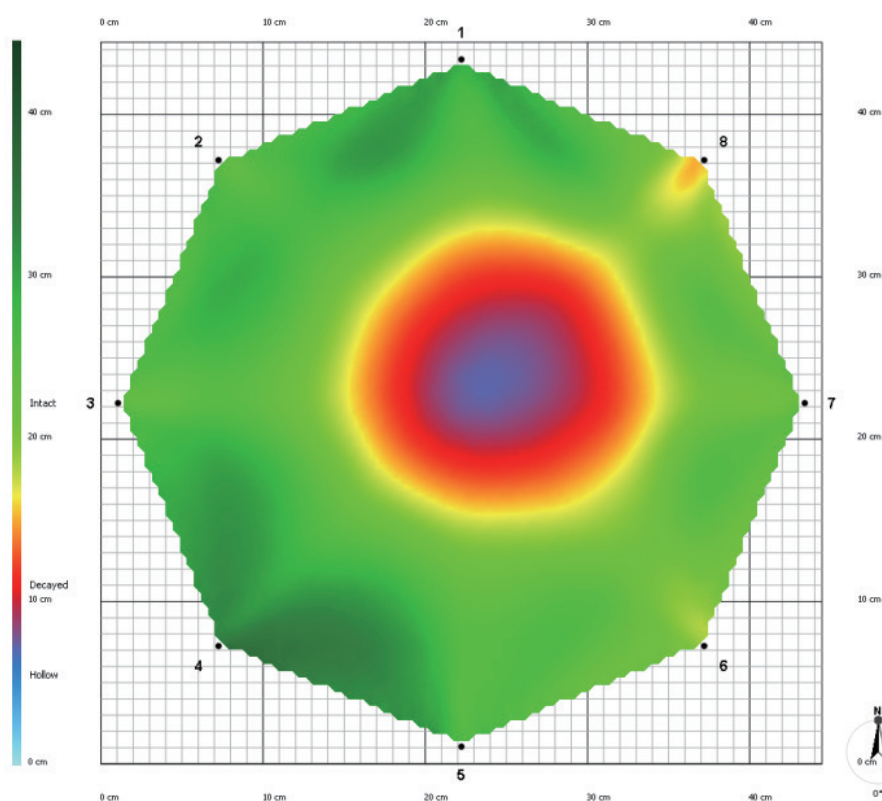
Chih-Hsuan Lee, Po-Heng Lin, Cheng-Jung Lin

本計畫檢查臺北市5株樟樹3株牛樟樹木，依據目視樹木評估法及非破壞性技術檢查樹木危險性，樹幹內部檢查結果有腐朽狀況，建議陸續監測及簡易外科手術。目視樹木評估及應力波2D檢測數值之橫向應力波速度等資料，將列入樹種資料庫，以提供後續追蹤檢查及評估參考。

A total of 5 *Cinnamomum camphora* and 3 *Cinnamomum kanehirae* trees were examined and visualized using the Visual Tree Assessment (VTA) and stress wave imaging nondestructive technology (NDT). The result of internal inspection of the trunk is decay reaction in trunk. It is recommended that trees should be monitored subsequently and simple surgery for recovery. Visual tree assessment and stress wave 2D detection values of transverse stress wave velocity and other data will be included in the tree species database to provide follow-up inspection and assessment of reference.



目視樹木評估法檢查樹木。
The detection of tree body by visual tree assessment.



橫向應力波速度1298-1698 m/sec (樟樹)。
Transversal acoustic velocity 1298-1698 m/sec (*Cinnamomum camphora*).

樹幹斷面橫向應力波速度2D影像。
The 2D image of transversal acoustic velocities in trunk by stress wave method.

東新國小轄區樹木危險性風險檢測及診斷之研究

Study on the Detection and Diagnosis of Tree Hazard in Dong Xin Elementary School

李志璇、林柏亨、林振榮

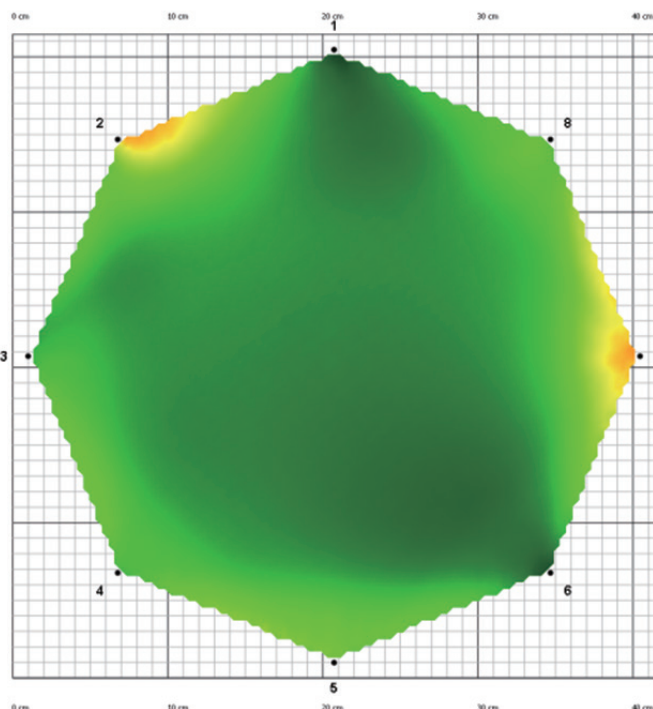
Chih-Hsuan Lee, Po-Heng Lin, Cheng-Jung Lin

七株印度橡膠樹目視樹木評估法檢查，發現樹木傾斜、浮根、樹冠層葉子稀疏等，有生長勢較弱的現象，為主要外觀樹木的結構性問題，可能是樹木生理反應，栽植區域有積水，或是植穴土壤問題。使用應力波2D法檢測樹幹內部狀況，發現樹幹內部正常反應。目視樹木評估及應力波2D檢測數值之橫向應力波速度等資料，將列入樹種資料庫，以提供後續追蹤檢查及評估參考。

A total of 7 *Ficus elastic* trees were examined and visualized using the Visual Tree Assessment (VTA) and stress wave imaging nondestructive technology (NDT). It is found that the tilting and floating roots of trees, the sparse canopy leaves and the weak growth potential are the structural problems of the main appearance trees, which may be the physiological responses of trees, the planting areas have water or soil problems of planting holes. The internal condition of the trunk and the normal reaction inside the trunk was found by stress wave 2D method. Visual tree assessment and stress wave 2D detection values of transverse stress wave velocity and other data will be included in the tree species database to provide follow-up inspection and assessment of reference.



目視樹木評估法檢查樹木。
The detection of tree body by visual tree assessment.



橫向應力波速度970-1268 m/sec。
Transversal acoustic velocity 970-1268 m/sec.



樹幹斷面橫向應力波速度2D影像。
The 2D image of transversal acoustic velocities in trunk by stress wave method.

監測管理並綜合防治刺桐釉小蜂案

董景生、楊恩誠、楊曼妙、張德斌、王庭碩、陳建文、林裕哲、洪宗佑、潘亮瑜、林怡德

本計畫針對入侵種刺桐釉小蜂，追蹤危害情形以便於後續的監測管理與防治，此計畫分五個主題：1.定期監測其病徵與寄生蜂調查；2.刺桐防治網站的強化；3.氣味陷阱研究與開發殘藥量檢測；4.評估具抗性之刺桐植株與5.協助後期教育訓練與推廣。目前於全臺各地攜回已感染之刺桐枝條飼養出12科42種寄生蜂，共獲得雌蟲230隻，雄蟲395隻，其中最具本土生物防治潛力的寄生蜂為*Aprostocetus felix*與*Eupelmus* sp.1；刺桐資料庫網站已完成重新整合，並重新架構為推廣性質為主的網

站；氣味陷阱生物性分析得知刺桐葉片的酒精萃取物對雌蟲有顯著的誘引效力，分析結果顯示吸引釉小蜂的主要因子為trans- β -ocimene，尚無符合的市售商品可以使用，依據小型田間測試結果，酒精萃取物有助於吸引捕捉雌蟲，殘藥量檢測結果則顯示，刺桐葉片適合以ELISA進行測定，並經苗木用藥試驗確認殘藥量檢測可行；將刺桐嫁接於有抗性的雞冠刺桐上，似乎有助於降低感染率；執行期間並進行南北兩場刺桐釉小蜂防治的教育訓練。



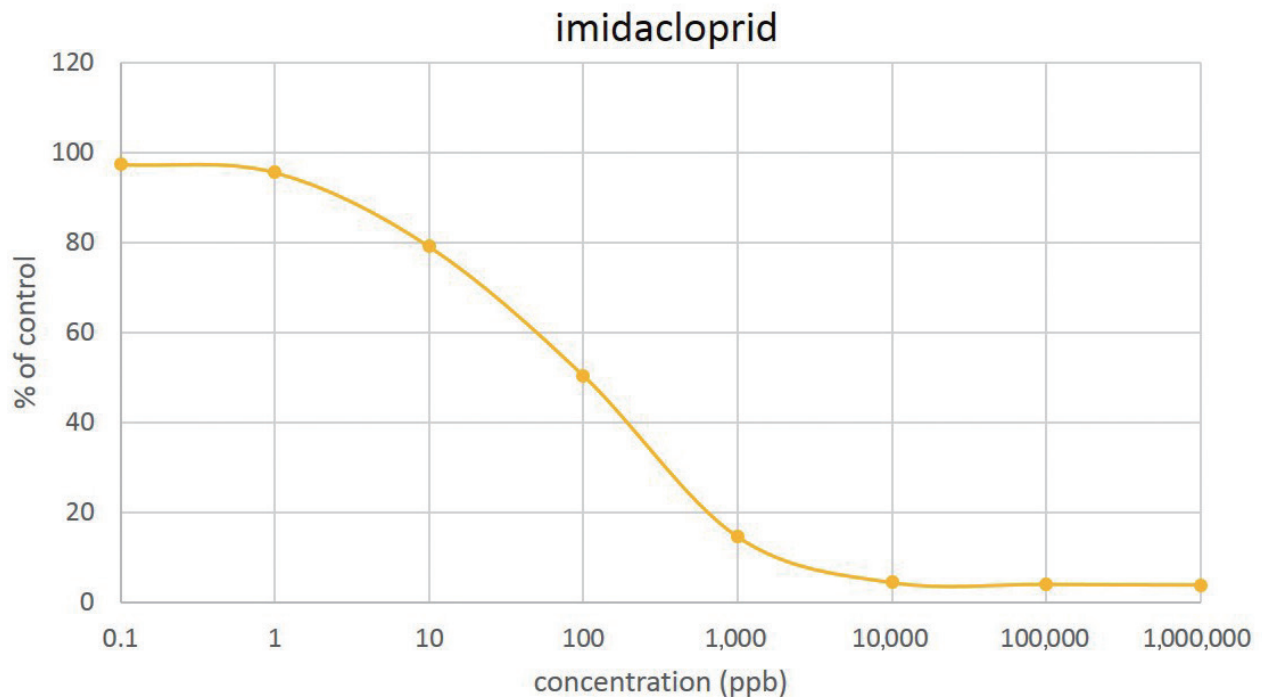
與琉球代表團現場示範防治方式及訓練會。
A training session in field and workshop with the Okinawa delegation.

An IPM-based monitoring on *Quadrastichus erythrinae* for *Erythrina* trees

Gene-Sheng Tung, En-Cheng Yang, Man-Miao Yang, Te-Pin Chang, Ting-Shuo Wang, Chien-Wen Chen, Yu-Che Lin, Tsung-Yu Hung, Liang-Yu Pan, Yi-Der Lin

In order to understand the damaged situation and to facilitate the follow-up monitoring and controlling of invasive galling wasps *Quadrastichus erythrinae* Kim (Eulophidae), we conducted this project on five levels in the hope to manage the pest infestation properly: 1, to periodically monitor the symptom development on the infected host plants *Erythrina variegata* (Fabaceae) and to investigate the native parasitoids of *Q. erythrinae* in general; 2, to enhance the website's functions on integrated management against *Q. erythrinae*; 3, to develop the odor traps for reducing the pest population and the rapid immune-detection method for residual imidacloprid pesticides; 4, to evaluate the resistance of different *Erythrina* species to *Q. erythrinae*; 5, to facilitate local governments to promote and proceed the integrated management training. At the moment, we have found 42 species of native parasitoids in 12 families, among these specimen collected, 230 are females and 395 males. *Aprostocetus felix* and *Eu-*

pelmus sp.1 are the two species that could be chosen to develop bio-control methods. The *Q. erythrinae* integrated management website has been re-constructed and is mainly used to promote the controlling principles. Through the biological analysis of odor traps and field trials, our findings show that the ethanol extractions from *E. variegata* leaves is apparently effective in attracting and capturing females of *Q. erythrinae*. And trans- β -ocimene is regarded as the major attracting factor in the leaves of *E. variegata*. The rapid immune-detection method "ELISA" is confirmed by soil drenching experiment suitable for residual imidacloprid pesticide tests. Grafting *E. variegata* on a more gall-wasp-resisted species *E. crista-galli* seems to be helpful to reduce the infection rate. In regard to the integrated management training for pest control, so far, two training sessions have been completed at two districts.



針對益達胺葉片殘藥的快速檢測方式(ELISA)，可檢出的最低值為10 ppb。

A fast pesticides detection method, ELISA, for residual imidacloprid pesticides in leaves. The lowest detectable concentration of this antibody is 10 ppb.

桉樹優良品系採穗園維護管理與苗木培育

鍾振德

農委會從2013開始調整耕作制度活化農地計畫。為了增加木材與紙漿原料供給，此計畫鼓勵農民將休耕地栽植林木，並以木材生產為目標，政策主要在增加木材與紙漿原料的自給率，以供國內木材與造紙工業需求。桉樹優良品系的營養系林提供顯著的收穫，均質與高品質的木材。本研究之目的在於經營管理桉樹優良品系採穗園，這些優良品系為抗桉樹枝癭蝨小蜂(*Leptocybe invasa*)，且選拔自生長優良精英樹，扦插繁殖苗木提供農民栽植。2013年我們建立三種型態的採穗園，包括土床、容器與礫耕栽培。然而，由於申請栽植的面積少，因此我們選擇礫耕栽培的採穗園進行後續扦插繁殖。

礫耕栽培的採穗園小母樹數量約4,500株，每株小母樹每個月可以採穗數量約2.5支插穗。插穗剪取3~4節，帶有4片葉子枝條，扦插介質全部使用泥碳土：珍珠石：蛭石體積比1：1：1之混合物，不同優良品系扦插發根率48~100%不等，所有插穗的扦插發根率平均約80%。今年我們共提供33,617株苗木給9位農民栽植，其中3位申請人在花蓮，2位在臺東，1位在苗栗，其他3位在臺南。栽植後的大部分造林地成活率超過90%以上，K41赤桉品系高生長與徑生長優於其它品系，歸因於抗風能力佳。評估整個桉樹的育苗成本，每株約臺幣6.7元，最後，我們仍將持續努力推廣提高農民參與本計畫意願。



桉樹K41品系扦插苗。
Eucalyptus camaldulensis variety, clone K41.

Clonal Garden Management and Propagation by Stem Cuttings of Elite Clones of *Eucalyptus*

Jeng-Der Chung

The Council of Agriculture (COA) adjusted the policy “The Paddy Land Utilization Adjustment Program” since 2013. In order to enhance the wood and wood pulp supply, this project encouraged land owners to plant more trees. The major advantage of the policy was to increase the self-supply rate of wood pulp for Taiwan’s wood and paper industry. Clonal *Eucalyptus* plantations of elite clones provided significant improvements in forest productivity, uniformity and wood quality. The aim of this study was to manage clonal garden and propagation by stem cuttings of elite anti-galling pest (*Leptocybe invasa*) clones of *Eucalyptus*. In 2013, we developed and compared three types of clonal gardens, including open-field soil, container, and gravel-bed culture. Finally, we selected the type of clonal garden of gravel-bed culture because areas applied for *Eucalyptus* plantation were little. The amounts of scion mother trees in clonal

garden of gravel-bed culture were ca. 4,500. On average, a scion mother tree produced 2.5 new stems per month. Cuttings were prepared in 3 to 4 nodes with 4 leaves. Rooting media was a mixture of 1:1:1 by volume of peat moss, perlite, and vermiculite. The rooting percentages of cuttings from different elite clones were from 48 to 100%, while the average of all cuttings was ca. 80%. Moreover, we offered 33,617 plants for 9 land owners, including 3 applicants from Hualien, 2 applicants from Taitung, 1 applicant from Miaoli, as well as 3 applicants from Tainan. The survival rates in most plantations were over 90%. The tree height and diameter growth of clone K41 (*E. camaldulensis*) is better than other clones because of its good wind resistance. Furthermore, the production cost was about NT\$6.7 dollars per cutting. We encourage more land owners to participate this program.

生質料源作物：蓖麻矮性品系純化與選種技術

馬復京

林業試驗所執行中油公司委託計畫「生質料源作物：蓖麻矮性品系純化與選種技術」，以中油公司提供之雜交蓖麻種子進行選育研究，藉由種子發芽，田間栽培，種子收穫等，調查其發芽成苗生長至開花結實等各生長階段的性狀表現以及種子的含油率，完成蓖麻雜交種的生長結實調查，期望選拔出矮莖、高產且含油率高的蓖麻雜交品種，並完成品種性狀調查表，以利後續蓖麻雜交品種權的申請及蓖麻產業的推廣。結果顯示中油公司提供之L13與L14種子經過3期的栽植與選育其子代單株在莖色、新芽色、果穗長、果實形態、果柄、種子形態等有遺傳分離的現象，後代性狀表現仍未穩定。但從第1次開花高的表現來看L13及L14的後裔至第3期世代卻仍能維持矮生早花的遺傳特性。從第2期形態性狀的相關

性來看蓖麻家系後裔並無法選育出長穗且大果的品系。各期作收穫之種子形態與移交種子進行檢定的結果顯示有顯著差異，然而種子形態顯現的差異來自栽培環境、介質等的不同而有差異。綜合3期栽植作業的調查研究，我們選出4個品系：(1)頂下9-1號，中果中長穗高產品系(2)臺10號，中長穗大果品系(3)臺4號，中長穗大果品系(4)信6號，中穗偏大果中產品系。另L14品系的後裔在3期作中各形態性狀及產量均無大差異，屬小果中長穗產量中上的品系，也可視為已純化品系。我們也完成臺4、臺5、臺10、信6、信7、信20、信21、頂下9-1及油1-1的性狀表，提供中油公司在未來蓖麻品種權申請及產業推廣的參考。



蓖麻田間栽植及優良農藝特性單株選育。
Field cultivation and agronomy characters selection of *Ricinus communis*.

Biomass Energy Crop: the Selection and Purification Techniques on *Ricinus communis* Short Stem Strains

Fu-Ching Ma

CPC Corporation, Taiwan sponsored TFRI to carry out a study on growth forms, seed mass production, and seed oil content by field cultivation and agronomy characters selection in order to purify short stem *Ricinus* hybrids. To acquire varieties right for promoting *Ricinus* cultivation, short stem, high seed yield, and high seed oil content *Ricinus* varieties were selected. The results showed genetic segregation of agronomy characters such as stem color, generating bud color, spike length, pedicle length, and seed size on the descendants of hybrid strains L13 and L14 after 3 crop season cultivations in 18 months. But the primary inflorescent height of stem indicated that the character of short stem was maintained. The morphologic characters study showed that there was no correlation between spike length and larger fruits descendants in the second crop. There is a significant difference on seed size between the original seeds and

crop seeds we produced, but the difference might come from the different cultivation environments. After 3 crop seasons, 4 series were selected: 1. Dingshia 9-1, a medium fruit size and spike length high yield strain; 2. Tai 10, a medium spike length and larger fruits size strain; 3. Tai 4, a medium spike length and larger fruits size strain; 4. Tsing 6, a medium spike length, medium larger fruits size and medium seed yield strain. Besides, the L14 decedents showed no difference on seed morphology and seed yield during 3 crop season cultivations. L14 is a smaller seed size, medium spike length and medium high yield strain and may be recognized as a purified strain. The agronomy characters of Tai 4, Tai 5, Tai10, Tsing 6, Tsing 7, Tsing 20, Tsing 21, Dindshia 9-1, and Yu 1 were accomplished. This study supports the CPC, Taiwan to apply for variety right and to promote *Ricinus* production in near future.

多食華小蠹蟲天敵生態資料之建立、飼養及生物防治試驗

汪澤宏、Richard Stouthamer

多食華小蠹蟲是原產於亞洲的物種，近年在美國西岸發現，據報導，南加州在335種樹木中有207種會被多食華小蠹蟲及其共生真菌危害，尤其是加州的酪梨園因為這種小蠹蟲的入侵而造成酪梨樹的逐漸衰敗死亡。小蠹蟲並不適合用化學藥劑防治，非農藥防治的方法也必須加以建立，本研究主要針對多食華小蠹蟲的產地進行其天敵的調查與大量飼養，飼養多食華小蠹蟲的專一性天敵族群數量，進行其生物防治室內試驗。

本計畫在臺灣以誘引劑及段木調查多食華小蠹蟲族群，採集的標本以外部形態及COI基因序列加以鑑定確認身分。結果發現本種主要分布於海拔高25至1,000公尺，2,000公尺以上地區確定沒有分布。另外確定其在臺灣的

寄主樹木種類，分別為長梗紫麻、酪梨、苦楝、紫藤、蓖麻以及榴槤蜜，其中長梗紫麻、苦楝、紫藤及榴槤蜜是世界上首次記錄。成功完成人工大量飼養多食華小蠹蟲以供實驗使用。在採集多食華小蠹蟲天敵部分，採用誘引木陷阱法及感染木採集法，在宜蘭、南投、嘉義及臺南四個縣的樣區進行調查，共採集5科9種寄生性天敵以及2科2種捕食性天敵。寄生性天敵分別為小蘗蜂科1種、釉小蜂科1種、蟻形蜂科5種、旋小蜂科1種、金小蜂科1種。捕食性天敵分別為郭公蟲科1種及捕蠹蟲科1種。其中利用大量飼養的多食華小蠹蟲而成功繁殖的寄生性天敵為小蘗蜂科1種、釉小蜂科1種、蟻形蜂科1種。



小蠹蟲誘引器。
The trap for bark beetles.

Researches on the Ecology and Breeding of Natural Enemies for Polyphagous Shot Hole Borer, and the Experiments on the Biological Control of these Beetles

Liang-Jong Wang, Richard Stouthamer

Polyphagous shot hole borer (*Euwallaceae fornicates* species complex) (=PSHB) is native to Asia but was found in the West Coast in the United States in recent years. It was reported that 207 of the 335 tree species in Southern California were attacked by PSHB and its symbiotic fungi. Especially, the avocado trees in the California groves got weaken and dying due to PSHB's invasion and attack. It is not appropriate to control bark beetles by chemical. It is necessary to establish some methods of non-chemical control on bark beetles. The current research mainly focuses on the investigation and the mass breeding of the natural enemies of PSHB. The experiments of biological control could be conducted by the mass breeding of the specific natural enemies in the laboratory.

The project was conducted to investigate the population of PSHB by the methods of funnel traps with the lure and bolts. The specimens were collected and identified to species level by morphological characters and COI sequences. The results indicated that PSHB mainly distributes from alt. 25 to 1,000 meters. There was no finding PSHB in the regions more than 2,000 meters above the sea level. Besides, 6 host plant species

of PSHB have been confirmed in Taiwan as follow: *Oreocnide pedunculata*, *Persea americana*, *Melia azedarach*, *Wisteria sinensis*, *Ricinus communis* and *Artocarpus integer*. Among them, *Oreocnide pedunculata*, *Melia azedarach*, *Wisteria sinensis* and *Artocarpus integer* are the first records of host plant for PSHB in the world. The artificial mass breeding of PSHB was established successfully in order to be provided as the material in the biological control experiments. In order to collect the natural enemies of PSHB, the methods of bolt traps and the invested logs were used. The investigation was conducted in the regions of four counties including Ilan, Nantou, Chiayi and Tainan. The total collection of natural enemies include the parasitoids of 9 species in 5 families and the predators of 2 species in 2 families. The parasitoids were identified to Braconidae (1 species), Eulophidae (1 species), Bethylidae (5 species), Eupalmidae (1 species) and Pteromalidae (1 species). The predators were identified to Cleridae (1 species) and Passandridae (1 species). Among them, each species in three families (Braconidae, Eulophidae, Bethylidae) were bred successfully.

建立低成本高產值速生相思樹造林體系之研究

游漢明、蔡佳彬、張森

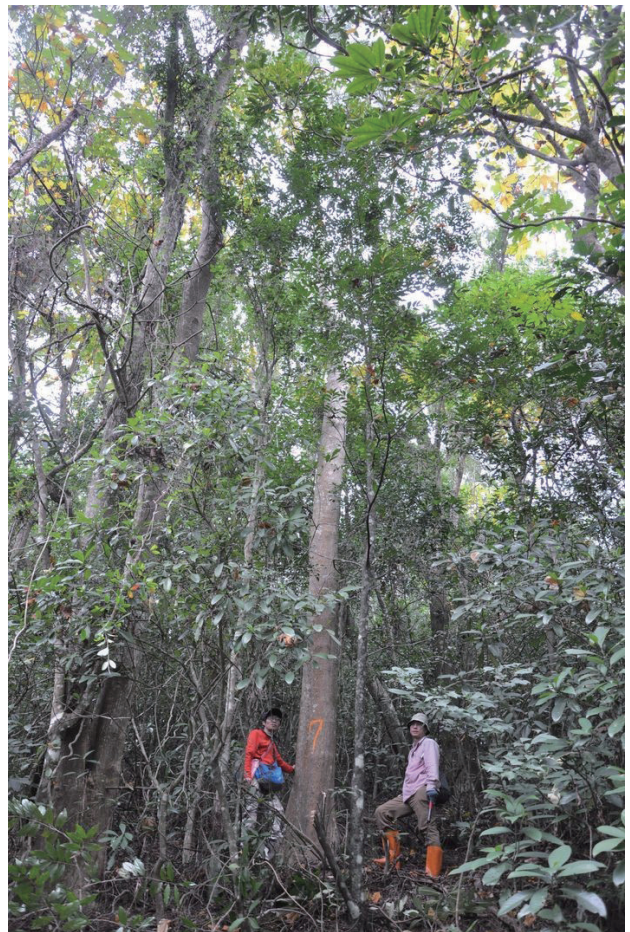
相思樹(*Acacia confusa* Merr.)是分布於低海拔且適合瘠劣地復育造林的造林樹種，抗風耐旱，根部發達，同時具有根瘤菌，能固定空氣中氮素，改良土壤，全臺造林面積達2萬公頃以上。近年相思樹不但已成為臺灣地區生產菇類最主要之木材，需求且殷，同時亦為優良之紙漿材，可以解決臺灣紙漿材部份來源。尤有甚者，相思樹大徑材生產之板材，材質堅硬，供製造高級家具及地板，目前大徑材市場需求殷切，商品名稱為臺灣黑檀。故相思樹是適合短中長期綜合經營，為多重利用、彈性營林之最佳樹種。三年來林業試驗所，已在全臺相思樹林地尋獲並標定近百株優良形質母樹，證明建立通直、圓滿、枝下高大、速生、豐產、高效率、低成本之人工林育林技術是可行的。

目前標定之優良母樹，最大胸徑102 cm，樹高可達23 m，顯見野外之優良母樹仍可繼續進行選優工作，同時完成優良母樹嫁接苗305株之培育，可提供未來增建嫁接苗種子園苗木之需求。種子苗的培育共計採25株優良母樹種子，顯示果莢內飽滿種子數量比率不高，結實率低，經發芽試驗，最高發芽率僅為57.7%，種子品質欠佳，顯示母樹單株間，優良母樹結實及種子品質仍存有差異極大的不確定因素，種子品質不佳影響發芽率及後續大規模造林苗木數量的供應，亟待嫁接種子園生產種子及後續種子品質的鑑定，再予釐清。

完成嘉義中埔澗水及臺南楠西照興二處嫁接苗種子園之建立，共完成57株優良母樹396株嫁接苗及98株種子苗之栽植，而澗水嫁接苗平均高生長達 254.8 ± 66.3 cm，最高苗高已達4公尺，六龜的盆栽種子園亦完成84單株及85株嫁接苗的栽植，平均嫁接苗木高生長 140 ± 38.4 cm，不同單株生長差異極大，三處嫁接苗種子園現場均發現有枝條下垂呈現生長惰性形態之嫁接苗，待進一步後續生長的檢定。

本研究觀察發現相思樹的花期先由南部3月下旬逐漸往北，至北部約5月下旬完成開花，種子至8月初陸續成熟，俟遭逢臺灣進入颱風豪雨期，影響母樹種子的採集至鉅，對優良母樹種子採集之適期極具參考價值。

每年七、八月之颱風過境臺灣，適逢全臺相思樹種子即將成熟之關鍵時期，因此颱風的危害亦為優良形質之相思樹成熟種子取得不易的原因之一，同時母樹樹高均約20公尺，故野外採集種子取得更加耗費時間，長期耗時更顯母樹種子園之建造及設立種子生產區的必要。



通直、圓滿及枝下高大的相思樹母樹。

Mother tree characterized straight, good roundness trunks with high limb-clearing of *Acacia confusa* Merr.

Development of a Low Cost, High Value, and Fast Growing Silvicultural System for *Acacia confusa*

Han-Ming Yu, Jia-Bin Tsai, Sun J. Chang

Acacia confusa Merr. is a tree of Leguminales Order, it resists wind and tolerates draught with a well-developed root system. Roots of the tree also contain root nodules and are capable of fixing atmospheric nitrogen thereby improving soil conditions. The species was a main plantation afforestation tree at low elevations broadleaf forests in earlier days of Taiwan, and the total afforestation area had reached more than 20,000 ha. In recent years, *A. confusa* logs are eagerly sought after for cultivating shiitake and other mushrooms, the wood is also an excellent pulpwood species capable of resolving partial demands for pulpwood supply. Furthermore, paneling obtained from large-diameter logs has good solid quality which can supply high grade furniture and flooring needs. At present, there is also an eager demand for large-diameter logs of the tree; it has been named Taiwan ebony in the Chinese Mainland marketplace. Therefore, the species is imminently suited for general forestry in short-, mid-, and long-term afforestation programmes, providing multiple uses and flexible management goals. We deem it to be the best choice for afforestation. In recent years, the Taiwan Forestry Research Institute has scouted the land and found in the eastern and central-southern parts of Taiwan a few superior individual *A. confusa* trees with straight trunk-shapes. This has proven that it is feasible to seek superior trees in the field, and through the application of silvicultural techniques to artificially create forests with straight, good roundness trunks with high limb-clearing, fast growing, rich yielding, highly efficient and low cost plantation of the tree. In view of the present and future wood market demands, how to establish low-cost, high-yield and fast growing *A. confusa* afforestation system has become an urgent task.

As so far, we keep on marked superior mother trees, the largest having a maximum diameter at breast height (DBH) of 102 cm, and height of 23 m. Apparently there are superior mother trees in the field which can be continuously selected for their superiority characteristics. In addition, we have completed grafting 305 saplings from the superior mother trees which can provide for the need of setting up a grafting scion garden. On raring of seedlings, seeds of 25 superior mother trees were collected; however, mature seeds in pods were at a low proportion, indicating poor fruitions. Thus, grafting sapling will be counted on to provide stable and superior seed supplies. It indicates that the quality of fruits and seeds of individual excellent mother tree has significant difference. Bad seeds will affect the germination rate and the seedlings supply of subsequent planting. Therefore, the promotion of *Acacia confusa* Merr. afforestation is highly depended on the production of high quality seeds from the grafted seed garden and the quality of seeds for sowing must also be assessed for its goodness.

We've completed two grafting scion gardens establishment at Yunshue, Chungpu, Chiayi County, and Chaohsing, Nanshi, Tainan County, both were having convenient traffic, flat terrain and good drainage. In the gardens 396 grafting saplings from 57 superior mother trees and 98 seedlings have been planted. The grafting saplings had an average height growth of 254.8 ± 66.3 cm; with the highest sapling reaching 4 m. In Liuguei, the potted seed garden has completed planting of 85 saplings from 84 mother trees grafting. The average grafted sapling height growth was 140 ± 38.4 cm. There were tremendous differences among the growth of individuals. In all three grafting scion gardens, trees of drooping branches and idled growth were found which require further growth inspection.

From the field observations, this research project has found that the blossom period of *Acacia confusa* Merr. is beginning at late March in the southern part of Taiwan and the beginning time is delayed gradually from south to north. Eventually the *Acacia confusa* Merr. in the northern part of Taiwan has completed flowering at late May and seeds are successively matured from late July to early August. However, the period of seed mature is also the season of typhoon and heavy rain in Taiwan, the bad weather will impede seed collection tremendously and is one of the reasons for difficult getting matured seeds. In addition, seeds collection of *Acacia confusa* Merr. is a task of time and labor consuming due to the height of mothers are commonly over 20 meters. It is necessary to set up mother trees garden urgently for establishing seed production areas.

森林碳管理策略分析與行動方案研擬

邱祈榮、劉恩妤、林俊成

2015年底在法國巴黎召開的聯合國氣候變化綱要公約 (United Nations Framework Convention on Climate Change, UNFCCC)第21屆締約國會議(COP21)通過的巴黎協議為全世界共同關注的焦點，協議的減量目標為世紀末全球升溫幅度不超過工業革命前2°C，並以1.5°C為努力方向。臺灣1990-2015年間溫室氣體排放量呈2.1倍成長，為呼應國際上的氣候變遷相關公約及協定，溫室氣體減量及管理法(溫管法)已於2015年7月1日正式公布施行，明訂國家的長期減量目標為2050年的溫室氣體排放量需降至2005年排放量的50%以下，且能源、製造、運輸、住商及農業等各部門應訂定溫室氣體排放管制行動方

案。林業隸屬於農業部門，在溫管法規範下，需研擬部門行動方案。本研究已邀請公部門及專家學者們辦理 3 次研商會議，決議優先提報具實質減量的造林及加強森林經營等2大項行動方案，造林實施的項目包括海岸及離島造林、國有林造林及山坡地獎勵造林等，而加強森林經營實施項目包括復舊造林、國有人工林修枝作業、國有人工林疏伐及平地造林疏伐等項目，預期第一階段管制目標期間(2016~2020年)累積造林面積可達3,636公頃，而加強森林經營累計面積可達4,799公頃。建議未來可參考各國林業減量策略及國際情勢來作為後續林業減量措施滾動修正之參考。



林業部門於溫室氣體減量及管理法第一階段管制目標(2016-2020年)所提出的行動方案。

The action plan proposed by Forestry department according to Greenhouse Gas Reduction and Management Act during 2016-2020.

Analysis of Forest Carbon Management Strategy and Action Plan

Chyi-Rong Chiou , En-U Liu, Jiunn-Cheng Lin

The Paris agreement adopted by the 21st annual Conference of Parties (COP 21) to the United Nations Framework Convention on Climate Change (UNFCCC) is the common focus of the world. The reduction target of the agreement is that holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels. Taiwan's greenhouse gas emissions increased by 2.1 folds during 1990-2015, in order to respond to the international climate change conventions and agreements, Greenhouse Gas Reduction and Management Act was officially published on July 1, 2015. Taiwan's long-term reduction target is set to reduce greenhouse gas emissions less than 50% of 2005 emissions by 2050, in addition, various departments such as energy, manufacturing, transportation, business and agriculture should draw up greenhouse gas emission control action plans. Forest is a part of the agriculture

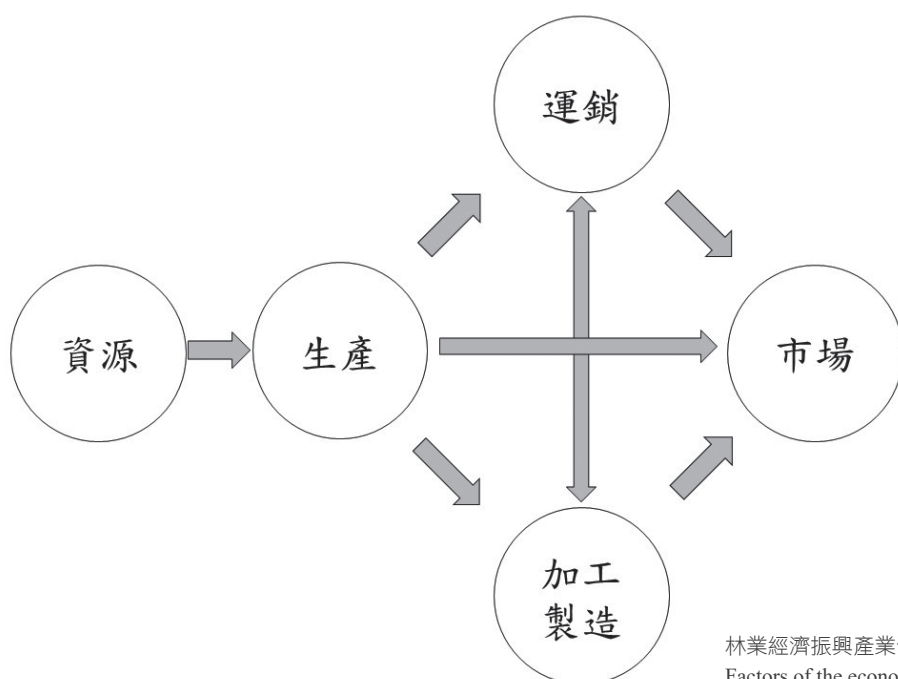
department which is required to develop departmental action plan. This research has invited public departments, experts and scholars and held 3 discussion meetings, and these meetings concluded that action plans with substantive reduction effects such as afforestation and strengthening forest management has a high priority. Afforestation projects include afforestation on the coastal area, state-owned forest land and hillsides; the projects for strengthening forest management include ecological restoration, pruning and thinning of state-owned plantations and other projects. It is expected that during the target period of the first phase of control (2016-2020), the cumulative afforestation area will reach 3,636 hectares, while the total area for enhancing forest management may reach 4,799 hectares. It is suggested that reduction strategies from various countries and international situation can be used as reference to modify subsequent forestry action plans.

林產物產銷推動架構規劃

詹為巽、邱祈榮、林俊成

在國際木材市場限制日增及國產材自給率極低的環境下，振興林產經濟以提高國產材供給是必要趨勢。因此，為促進臺灣林業產業得以健全發展，本計畫藉由政策分析、文獻回顧及實地訪查等方式，檢討過去林產經濟策略缺乏所造成之現況及問題，並比較國外(如日本)執行林業振興工作的得失，分析相關政策及措施對我國林產業的影響，同時盤點現有林產業資源，包括林業及農牧用地上之私有林資訊、林產品市場需求及產業鏈現況等，以便利用現有之政策工具規劃協助、輔導林產業，生產符合市場需求之林產品，評估提高我國木材自給率之比率及照顧林農生計。最後，本計畫歸納總結當前國內林產業發展5大重要因素，各項目完成分析之內容如下：

- 1.資源：全國所有森林具備生產潛力、可生產之資源熱區分佈及其面積分析，以及生產潛勢區位與生產量推估。
- 2.生產：林業經濟中所有森林主副產物之生產趨勢、林農與從業人口數、從業人口比例等項目分析。
- 3.加工製造：各項木材、竹材相關產品之生產趨勢，加工製造相關工廠與據點，以及技術成熟度、開發需求、加工製造之成本分析等與林產物加工與增值相關產業之核心項目分析。
- 4.供銷：產品銷售去向分析、木竹產品銷售通路分析以及木竹品銷售成本分析等。
- 5.市場：木材產品市場需求度與成熟度、銷售通路細節分析以及價格、品牌與新市場開發分析等。



林業經濟振興產業發展重要因素關係。
Factors of the economic revitalization of forest products industry.

Strategic Planning on Economic Revitalization of Forest Products Industry

Wei-Hsun Chan, Chyi-Rong Chiou, Jiunn-Cheng Lin

Under the increasingly restrictive international timber market and the extremely low self-sufficiency rate of domestic wood material, it is necessary to rejuvenate the forest economy to improve the supply of domestic wood materials. Therefore, to promote the full development of Taiwan's forestry industry, this project reviews the current status and problems caused by the lack of economic and business strategies in the past by means of policy analysis, literature review and field visits, and compare the gains and losses of the forestry rejuvenation carried out by foreign countries (such as Japan), analyze the impact of relevant policies and measures on Taiwan's forest industry. At the same time, take inventory of existing forest industry resources, including private forestry information on forestry and pastoral land, and forest products market demand and the status of the industry chain, etc. To conveniently use the existing policy tools to help plan and guide the forest industry, producing forest products in line with market demand, assess the rate of increasing the self-sufficiency rate of timber in our country and take care of the farmers' livelihood. Finally, this project summarizes the current five major factors in the development of domestic forest industry, the completion of the analysis of this project are listed as follows:

1. Resources: All the forests in the country have the potential of production and the distribution of hot zones of resources that can be produced and the area analysis, as well as the potential location of production and production quantity estimation
2. Production: Analyze the production trends of all forest primary and secondary products in forestry economy, forestry and employment population, proportion of employed population, etc.
3. Processing and manufacturing: Analyze various wood, bamboo related products production trends, processing and manufacturing related factories and strongholds, as well as cost analysis on technical maturity, development demand, cost analysis of processing and manufacturing, etc., and core analysis on forest products processing and value added industries.
4. Supply and marketing: Product sales destination analysis, wood and bamboo product sales pathway analysis, and wood and bamboo product cost analysis, etc.
5. Market: Analysis on wood product market demand and maturity, details of sales routes, and price, brand and new market development, etc.



臺灣穗花杉胚胎發育與種子休眠性之研究

鍾振德

臺灣穗花杉僅分布於臺灣本島南端，由於族群稀少，被列為積極保育之本土樹種。臺灣穗花杉由於族群稀少，有性生殖能力薄弱，使得種子產生不易。過去兩年研究已完成誘導花芽分化，以及完成生殖系統胚胎發育之解剖觀察。利用枝條環狀剝皮處理，環狀剝皮1.0 cm寬，誘導100%臺灣穗花杉之花芽分化。枝條環狀剝皮處理後，間隔一定時間，取葉片進行激勃素定量分析，切取葉片後冷凍乾燥，秤取1克乾重萃取激勃素進行分析，結果在處理過後2星期，於葉片偵測到大量的 GA_4 與 GA_7 。另外對29株盆鉢植株，進行有性生殖觀察，包括花粉與胚珠發育、授粉、授精以及胚胎之發育。雄蕊在3月中旬結束休眠，小孢子形成於3月底漸漸發育成熟。成熟花粉大小

約25 μm 。雌蕊在3月底結束休眠，胚珠裸露後不久即分泌授粉滴。約在4月初開始授粉，授粉期約1~2星期。大孢子於3月底開始逐漸發育，此時雌配子體尚未成熟，直到6月初成熟時才完成授精。當種子成熟掉落時，胚還未發育完成，而且發現同時間人工授粉，但種子的成熟時間卻從授粉後隔年的4月一直到12月。胚未成熟發育應該是主因，因此後續將聚焦種子生理與胚休眠之研究，探討解除胚休眠的過程中，荷爾蒙(包括激勃素、細胞分裂素、離層酸與IAA等等)之代謝變化。這個計畫的目標，研究臺灣穗花杉生殖生物學之知識，解決臺灣穗花杉生殖之困境，增加飽滿種子之生產。



環狀剝皮處理過後2星期，於葉片偵測到大量的 GA_4 與 GA_7 。
Great amount of GA_4 and GA_7 were detected 2 weeks after girdling.

Study of Embryo Development and Seed Dormancy in *Amentotaxus formosana*

Jeng-Der Chung

Amentotaxus formosana is an indigenous tree native only in the southern areas of Taiwan. It is listed as a protected species by the Taiwan government because of its scarcity of populations and low seed production. In the last two years, we achieved the goal of enhancing flowering bud initiation and accomplished the anatomical survey of reproductive system of *A. formosana*. By using a girdling device to remove a 1.0 cm wide ring of bark, the flower bud differentiation was consistent with all container-grown cultivars achieving 100% induction. Quantitative analysis of gibberellins in leaf samples harvested at different developmental stages was conducted as well. These leaf specimens were excised and freeze-dried. Gibberellins extracted from 1.0 g of dried leaves were quantified. Great amount of GA₄ and GA₇ were detected 2 weeks after girdling. Furthermore, the reproductive system of 29 individuals, including pollen and ovule development, pollination, fertilization as well as embryo development, was surveyed. Pol-

len cones ended dormancy in middle-March, microsporogenesis occurred in late March. Mature dry pollen was about 25 μm in diameter. Seed cones ended dormancy at the end of March, opened exposing the ovules, and secreted pollination drops. Pollination occurred for about 1~2 week in early April. Megasporogenesis happened in late March but female gametophytes did not mature and fertilization did not occur until early June. Embryos were not well-developed when seed was mature and shed. Thus, we found that the timing of seed maturity varied from April to December in the following year, even being hand-pollinated at the same time. Therefore, seed physiology and embryo dormancy research, such as understanding the metabolic changes in phytohormones (including GAs, cytokinin, ABA, IAA etc.) of breaking embryo dormancy, is suggested in the future. To sum up, the goal of this study is to provide methods to increase cone and filled seed production of *A. formosana*.



福山植物園區內臺灣穗花杉環狀剝皮處理枝條雄穗花綻放。

Significant male flowering on girdled branches of *Amentotaxus formosana* in Fushan botanical garden.



非木纖維以四氫呋喃醇溶劑製漿法製備溶解級紙漿及廢液的回收與利用

何振隆

本計畫研究以非木纖維—稻草，進行常壓四氫呋喃醇有機溶劑法製備溶解級紙漿，分別探討製備溶解級紙漿之最佳蒸煮條件及特性、漂白製程後溶解級紙漿性質等三大部分。於常壓四氫呋喃醇有機溶劑法製備最佳溶解級紙漿之蒸煮條件為：液比10、四氫呋喃醇濃度9.7 mol/L、催化劑(HCl)濃度0.02 mol/L、蒸煮溫度120°C及蒸煮時間為240 min為最佳，其收率為59.8%。進行O-D₀-(EP)-D₁-P五段漂白後，紙漿白度為86.9%ISO， α -纖維素為90.3%，殘餘之聚戊糖為6.3%，漂白後之S₁₀-S₁₈值僅為1.92%。而稻草以預水解硫酸鹽法製溶解級漿料，其

最佳蒸煮條件為硫化度25%，液比10，用鹼量21%，升溫至170°C，升溫時間為60 min，恆溫時間為120 min，收率為39.3%。進行五段漂白，其漂白後，紙漿白度為88.1%ISO， α -纖維素為91.6%，殘餘之聚戊糖為5.8%，S₁₀-S₁₈僅為1.82%。因此，綜合上述，稻草以常壓四氫呋喃醇製備溶解級紙漿之性質與預水解硫酸鹽法所得之溶解級紙漿性質相近。但二方法於收率方面，預水解硫酸鹽法較四氫呋喃醇法為低，因此以常壓四氫呋喃醇製備溶解級紙漿是為可行的方法。

稻草以四氫呋喃醇法及漂白後之溶解漿料性質。

Dissolving pulp properties obtained from rice straw THFA, prehydrolysis kraft pulping and bleaching, respectively.

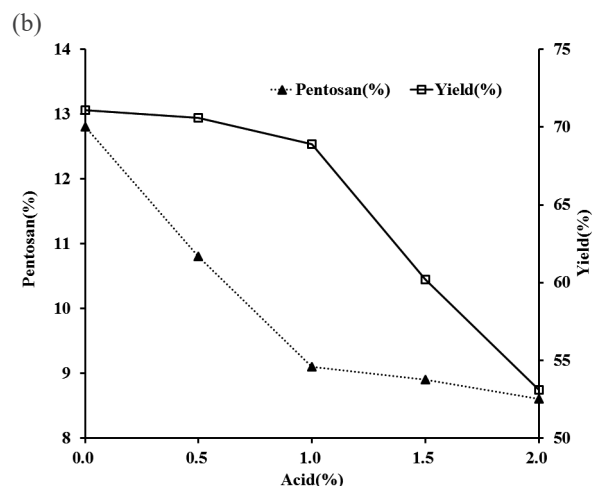
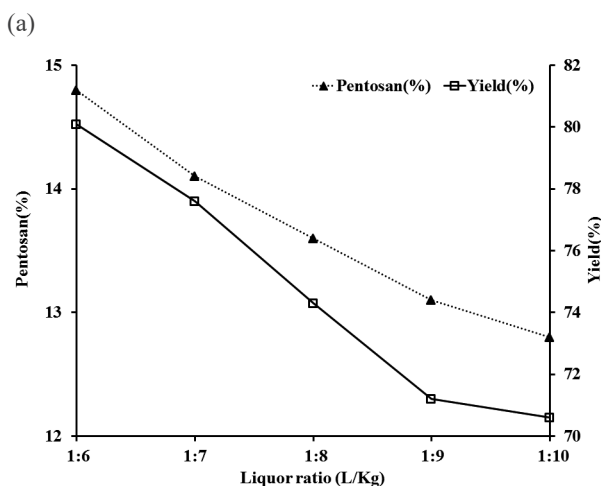
Properties	THFA	Prehydrolysis kraft
α -Cellulose(%)	90.3	91.6
Pentosan(%)	6.3	5.8
S ₁₀ (%)	7.13	6.88
S ₁₈ (%)	5.21	5.06
Brightness(%ISO)	86.9	88.1
Viscosity(mPa.s)	11.3	10.9

Tetrahydrofurfury Alcohol (THFA) Pulping of Non-wood Fiber for Making Dissolving Pulp and the Recycle and Utilization of Pulping Waste Liquor

Chen-Lung Ho

In this project, a nonwood fiber—rice straw, was studied with atmospheric pressure tetrahydrofurfuryl alcohol (THFA) organosolv pulping to prepare dissolving grade pulp. In the study, the optimal digestion condition and properties of the dissolving grade pulp obtained were investigated. In addition, post-bleaching pulp properties were also included. With respect to the optimal digestion conditions of THFA organosolv pulping at atmospheric pressure, the liquor to wood ratio shall be 10; THFA concentration of 9.7 mol/L; catalyst (HCl) concentration of 0.02 mole/L; digestion temperature of 120°C; and cooking time of 240 min. The pulp yield was 59.8%. Then after an O-D₀-(EP)-D₁-P 5-stage bleaching, the pulp brightness reached 86.9% ISO; α-cellulose content was 90.3%; with 6.3% of residual pentosan remaining. The post-bleaching pulp had a S₁₀-S₁₈ value of only

1.92%. For comparison, the optimal prehydrolysis kraft pulping conditions for rice straw were sulfidity 25%; liquor to wood ratio, 10; active alkali 21%; temperature rise to 170°C; with rise to temperature time of 60 min; and time at temperature 120 min. The pulp yield was 39.3%. After the same 5-stage bleaching, the pulp brightness reached 88.1% ISO; α-cellulose was 91.6%; residual pentosan content was 5.8%; and S₁₀-S₁₈ value was only 1.82%. Hence, summarizing the above, rice straw when pulped with THFA organosolv process could produce pulp of similar properties to the prehydrolysis kraft process. However, the two methods differed much with respect to yield, therefore, THFA organosolv process replacing prehydrolysis kraft appeared to be a feasible approach.



(a)不同液比(b)不同酸用量對稻草以預水解對聚戊糖含量及收率之影響圖。

Effects of (a) different liquor to material ratios, and (b) different acid dose on pulp yield vs. kappa no. ratio and pulp yield vs. pentosan content.



應用分子、化學與形態標誌解構臺灣的南洋紅豆杉的品種獨特性

何政坤、張淑華、吳家禎

臺灣紅豆杉(*Taxus sumatrana*)在植物分類上的位置隸屬在紅豆杉屬的南洋紅豆杉群(Sumatrana Group)或西藏紅豆杉群(Wallichiana Group)，頗有爭議。Gao et al. (2007)利用父系遺傳的葉綠體cpDNA *trnL-F*及RFLP分析西藏紅豆杉群50個族群，指出採自臺灣北部的17株紅豆杉歸類為南方紅豆杉(*Taxus wallichiana* var. *mairei*)，且具有獨特的2單倍型(haplotype)，不同於中國與北越49個族群。Huang et al. (2008)利用SSR分析臺灣中南部9株紅豆杉核DNA，顯示遺傳歧異度頗高。我們在2004年利用RAPD分析顯示臺灣紅豆杉與中國的南方紅豆杉明顯的分成2群，顯示二者間族群已明顯分化。我們已培育出臺灣紅豆杉品種含有高濃度紫杉醇(taxol)與可合成多西紫杉醇(Docytaxol)的10-DAB (10-deacetylbaactin III)，2個具有

品種權的紅豆杉，其中一品種已向大陸申請品種權中。同時在1997年建立6種源後裔試驗及7種源43個營養系的種子園，種子園已經開發結實。利用這些遺傳資源分析紅豆杉雌雄株花粉傳播的cpDNA與代表種子傳播的SSR分子標誌，可瞭解臺灣紅豆杉的遺傳結構，可檢視所建立的紅豆杉區外保育是否具有高度遺傳歧異度，同時開發具有鑑別品種權的分子標誌，以保護產業在臺灣與大陸投資栽培的品種保護。經1年種子園的調查，共有12株營養系開花雌株，11株營養系開花雄株，有8株雌株結實並經由胚培養培育出苗木。利用cpDNA與nDNA之分子標誌檢定後以PCoA分析可將種子園的營養系分成11群。

2016年高雄市六龜紅豆杉種子園雌株結實與胚培養苗數量。

The seeds and plants in vitro produced from seed orchard located at Liouquei, Kaohsiung City in 2016.

品種/種源 Variety/Provenance	營養系 Clones	種子數 Seed no.	飽滿種子 Full seed no.	綠/紅假種皮比 Green/red aril ratio	試管苗 In vitro plants	胚發芽率Embryo germination rate %
臺紅1號(Taiyew No.1)	TY1	33	31	4/27	31	100
新竹(Hsinchu)	SN4	4	2	0/2	2	100
	Nd1	81	77	1/76	77	100
	Nj7	8	4	0/4	4	50
苗栗南庄(Miaoli)	Nd4	3	3	0/3	3	100
	Nd6	43	6	0/6	6	100
南投碧祿溪(Nantou)	WX	40	38	0/38	38	100
中國(China)	Ch2	304	1	0/1	1	25

Application of Molecular, Chemical, and Morphological Markers to Reveal the Unique Varieties of *Taxus sumatrana* in Taiwan

Cheng-Kuen Ho, Shu-Hwa Chang, Chia-Chen Wu

There are some taxonomic ambiguities existing in *Taxus* Genus. *Taxus sumatrana* are distributed in Taiwan and belongs in Sumatrana Group or Wallichiana Group. Gao et al. (2007) statistically analyzed 50 populations of Wallichiana Group using cpDNA *trnL-F* and RFLP markers. The result showed that 17 trees sampled in northern Taiwan had 2 unique haplotypes that were differed from the other 49 populations grew in China and North Vietnam. Huang et al. (2008) reported that 9 Taiwan yew trees collected from central and southern Taiwan showed great genetic diversity. As reported by us in 2004, Taiwan and China yew populations were two distinct groups by using RAPD. We also obtained 2 new varieties Taiyew No.1 and No.2 to produce taxol and 10-DAB which is a precursor to semi-synthesize Docetaxol. One of the 2 varieties was applied for a plant variety

right in China. In 1997, we established a provenance and progeny test plantation of 6 provenances and a seed orchard containing 7 provenances with 43 clones, which have been fruiting for 3 years. These rich genetic resources helped us understand the genetic structure of Taiwan Yew by using cpDNA markers and SSR markers. This genetic information will detect genetic diversities in these 2 ex situ plantations and give specific markers of varieties, and in turn to protect the cultivations of pharmaceutical companies in both Taiwan and China. According the flowering survey of the seed orchard, we found 12 female clones and 11 male clones while 8 female ones produced fruits and developed seedlings by embryo cultures. The analysis of cpDNA and nDNA SSR/ITSR showed that the mating system could be divided into 11 groups based on PCoA analyses.



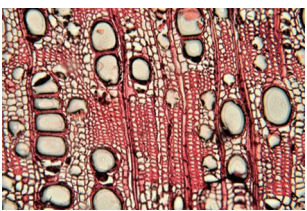
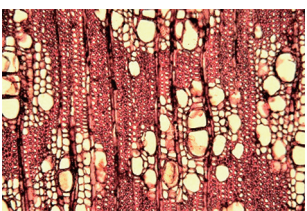
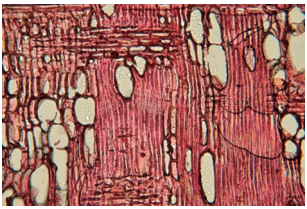
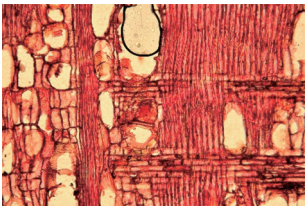
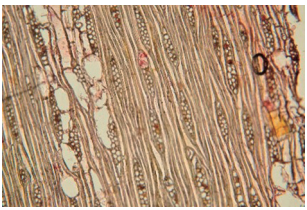
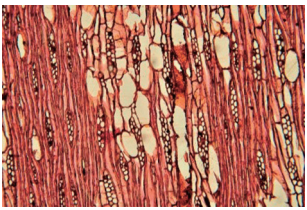
中海拔人工林更新及環境對樹木生長及健康性關係之研究

李志璇、林柏亨、林振榮

時代環境的轉變，社會對森林環境保育、生態多樣性及社會服務效益等日益重視，臺灣中海拔地區特別是一個重要的環境區域，我們能不能提供良好且健康的樹木給環境及社會大眾，同時，森林更新及不同的經營管理對樹木的生長及健康性是不是有影響，並沒有明確的答案，例如森林遊樂區提供了人類的活動及可能的健康效益，其中，遊樂區的經營管理及遊客活動是否對樹木的生長及健康性有影響，可能需要進一步探討，以提供管理樹木單位相關資訊參考。

因此，本研究之目的在進行中海拔人工林更新及環境與樹木健康關係之研究，以瞭解不同森林經營管理及環境、遊樂區內對森林中樹木生長及健康性的反應，以提

供優質森林環境的物理及化學因素，達成森林健康效益的社會服務效益，研究中針對不同樹木及不同經營管理的針葉樹及闊葉樹的生長及健康性進行檢查及評估，樹木多年來的生長反應可藉由樹輪研究來探討樹輪生長的質及量(樹輪寬度及密度)的反應，樹木健康性由樹木外觀檢查及無損檢測樹木內部的技術來調查及評估，最後，探討樹木診斷醫學，以瞭解樹木內外部的解剖、結構、防禦、適應性生長反應等特性，研究結果可以提供不同經營管理對樹木生長及健康性的影響，提供樹木健康性管理的建議，並建立樹木外觀檢查程序及方法，及無損檢測樹木的技術作為樹木經營管理的使用。

區域	正常木材	反應區
橫切面		
徑切面		
弦切面		

以光學顯微鏡觀察正常材及區隔化作用的細胞組織現象。

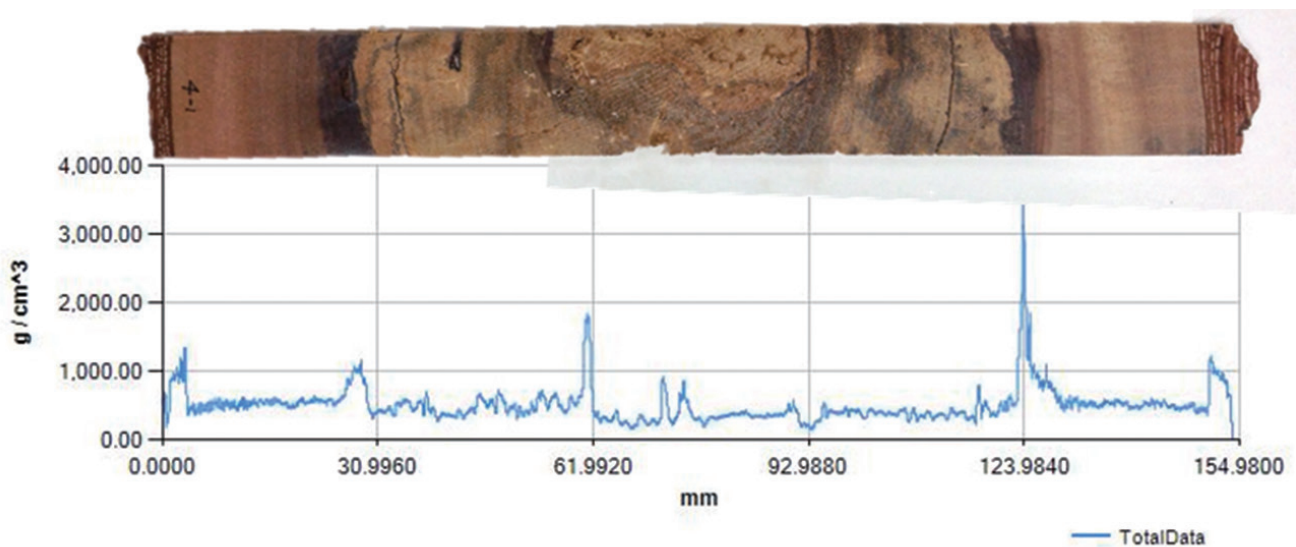
The cell structure of undamaged and CODIT reaction wood by optical microscope.

Study on the Relationship Between the Forest Regeneration, Environment and the Growth, Health of Trees in Medium Altitude Area

Chih-Hsuan Lee, Po-Heng Lin, Cheng-Jung Lin

Trends of the times change, forest conservation, biodiversity and social services benefits for people are increasing emphasis. Especially in medium altitude is an important environmental area in Taiwan. However, the effects of forest regeneration and different management on the growth and health of the trees, and there is no clear answer. For example, forest recreation area offers activities and possible human health effects. The effects and impact of forest management and tourist activity area on the growth and health of trees; may need to be further explored in order to provide reference information on tree management unit. The purpose of this study is to explore the relationship between the forest regeneration, environment and growth, health of trees in medium altitude area. The reactions of growth and health of trees in different forest management, environment, and recreation area are investigated in this research. Tree growth and health, and physical and chemical factors in forest envi-

ronment, and forest health effects are related for social service benefits. The inspection and evaluation of the growth and health of conifer and broadleaf tree in recreation area and different management practices are researched in this study. The growth reactions of trees are explored by tree ring method; included the quality (ring density) and quantity (ring width) of tree growth. The tree health grades are inspected and evaluated by visual tree assessment and nondestructive techniques. Furthermore, the anatomy, structure, defense, and adaptive growth reaction of softwood and hardwood are explored by tree diagnostic medicine. The information of results can provide the effects of different forest management on tree growth and health for tree health care management. Moreover, the tree health grades are built by the visual tree assessment form and nondestructive techniques of tree trunk for tree management.



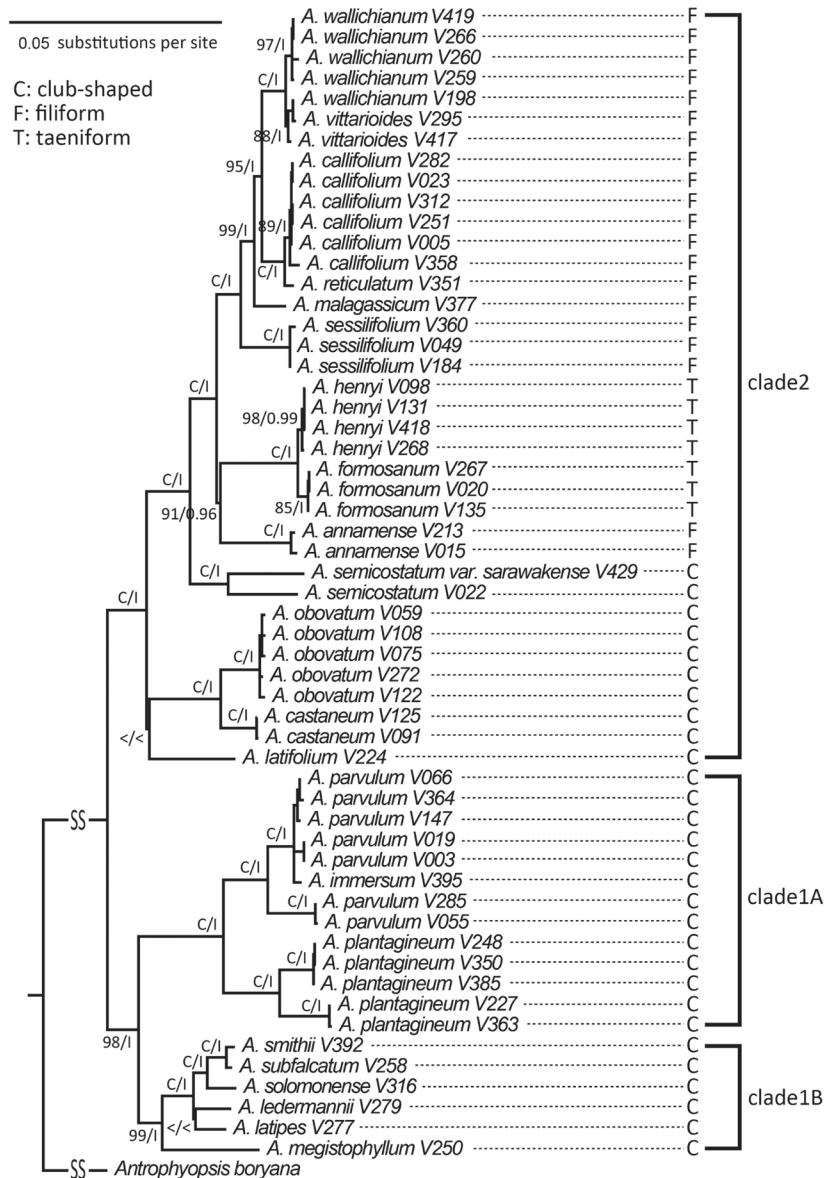
以X-ray樹輪密度法檢測腐朽、正常材、區隔化木材密度差異。
The wood density of decay, undamaged, CODIT wood by X-ray scanning method.



舊世界書帶蕨類群之系統分類研究

黃曜謀、陳正為

我們正在經歷地球史上的第六次物種大滅絕，生物多樣性之保育刻不容緩，然而在許多類群中缺乏跨地理區域的完整分類研究，生物多樣性之保育難以落實。書帶蕨類群主要分布於全球生物多樣性熱點之熱帶雨林地區，由於形態上的極度簡化造成分類的困難，其物種多樣性難以評估。除此之外其配子體世代具有特殊的“獨立配子體”現象，提供了研究蕨類適應與演化的良好材料，然而更深入的研究卻因為基本分類問題尚未釐清而受到阻礙。全世界書帶蕨類群約有300個學名曾經被發表，然而近代的分類學者普遍認為實際物種數不到一半，造成物種認知差異的主要原因包含了種間界線模糊與獨立配子體現象的存在，此一物種數目明顯的落差也突顯了分類訂正之必要性。本研究針對東亞地區包含中國、日本、韓國與臺灣之書帶蕨類群進行系統分類研究，藉由分子親緣關係分析與詳細之形態特徵比較，許多分類學上的問題得以釐清。主要成果包含探討廣葉書帶蕨複合種群 (*Haplopteris taeniophylla*) 內各分類群之形態變異與親緣關係。提供親緣關係上之證據支持前人將數個學名合併至書帶蕨 (*H. flexuosa*) 下之分類處理。另外也釐清了兩個長久以來被誤用之學名 (*H. amboinensis* 與 *Vaginularia paradoxa*)，與提供了三組形態上相似之物種間 (*Antrophyum formosanum* vs. *A. henryi*、*A. annamense* vs. *A. callifolium* 與 *H. elongata* vs. *H. ensiformis*) 之區別特徵。



根據4段cpDNA分子標誌序列(*chlL*、*matK*、*ndhF*與*trnL-F*)以最大或然率法重建之車前蕨類群親緣關係樹。

Phylogenetic tree for *Antrophyum* resulting from maximum likelihood analysis of a four-marker (*chlL*, *matK*, *ndhF*, and *trnL-F*) dataset.

Systematics of the Old World Vittarioids

Yao-Moan Huang, Cheng-Wei Chen

We are experiencing the sixth mass extinction and must waste no time in biodiversity conservation. However, the implementation is impeded by insufficient taxonomic studies across the entire geographical distribution of taxa. The vittarioids are mainly distributed in the tropical rainforests, which are also the global biodiversity hot spots. The taxonomy of vittarioids is not an easy task because of their simplified morphology. As a result, the assessment of their species diversity is still unavailable. Vittarioids also holds considerable promise for studying adaptation and evolution in ferns with their special “independent gametophyte” phenomenon. However, further research is hindered by the lack of well-resolved taxonomy. Although about 300 names have been published, less than half of them are recognized by modern taxonomists due to the indefinite species delimitation and independent gametophyte phenomenon, indicating the

need for a taxonomic revision. A systematic study of vittarioid ferns of East Asia including China, Japan, Korea and Taiwan is presented. Several new taxonomic insights are derived from well-resolved phylogenies and detailed morphological comparison. The morphological variation and molecular phylogenetic relationships among the taxa of the *Haplopteris taeniophylla* complex are presented and discussed. Molecular phylogenetic evidence supports the lumping of several morphological forms (each previously recognized as a species) under *H. flexuosa*. In addition, two historically misapplied names (i.e. *H. amboinensis* and *Vaginularia paradoxa*) and the species delimitation of three morphologically similar species pairs (i.e., *Antrophyum formosanum* vs. *A. henryi*, *A. annamense* vs. *A. callifolium*, and *H. elongata* vs. *H. ensiformis*) are clarified.



比較研究臺灣南北二地同一物種種子的休眠與發芽藉以評估氣候變遷之效應

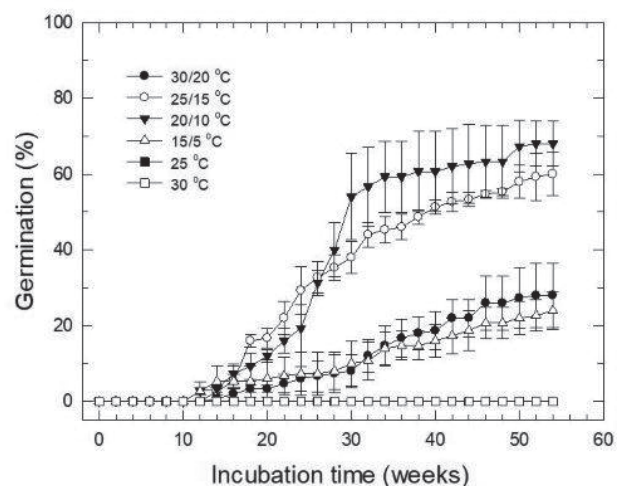
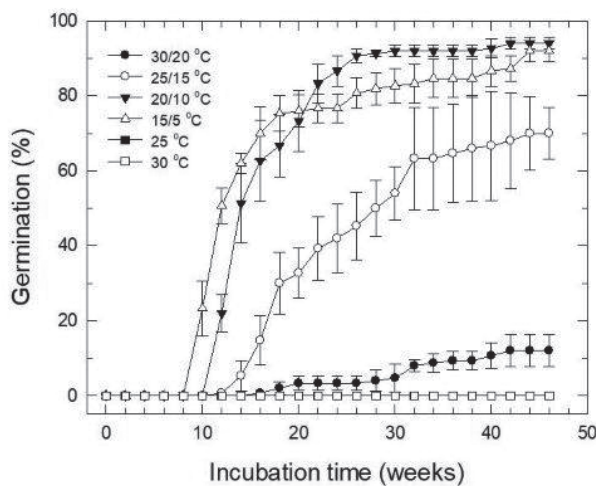
簡慶德、陳芬蕙

全球氣候會影響植物族群的更新，溫度和水不僅是植物擴展分布很重要的動力，也是驅動植物種子休眠和發芽不可缺少的元素。本計畫目的是選擇臺灣南北二地森林內原生的木本植物，忍冬科莢蒾屬呂宋莢蒾和冬青科冬青屬鐵冬青，進行二地種子的採集，比較休眠性和發芽情形，並進行果實荷爾蒙離層酸和激勃素分析定量。

採自南部呂宋莢蒾種子第8周開始發芽，以25/15°C和20/10°C之發芽率和發芽速率最高，20周後可達70%以上的發芽率；採自北部種子10周後開始發芽，仍以20/10°C之發芽率較高，但需40周才達到60%。所以南部熱帶採收的呂宋莢蒾種子休眠性較北部淺，容易發芽，但未來氣溫若升高，南部呂宋莢蒾種子之發芽率會下降，天然更新數量可能減少。採自南部鐵冬青種子10周後開始發芽，以25/15°C之發芽速率最快，其次是30/20°C，最

高發芽率84%；採自北部的種子20周以後才開始發芽，發芽最適溫度為20/10°C，發芽率80%，但溫度升高至25/15°C，發芽率急速下降，推測氣候變遷對北部鐵冬青族群之天然更新影響較大。

呂宋莢蒾和鐵冬青種子皆有形態生理的休眠。低溫5°C層積處理對南北二地的呂宋莢蒾種子發芽促進沒有效果，但可促進南北鐵冬青種子的發芽。分析呂宋莢蒾離層酸含量發現果肉離層酸濃度北部較南部高，但種子則相反，南部較高；鐵冬青也是如此，南部果肉和種子的離層酸含量都比北部高，此結果與原先認為北部應較南部高有出入，未來需要累積其他資料後再行討論。分析激勃素發現呂宋莢蒾和鐵冬青新鮮種子激勃素含量皆低，但推測種子發芽前之激勃素含量會提升。



呂宋莢蒾南部種子發芽百分率(左圖)及北部種子發芽百分率(右圖)。

Accumulative germination of *Viburnum luzonicum* seeds collected from southern Taiwan (left) and northern Taiwan (right).

Comparative Study of Seed Dormancy and Germination in Identical Species at Northern and Southern Taiwan for the Evaluation of Climate Change Effect

Ching-Te Chien, Fen-Hui Chen

Climate influences plant regeneration, and temperature and water supply (mostly by precipitation) are not only critical drivers for plants' distribution, but also mainly drive seed dormancy and germination. This project focuses on the seed dormancy and germination of two woody species, *Viburnum luzonicum* (Caprifoliaceae) and *Ilex rotunda* (Aquifoliaceae), which grow in different habitats, southern tropical and northern subtropical areas. Moreover, plant hormones ABA and GAs were analyzed.

Results showed that seeds of *V. luzonicum* from southern Taiwan began germinating after 8 weeks incubation and germinated to >70% after 20 weeks incubation. The optimum temperature was 25/15°C and 20/10°C. Seeds of *V. luzonicum* collected from northern Taiwan began germinating after 10 weeks incubation and germinated to 60% after 40 weeks incubation. The optimum temperature was 20/10°C. Thus, seeds from northern Taiwan have deeper dormancy than those from southern Taiwan. We speculate that the increase of temperature during global warming results in population decreases of *V. luzonicum* in southern Taiwan because seed germination decreases under higher temperature. Seeds of *I. rotunda* collected from southern Taiwan began germinating after 10 weeks incubation and seeds germinate to 84% after 20 weeks. However, seeds of *I. rotunda*

from northern Taiwan began germinating after 20 weeks incubation and seeds germinate to 80% with optimum temperature of 20/10°C. Obviously, dormancy of seeds from northern Taiwan is deeper than which of seeds from southern Taiwan. We speculate that climate change will influence northern population of *I. rotunda* but not southern one because germination speed of seeds from the northern rapidly decreased during temperature increase.

Seeds of *V. luzonicum* and *I. rotunda* have morphophysiological dormancy. Cold stratification does not affect seed germination of *V. luzonicum*, but it does promote seed germination of *I. rotunda*. Concentration of plant hormone abscisic acid from pericarps of northern *V. luzonicum* fruits was higher than those of southern fruits, but vice versa for seeds. Similar result from *I. rotunda* fruits, abscisic acid concentrations of pericarp and seeds from southern Taiwan were higher when compared with northern one. These results of abscisic acid levels cause us questions and require more data for answering in the future. Concentrations of gibberellins were low in fresh seeds of *V. luzonicum* and *I. rotunda*. We speculate that the concentrations of gibberellins will be increased when seeds are ready to germinate.



都市林生態效益評估與綠資源產業發展之研究

吳孟玲、劉則言

臺灣都市林生態資源豐富，卻未有完整機制評估生態系服務效益和價值，本計畫研究都市林生態效益價值，探討應用美國林務署所研發i-Tree系統於評估、監測及管理臺灣都市林生態系，設置以i-Tree模組為架構的臺灣都市林生態效益評估系統、評估網站、都市林效益評估資料庫及智慧平台，期望以此機制作為發展林業加值轉型之根據，初期以北部和南部公園進行效益評估樹木資料庫收集，調查臺北青年公園樹85株、大安森林公園樹65株及高雄都會公園139株，紀錄其基本特性如地點、物種、樹高、胸徑、樹冠高及冠幅等，並收集當地空汙及氣候資料，推算其環境影響程度及經濟價值，截至106年6月，已收集全國超過1,000筆資料，此外持續透過林木疫情中心資料庫、相關研究計畫、文獻等收集臺灣

都市林樹種學名、健康狀況及種植環境等資料，增加臺灣都市林樹木資料庫完整性，提供都市林生態效益評估最新資訊，並透過參訪美國林務署、日本綠化中心、日本樹木醫會及日本樹木醫學會，進行都市林效益評估系統及健康管理等相關研習交流，了解與學習建置科學性量化生態系評估機制與開發都市林服務綠資源加值。綠資源產業加值如「林園療癒」是近年日韓及歐美等其他國家林業轉型產業之成功模式，包含推廣森林療癒與都市森林食園，本計畫透過了解目前林園療癒科學研究之證據，拜訪西雅圖森林食園與社區園圃，從理論面、執行面及推廣面探討林園療癒的發展，以作為臺灣推廣林園療癒的基礎藍圖。



本計畫團隊拜訪西雅圖市政府之鄰里處，了解社區園圃與食物森林之運作模式，從理論面、執行面及推廣面探討都市林園療癒發展，以作為臺灣推廣林園療癒的基礎藍圖。

To understand the development of urban food forests and community gardens, our research team visited Beacon Food Forest and P-Patch community gardens. Introduced by the Seattle Department of Neighborhoods, the research team met different stakeholders of these places. In the process of sharing experience, not only was new knowledge generated but also new practice was discussed.

Study of Urban Forest Ecological Assessment and Industrial Green Resources Development

Meng-Ling Wu, Tse-Yen Liu

Taiwan is characterized by rich urban forests, but lacks a holistic approach to assess the benefit and value of the resource. To tackle the problem, our research team attempts to assess, monitor and manage the urban forest ecosystem of Taiwan by using i-Tree System (an ecosystem assessment tool developed by the United States Department of Agriculture (USDA) Forest Service). The major achievement includes a Chinese version of i-Tree System, an assessment website, urban forest database and intelligent platform. At the beginning of the project, eighty-five trees in Taipei Youth Park, sixty-five trees in Da An Forest Park and one hundred and thirty-nine trees in Kaohsiung Metropolitan Park were surveyed. Their location, species, height, diameter at breast height, crown height and width were collected. Given this data and local climatic information, we are able to calculate the economic value and environmental impacts of these trees by using the system. More than one thousand trees are surveyed and analyzed at the end of June, 2017. This system is later integrated with the database of Forest Disease Information Center in the Taiwan Forestry Research Institute. The purpose is to provide more complete and newest urban forest information including species, health conditions and environmental information and serve as nation-wide database for urban

forest ecosystem service assessment. Besides, our research team visited the USDA Forest Service, Japan Greenery Research and Development Center, Japan Tree Doctor Association and Tree Health Research Society. The process of knowledge exchange between the institutes helped set up the protocol of i-Tree system specific to the characteristics of Taiwan urban forests. In the future, the system will produce ecosystem assessment data, which will assist in analyzing the value and benefits of “Forest and horticultural therapy bases” in Taiwan. The forest and horticultural bases including forest therapy and food forest bases are viewed as a new type of forest economics in Japan, Korea and the United States of America. They are applied to improving people’s wellbeing and revitalization of local communities. Through literature reviews, this report summarized scientific research evidence on forest therapy and horticultural therapy and discussed the business model of the bases. The concept of food forests is rarely studied in literature. To increase the understanding of urban food forests, our research team visited Beacon Food Forest and P-Patch community gardens in Seattle, USA and met different stakeholders of these places. In the process of sharing experience, not only was new knowledge generated but also new practice was discussed.



臺灣里山環境之療癒功能與活動規劃研究

董景生、林鴻志、黎明儀、趙芝良、陳瑋苓

里山倡議強調在友善森林的社會與環境前提下永續生產，在地山村社區團體自主性的在兼顧生態保育、社會經濟與永續利用的平衡點中從事農林牧生產活動，同時也提供多樣化的生物棲地與生態系統服務功能。而近年由於社會人口老齡化、面臨各種壓力，產生了預防醫學的療癒需求，亦構成新的里山生態服務型態。本計畫旨在發揮森林的療癒功能，藉由規劃完善的森林環境、步道及活動遊程，透過在地參與現場引導解說，實際身體五感去體驗森林環境及其生命力，而達到恢復身心健康狀態的森林療癒效果，創造環境友善、生態旅遊、活絡里山在地經濟的新可能。

計畫中以蓮華池療癒基地作為示範點，透過在地資源盤點與規劃，進行里山地區的療癒活動模組化設計，藉由2次活動實際操作及問卷調查，評估活動規劃之效果，修正設計並建立完整的活動操作模式。問卷分析之活動效益評估結果，參與者對各項活動及解說均有4分(滿意)以上之滿意度，受測者活動後有正向情緒程度增加、負向情緒程度減少之改變，顯示適度的活動規劃有助於引導體驗者達到療癒之效果；參與者對於一日活動之收費區間，以支持100~400元者為多數約佔74%，以多數使用者最大消費意願估算尚不敷營運成本，如何提升使用者消費價值及意願，營運單位應審慎思考與研議，而參與者所提之意見亦作為各項活動檢討及修正之參考。



從森林活動中獲得身心療癒的效益。
Physical and psychological healing from forest activities.

The Study of Forest Therapy and Tour Design in Taiwan Following Satoyama Initiative

Gene-Sheng Tung, Hung-Chih Lin, Ming-Yi Li, Chih-Liang Chao, Wei-Lin Chen

Satoyama Initiative emphasizes sustainable production under the premise of friendly society and environment towards forests. The local communities engaging in agricultural production follow the principle of balances between ecological conservation, social economy and sustainable use. Satoyama landscape also provides a variety of biological habitats and many other services of ecosystem. In recent years, causing the need of preventive medicine for population aging and pressure increasing, Satoyama ecosystem provides the new service, forest therapy.

To display the healing function of forest, the forest environment, trails, experiential tours and interpretation proceeding were well-designed and arranged in this project. Liehuachih, as the Satoyama demonstration site, was made an entire inventory of all kinds of local resources. Activities were designed modularly for therapy. Through twice of practical activities and questionnaire surveys, the tour design was calibrated for better healing

effects, while the complete activity modules were built up.

Effectiveness of the activities assessed from the questionnaire showed that all participants satisfied with the activities and interpretation (satisfaction score >4, full=5). Participants after activities have increased the level of positive emotions and decreased the negative emotions. The changes show that moderate activity by planning helps guide participants to achieve the effects of healing. Most participants (74%) support NT\$100-400 to the toll interval for one day activity, but the income from major consumer willingness to pay would be not enough to cover the operating costs. The operating unit should carefully consider and research to enhance the consumer's value and willingness. The forest therapy within Satoyama would be the new opportunity to create the balance between friendly environments, ecotourism, and local industrial development.



煉製事業部高雄廠區及宿舍區特定紀念樹木健檢工作

邱志明、彭炳勳

臺灣中油股份有限公司煉製事業部高雄廠區及宿舍區所轄管理之特定紀念樹木共166株，林齡皆在80年以上，為了維護行道樹及都市居住環境的安全性，委託本所進行樹木健康檢測，樹木的健康度及安全性是息息相關的，更攸關人、樹木與環境之間的共存及利益平衡關係，亦是許多領域科學的綜合，本計畫是以非破壞檢測系統整合樹木健康度診斷方法，擬定一個適當的樹木安全性評估的流程，運用樹木目視診斷法、非破壞檢測

技術(包含應力波斷層影像評估、阻抗圖譜儀等)進行檢測，做為該區域特定紀念樹木保護管理之科學依據。經非破壞檢測技術取得腐朽孔洞率，配合樹木目視診斷法綜合評量結果，安全的有57株，佔34.3%，暫無危險40株，佔24.1%，有危險之虞20株，佔12.0%，危險建議移除有49株，佔29.5%，其中19株已因莫蘭蒂颱風過後嚴重損傷而移除。



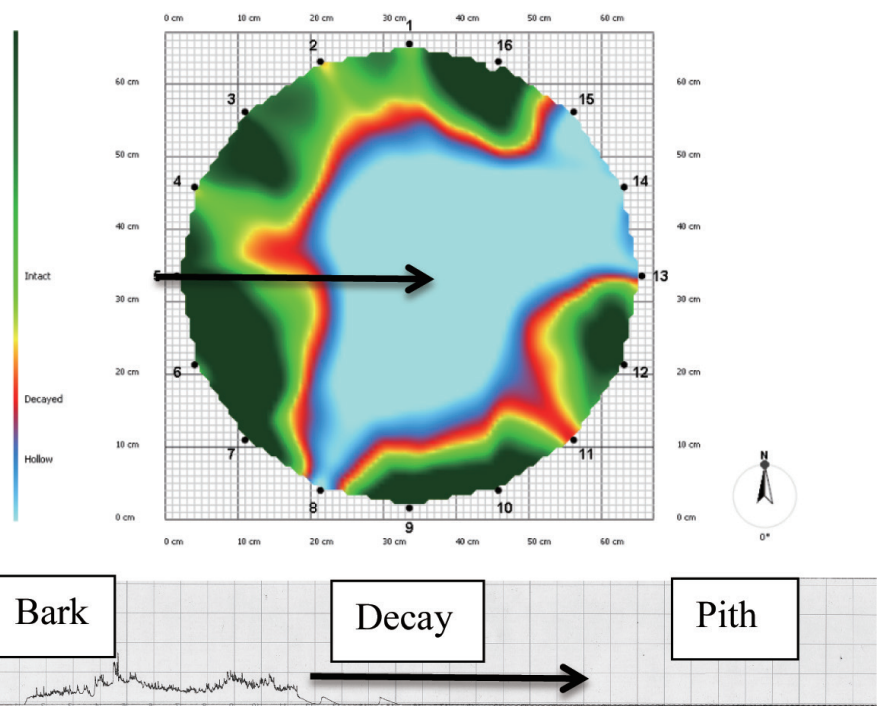
高雄市列管特定紀念樹木白千層及非破壞檢測儀器(A. ArborSonic 3D · B. IML, RESI F500-SX)。

Kaohsiung City management memorial-trees *Melaleuca leucadendron* and Non-destructive testing instrument(A. ArborSonic 3D, B. IML, RESI F500-SX).

The CPC Corporation, Taiwan, Refining Business Div. Memorial-trees Health Detection in Kaohsiung Factory Area and Hostel Area

Chih-Ming Chiu, Ping-Hsun Peng

In order to maintain the safety of street trees and urban living environment, The CPC Corporation, Taiwan, Refining Business Div. entrusted the TFRI to handle the memorial-trees health detection, with a total of 166 trees in Kaohsiung factory area and hostel area. The purposes of the study were to use non-destructive detection and visual tree assessment method for tree health detection, as the scientific basis for protection and management of memorial-trees in the region. According to the results of this study, there were 57 trees safety, accounting for 34.3%, 40 trees temporarily without risk, accounting for 24.1%, 20 trees risky, accounting for 12.0%, 49 trees in danger, accounting for 29.5%, of which 19 trees were destroyed due to typhoon Meranti.



ArborSonic 3D及RESI F500-SX對於木材材質皆具備良好檢測能力。
ArborSonic 3D and RESI F500-SX are well tested for wood.



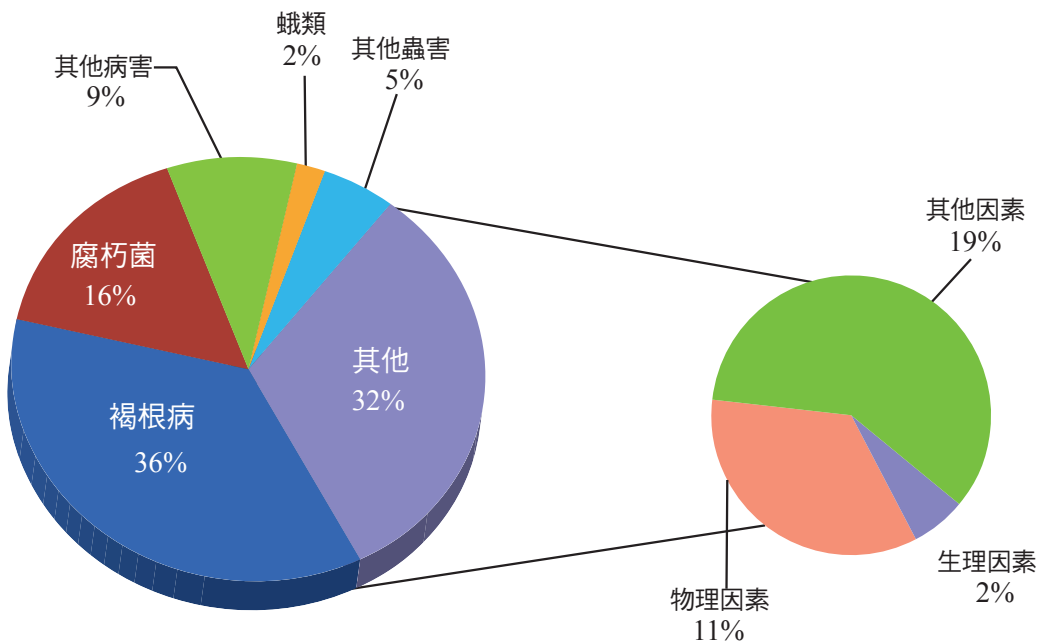
林木疫情監測及防治體系及重大病蟲害網路綜合管理研究

吳孟玲、徐孟豪、莊鈴木、劉則言

106年本計畫持續更新、維護、管理及開發農委會「林木疫情監測及防治體系」各網站系統。依體系分工架構協助林務局維護「林木疫情管制、策劃與防治中心」網站，擴充管理系統功能，以及強化林業試驗所「林木疫情鑑定與資訊中心」之網站功能，包括開放地圖範圍查詢功能、新增各縣市案件查詢及危害種類查詢等功能，並每日定時備份虛擬主機系統及網站資料庫，增加網站運作穩定及安全性，使二網站中心形成網狀聯繫，統合行政資源，協助落實國內林木疫情管制之效能。本計畫亦將「林木疫情鑑定與資訊中心」、「樹木褐根病調查

通報系統」及「筆筒樹疫情監測網資訊網」三網站彙整於統一資料庫，提升資料整合查詢、分析之效能，並將褐根病檢疫及林木非破壞性檢測等服務新增至「林木疫情鑑定與資訊中心」服務項目內，106年1月1日累計至12月31日，受理林木疫情之通報案件共計1,038件。整合「樹木醫學中心」與「林木疫情監測及防治體系」網絡，及其服務業務，開發樹木醫學中心相關網絡服務系統，並辦理樹醫座談會及研討會共計6場，以利防疫工作之推展。

疫情通報病蟲害種類分析



106年林木疫情案件統計分析。
Percentage of the various causes of threats to tree health in 2017.

Integration of the Systems on Forest Epidemic Diseases Monitoring and Prevention and the Network on Information of Important Tree Pests

Meng-Ling Wu, Meng-Hao Hsu, Ling-Mu Jaung, Tse-Yen Liu

The goal of the project is to provide continuous update, maintenance, management and development of “Forest Epidemic Diseases Monitoring and Prevention Systems”. According to the task division of the systems, we assist Forestry Bureau to maintain the website of “Forest pest control, planning and prevention center”, to expand managing functions, as well as to strengthen availability of the website, “Forest disease information center”. The service of website includes user-friendly search functions by geographical regions, cases of individual counties and causes of threats to tree health. Besides, daily scheduled backups of virtual host computer systems and website database are executed to maintain stability and safety for website operation. The two website centers are connected to form a network, by integration of administrative resources to help improve the pest control efficiency of forests. Moreover, the project combined

three databases including “Forest disease information center”, “Brown root rot investigation system” and “Fern trees disease monitoring system” to establish a combo-database for improvement of query data integration and performance analysis. The brown root disease quarantine and non-destructive detection techniques are added as new services of “Forest disease information center”. In the year of 2017, 1,038 cases were registered and accepted. We have even integrated “Tree medical center” with “Forest disease information center” and provide other extensive services. Totally, we hold six domestic and international symposiums and conferences on tree medicine to raise the public concern on better and efficient prevention and control of epidemic tree pests and diseases, and hopefully more trees will be benefited from our help and stay in good shape.



106年度金門縣林木病蟲害調查及防治建議

劉則言、吳孟玲

民國105年9月強烈颱風莫蘭蒂吹襲金門，在強風豪雨下，大量的林木風倒折損，使全縣生態綠廊環境劇烈改變，隨著棲地環境的變化，褐根病等林木病害亦易擴散，也使部分昆蟲大發生。為維護這得來不易的綠色資源，須透過完整的病蟲害調查，來擬訂合適的樹木健康管理策略。本計畫共完成金門全縣251株列管珍貴老樹，以及18條主要道路、40條次要道路、19處公園與29所學校所栽種林木的普查，藉此追蹤全縣風災後病蟲害發生地點及受害程度，並依照病蟲害發生的情形，給予適當的防治建議，包含非農藥防治方法及建議使用之農藥。其中251株列管珍貴老樹，並依本團隊所建立的樹木健康檢查表格，逐一進行病蟲害與健康狀況之評估，

建立每株樹木的健康診斷表，並依據診斷表的內容，作出風險評估及處置建議，以提供珍貴樹木的綜合健康管理參考。最後針對於《金門縣林木病蟲害防治手冊1》未調查到之金門地區重要病蟲害，包含11種蟲害及5種病害，將其主要寄主植物、危害方式、病徵、形態特徵、發病生態、生活史及防治方法等資訊彙整編撰，出版《金門縣林木病蟲害防治手冊2》，將可完整作為金門縣都市樹木病蟲害防治的參考。同時並透過辦理2場防治講習訓練，以及金門地區林木病蟲害調查資料庫的建置，來大幅提昇病蟲害的防治成效，藉此強化金門地區的林木健康。



出版《金門縣林木病蟲害防治手冊2》。

The manual 《Tree Pests and Diseases Control Manual in Kinmen 2》 was published.

Pests and Diseases Survey and Control Recommendation in Trees of Kinmen County in 2017

Tse-Yen Liu, Meng-Ling Wu

Severe typhoon Meranti hit Kinmen in September 2016, lots of trees were blown down during severe storm, and the disaster caused violently changes to environment. It increased the prevalence rate of brown root rot or other tree diseases and pests due to radical change. Therefore, to develop appropriate tree health management strategies by integrating pests and diseases surveys were necessary. In the project, a total of 251 precious trees, as well as trees on the 18 major roads, 40 secondary roads, 19 parks and 29 schools in Kinmen were surveyed. According to the pest or pathogen prevalence and occurrence sites, each control methods were provided, including non-pesticide control and the recommended pesticides. The health conditions of 251 precious trees were evaluated by the assessment form estab-

lished by the research team. Following that, the risk assessment and treatment recommendations were provided. Based on the results of survey, we described 11 pests and 5 pathogens which were not mentioned in the manual 《Tree Pests and Diseases Control Manual in Kinmen 1》. Our research team collected the information about the main host plants, morphology, symptom, life cycle and control methods of these species, and published the manual 《Tree Pests and Diseases Control Manual in Kinmen 2》. The two manuals would consider as the important references for urban forest health management in Kinmen. In addition, two training workshops were scheduled and the survey database was established to enhance the effectiveness of the tree health management in Kinmen.



2017 Annual Report



附錄 Appendix



106年度 1月—12月

1 JAN

- 105年度期末考察及107年度預定案審查於1月8日至10日及16日舉行，黃裕星所長偕同臺灣大學蔡明哲教授、中興大學曾彥學教授及本所委員等共10人組成之試驗林小組，至蓮華池、中埔、六龜、福山研究中心及信賢苗圃，藉由現地考察檢討，提昇試驗林的經營管理成效，並強化研究及示範功能。
- 本所於1月19日至5月28日在高雄與國立科學工藝博物館合辦「森林與我一永續·歲月·人間」特展。以實體場景、互動多媒體及劇場表演呈現「森林的永續管理」、「樹輪的歲月痕跡」和「資源的人間應用」等主題內容。展覽內容及展覽品由森林利用組、森林化學組、木材纖維組等林產三組人員提供；展期中由何振隆博士演講「樹木的內在世界—精油萃取及生活應用」專題，以森林於生活上的應用、心靈上的療癒等與民眾連結，展現都市林的重要性。

2 FEB

- 六龜研究中心為恢復遭民國98年莫拉克風災毀損崩塌之林地，於2月邀屏東科技大學郭耀綸老師，現地勘查多納溫泉溪流兩側試驗林風災崩塌地，調查結果發現目前多為演替初期的植物群落，屬速成良林，郭教授建議未來可種植適合的造林苗木，提高崩塌地惡劣環境下造林苗木的存活率。
- 蓮華池研究中心與國立清華大學、辜嚴倬雲植物保種中心等單位於2月8至10日合辦「未來地球生態學程」研習營。參加的30位學員分別來自清華大學、臺灣大學、東海大學及民間單位。課程內容兼具學術研究、生態倫理與解說、產業實務三者，並透過分組討論與實地操作讓學員們收穫滿滿。
- 蓮華池研究中心許原瑞主任於2月18日率領員工進行林地巡視與古道踏勘，以瞭解中心林地狀況與界線。沿著客家先民往來的百年姻親古道而行，由新山林道1號量水堰沿溪而上穿越原始林到達西界造林標竿，翻越山頭後續下出林，接到國姓鄉南港村涂家宅院。全長約2.5公里。於巨木獸徑之間遙想古道的歷史，規劃未來林業經營與林地管理的方向。

3 MAR

- 福山研究中心利用三月休園期間，由中心同仁帶領生態保育志工、清華大學曾晴賢教授團隊及宜蘭縣合作式中途班得安學園師生，以維持原棲地，並減少對動植物的干擾的友善方式施作，進行水生植物池清理工作，花費15個工作日，約清除12噸的水草，還給水生植物池的動植物們一個乾淨、舒適的環境。
- 本所木藝科學教室於3月3日開幕，祈望木藝科學教室能做為國產木材、竹材新產品之研發基地，及創作木藝作品的教育平台，提供親民的教育活動；並與國立科學工藝博物館合作，共同辦理推廣國產材利用系列活動，邀請百位孩童及家長一同體驗親子木工樂趣。

- 本所為響應植樹節活動，與新竹市政府環保局、梧桐基金會、臺鐵新竹火車站、宏利生化科技股份有限公司等多個單位，於3月9日在新竹火車站前聯手舉辦「帶小樹苗去旅行」活動。本所提供臺灣原生樹苗5種，計1,000棵，置於可生物分解之環保提袋中發送給民眾；並由本所同仁提供樹木種植、養護、照顧等諮詢，以及宣導照顧小樹苗的正確觀念與方法，以提高種植樹木的存活率，並進一步達到減碳及改善空氣品質之目的。
- 太麻里研究中心與林務局知本工作站、大王國小、太麻里鄉公所、臺東環境教育中心及金針山休閒農業區等單位，於3月10日在臺東縣大王國小舉辦「植樹護林+守護臺灣」贈苗活動。活動內容計有茄苳樹下音樂會、憑發票或廢電池換苗、植樹活動、愛樹宣導、農特產展售、DIY及環教主題闖關體驗等。民眾紛紛響應並熱烈參與，總計發放2千餘株苗木，另將活動所募得之發票全數轉贈臺東縣關懷生命保護協會及臺灣穿山甲保育協會挹注公益活動，以善盡社會責任。
- 恆春研究中心解說志工於3月21日至22日於臺東知本、太麻里研究中心辦理增能移地訓練；增加恆春志工對於知本森林遊樂區植物的認識，並由劉一新主任、范義彬博士、黃俊元助理研究員介紹太麻里研究中心的保育成果及分享森林資源調查的經驗。

4 APR

- 本所為推廣樹木專業知識與培訓ISA國際認證樹藝師之專業人才，與社團法人台灣都市林健康美化協會、國立臺灣大學園藝暨景觀學系合作，利用四月份至五月份之周末，分別在所內及羅東林管處開設樹藝研習班，各招收50名學員，由具ISA認證的攀樹師及所內同仁予以專業授課，上課含結業考試時數共計80小時。
- 本所與高雄市政府農業局於4月25日在高雄市政府鳳山行政中心辦理珍貴老樹保護研討會，帶領現場140位民眾共同了解高雄市內珍貴老樹現況及健康狀況，並針對老樹未來疫病的防治及樹藝技術的應用做專業的交流與討論。

5 MAY

- 蓮華池研究中心協助彰化縣政府於5月5日在蓮華池舉辦「環境教育議題教師增能研習活動」，活動經由野外參訪與實作，提升各校環境教育推廣人員之專業能力；參加人員係來自國中小老師、校長共40位，並於活動結束後贈予40株殼斗科苗木，期望藉由教師帶回校園種植，進一步推廣原生物種之栽植。
- 本所於5月9至10日在蓮華池研究中心，舉辦林園療癒基地推動小組106年度第一次工作會議，內容係由保護組及蓮華池研究中心共同規劃，經由「林園療癒步道」與「森林保健步道」二種不同功能之林園療癒活動，並結合森林食療、勞動、美育、體驗等森林生活家理念，以落實於林園療癒中，達到寓教於樂的效果。
- 中國科學技術大學手工紙研究所所長湯書昆、李憲奇教授等一行人於5月15日參訪本所手工紙研究室，由本所木材纖維組徐健國助理研究員與退休人員王國財先生接待並進行交流，以了解兩岸手工紙的現況及人才傳承等問題，並進行「華人地區手工紙現況」計畫之田野調查。

- 本所創新育成中心為累積實務經驗、增加進駐廠商之交流及促進異業結盟，與水產試驗所於5月17日在屏東生物科技園區辦理2017創育廠商標竿學習觀摩會，並前往亞太水族中心、芝林企業有限公司觀摩參訪，與會業者大多表示對於農企業營運管理及未來發展方面獲益良多。
- 本所特邀美國伊利諾大學景觀系William Sullivan教授兼系主任、韓國建國大學環境健康科學系 Sin- Ae Park助理教授以及多位園藝、景觀等國內外學者，聯合台灣造園景觀學會於5月22日在本所森林研究大樓12樓國際會議廳舉辦「2017農林景觀之療癒國際研討會」。以農林景觀之療癒為主題，介紹國內外療癒型景觀照護資源相關工作之發展現況、作法與經驗。出席響應交流人數共有313人。
- 植物園組於5月份發現植物園中出現農委會防治名單上之入侵鳥種－白腰鵲鴝之鳥巢，此鳥疑似為寵物逸出；經由植物園組向臺北市政府提出移除申請，於25日移除並妥善安置，藉此並向民眾宣導正確寵物飼養觀念，減少外來種的引入。

6 JUNE

- 本所為評估林園療癒促進身心健康之效果，由森林保護組及福山研究中心於6月2日在福山共同舉辦一日林園療癒生態體驗活動。研究團隊帶領青少年進行大自然五感資源體驗，並利用心理情緒量表(POMS)，評估青少年參與療癒活動前後七大情緒種類：緊張、憤怒、疲勞、憂鬱、自尊、活力與困惑的變化；本次活動的參加者皆明顯獲得正面能量。
- 本所植物園組董景生組長及林奐宇助理研究員於6月25日至30日，參加在瑞士日內瓦召開的2017年國際植物園保育聯盟年會(Botanic Gardens Conservation International, BGCI)，於會議中發表報告，並與全世界各國的植物園研究學者及管理者進行交流，同時向與會成員介紹臺灣的環境特色與保育現況成果。
- 由國際森林管理委員會(FSC™)授權的第三方驗證公司於6月26至29日至蓮華池研究中心進行年度審核，本次的年度審核順利通過，並為蓮華池研究中心繼2016年取得第一張國有林森林經營(FM)驗證合格證書之後，再度通過審核。

7 JULY

- 本所圖書館於7月14日至28日在技術服務大樓辦理二手書「好書交換活動」，藉由二手書籍的資源分享再利用，不僅推廣惜福理念，進而提升所內閱讀風氣，今年共募集1,680冊書籍，活動近200人共襄盛舉；本所及各研究中心亦設置9個漂書點，持續舉辦漂書活動，本年共計漂書357冊。
- 本所於7月22日至8月31日在宜蘭縣中興文創園區舉辦「森林·生活」特展，使民眾瞭解森林研究與生活有著密不可分的关系。此展係由森林利用組、森林化學組、木材纖維組等林產三組人員提供六大針(闊)葉樹、木(竹)炭利用、環保材、樹木29種姿態、森林芳療、苦茶油、植物防蚊、木藝品研發等相關研究成果供民眾參觀及體驗。

8 AUG

- 六龜研究中心於8月3日邀請廖俊奎博士為中心同仁及志工進行R語言的教學與分享。對田野調查工作所攜回的大量數據資料做整合統計與分析，並做出明確易懂的圖表，對研究人員的工作有極大的助益，能事半功倍，聽者所獲良多。
- 本所於8月5日至10月15日在台北植物園南門町三二三，展出范承宗老師的竹工藝作品，「從傳統學創造」竹工藝特展，期間更舉行講座與工作坊；范先生的作品係為將傳統技藝智慧應用於新設計；工作坊則用植物園區內的自然素材加工，讓參與民眾也能在手作中體驗傳統的技藝之美，特展參觀人次1萬4千餘人，工作坊共計60人參加。
- 本所與臺灣義田公益協會、鑫昌二胡藝術琴坊及啄木鳥工作室，於8月11日至9月17日在台北植物園欽差行臺共同舉辦「琴森藝眾—宋國昌胡琴暨劉邦漢木藝創作展」。此次展出作品係為胡琴大師宋國昌先生所製作的胡琴，以及木藝創作家劉邦漢先生的木藝術作品，並於期間辦理四場推廣活動。總計展場參觀約1萬1千餘人次，除了讓民眾深入了解木藝製品之美，並拉近了森林與人的距離。
- 本所試驗林經營小組於8月24至26日，至太麻里、六龜及恆春研究中心，進行106年度「試驗林示範經營計畫」業務考察。
- 本所與墾丁國家公園管理處、滿州鄉生態旅遊觀光促進會等，於8月25日在小墾丁渡假村簽訂合作備忘錄，未來預計將連結本所恆春研究中心里德苗圃之「一號母樹園」，與滿洲鄉的「滿茶古道」推行在地生態旅遊，以實現里山精神，並活化在地社區的文化記憶。
- 蓮華池研究中心與荒野保護協會於8月26至27日，共同辦理生態研習營及蛙類調查團培訓，共計38人報名。藉由調查認識蛙類及其生態環境，提升學員的研究概念、實務操作能力與環境保護意識。
- 監察院召集人章仁香委員率5位監察委員，由農委會翁章梁副主委等人陪同，於8月31日至9月1日至本所福山研究中心進行業務巡查。由本所黃裕星所長、林務局楊宏志副局長、農委會國際處林家榮副處長，針對林業試驗所、林務局等二機關當前業務及政府所推農業之南向政策進行簡報，並進行交流討論。會後監察委員們實地參訪福山植物園，對植物園的生態環境及動植物就地保育，印象深刻且讚譽有佳。

9 SEP

- 本所與中華林學會及國立宜蘭大學於9月7日至8日在所內共同舉辦「森林資源保存與利用研討會」，研討會內容包括繁殖育苗、林木遺傳、林產物利用、育林技術以及森林生態等五個方向，發表專業論文共42篇。除國內林業專家外，另有福建農林大學共11位師生共同參與，使雙方對於兩岸森林資源現況以及經營模式有更進一步的了解。



- 本所與中興大學實驗林管理處於9月9日至17日在惠蓀林場共同舉辦第十屆「竹文化節」活動。所內由育林組、森林利用組與蓮華池研究中心前往設置「木工坊成果展示」及「林下經濟」之展覽攤位，分別介紹所內木藝科學教室之木文化推廣成果，與林下經濟的永續經營與作業規範。
- 中埔研究中心為推廣安全農業、友善農耕政策，於9月10日及27日，分別在本中心環境保護林研究大樓(嘉義市)及四湖海岸植物園(雲林縣西湖鄉)，辦理「食農教育推廣講習活動」，藉由此活動宣導，讓一般民眾及學校教師了解並認識植物的無毒栽種概念，及基本的植物養護照顧方法，兩場共計172人次參加。
- 本所由經濟組吳俊賢研究員代表，於9月18-22日參加2017年國際林學組織聯合會第125週年大會，會議於德國佛萊堡舉行，共有5個主題，包括(1)森林對於人、(2)森林及氣候變遷、(3)對於更綠色未來的森林及以森林為基礎的產品、(4)生物多樣性、生態系服務及生物入侵、(5)森林、土壤及水的相互作用等。本次大會有來自全世界89個國家、2,100人與會，交換最新的森林科學研究成果與心得。
- 本所為推廣我國盆景藝術文化以及發展多方向森林植物之療癒功能，與臺灣植物及樹木醫學學會、臺北市盆景協會於9月23日至27日在台北植物園欽差行臺共同舉辦「2017漢風盆景展」，展出雅石與盆景共16件。並於9月24日在本所森林研究大樓12樓國際會議廳舉辦「盆景技術研討課程」，吸引超過150位愛好者參與。
- 本所陳燕章組長兼中華林學會秘書長與林務局張岱組長及各大學教授等12人於106年9月23日至29日赴大陸重慶參加由中國林學會主辦之「2017兩岸林業論壇」。論壇主題為森林經營，並以人工林經營管理、非法木材查緝管控與森林認證為子議題，兩岸共計14位學者發表專題報告。會議前並先參訪重慶市縉雲山、南山、璧山、四面山及萬州三峽庫區等地，其造林、森林保育以及水土資源保護之經驗均值得仿效。
- 本所為積極推廣農業技術及建立國際化專業產業鏈貿易洽商平台，於9月28日至30日在臺北世貿南港展覽館辦理「2017年亞太區農業技術展—臺灣農業技術形象館」，以期擴大臺灣農業技術拓展新南向國家之商機。展覽重點展示全球運籌計畫10項重點科技產業，本所技術服務組與森林保護組配合參展之技術項目為樹木褐根病快速檢測套組，該套組為褐根病菌之快篩工具，可應用於林木褐根病診斷及疫情監控，強化防治管理。本技術現已技術移轉授權1家業者。
- 本所為展出創新且可技轉業界運用的亮點技術，提高農業科技國際宣傳的機會，並加速農業科技研發成果商品化及產業化，於9月28日至30日在臺北世貿中心展覽館辦理「2017臺北國際發明暨技術交易展」，本所技術服務組、育林組、植物園組與蓮華池研究中心配合參展技術項目共有4項，包括原木段之高溫乾燥技術、具護膚機能之紅豆杉品系與栽培採收、牛樟種質復育園的建立及新植小果油茶園之豐產模式建立技術，會展期間於展區同時辦理紅豆杉舞臺造勢活動，成功達成研發成果推廣之任務。
- 本所台北植物園於9月30日舉行「植物探險·百年榮光」—台北植物園腊葉館開幕暨佛里、早田紀念碑復原典禮。此舉係正式宣告腊葉館及兩座極重要紀念碑修復重

塑及重新整修完成。並於10月21日及11月14日舉行《早田文藏》、《佛里神父 Jean Faurie》新書發表會。

10 OCT

- 為響應10月4日世界動物日，本所森林保護組、環境護育協會與臺北市政府等單位，於大安森林公園辦理「臺北世界動物日，中央護動護樹行動」活動，本所設置「昆蟲生物多樣性」及「樹木健檢大進擊」等兩個攤位。讓參與活動的民眾在認識昆蟲及保護樹木的活動中，引發對森林保護相關知識的好奇及自然生態的關心。
- 本所於10月11日至18日由黃裕星所長率團赴德國巴伐利亞自治邦參訪，以永續農業、畜牧業、林業經營以及黑森林地景保護等議題為目標，研究當地的自然地景與傳統混農林業地區之振興案例，透過與當地官方機構交流互動，蒐集相關資料，並於10月12日與在巴伐利亞自然保育與地景經營研究院副院長Peter Sturm簽訂雙邊合作研究備忘錄，推動生態系管理教育推廣與研究。
- 考量線上的銷售通路具有傳播快、宣傳力強、更可增加網購消費之年輕客群等特性。本所農業創新育成中心10月16日在食在安市集—景安店舉辦展售記者會，以新的電商通路行銷模式，展示多家育成廠商之優質產品，並邀請民眾現場品嚐參觀選購。
- 本所與台糖公司、國立暨南國際大學於10月17日至20日在台糖埔里園場烏心石造林地，舉辦平地造林中後期撫育工作坊，以工作假期的方式邀請小競材設計競賽隊員、各鄉鎮林業承辦員等有興趣的人參與，由所內同仁帶領實際操作，學習撫育技巧與管理概念，營造優質健康的林地。共計40人參與報名。
- 本所偕同國立教育廣播電臺、臺灣聲景協會於10月21日在台北植物園共同舉辦「荷塘畔，浮聲錄夢」聲景體驗活動，回顧了自1998年與本所合作的「傾聽森林」活動，係為於荷花池畔發想，並製播20年的環境教育廣播「自然筆記」節目，活動藉由了解早期植物學家發現臺灣植物自然史的故事，傾聽學習聲景生態學的研究，再次回到池畔細聽聲景。透過這次活動，讓參與民眾在園區各樣的聲景之中更深度的體驗自然。共74人參加。
- 恆春研究中心協助水利署北區水資源局於10月23至24日在恆春熱帶植物園內辦理環境教育訓練課程。透過本所同仁的解說導覽，使水利署北區水資源局的學員們了解南部高位珊瑚礁的地質及動植物生態，並且參觀港口工作站區內培育及保存的特用及稀有樹種。
- 本所黃裕星所長與陳燕章組長及林務局林華慶局長等8人於10月29日至11月2日赴韓國首爾參加由韓國主辦之「第四屆APEC林業部長會議」。會中討論如何增加亞太地區森林覆蓋率，以達成APEC 2020森林覆蓋率目標；打擊非法採伐與相關貿易之合作；創造以森林為基礎之森林就業機會，以及生態旅遊與森林公益以及森林未來展望。會後並參訪三星創新博物館與韓國民俗村。

- 本所吳家禎助理研究員代表本所參加，於10月30日至11月4日在韓國首爾舉辦之亞太森林研究聯合組織(APAFRI)執行委員會會議及第10屆傳統林業知識文化國際研討會。執行委員會會議除了國際交流之外，更審核彙報一整年度已經完成以及預備完成的重要會議，後續研討會係為進行森林文化與知識交流。

11 NOV

- 本所林業經濟組林俊成組長等3人與農林相關學研單位，於11月4日至18日參加在德國波昂所舉行的聯合國氣候變化綱要公約第23次締約方大會、京都議定書第13次締約方會議暨巴黎協定第1屆第2次締約方會議。本次會議重點中在國家自定預期貢獻(NDCs)生效後的執行與發展、巴黎協定規則書(rulebook)草案內容、永續發展目標(Sustainable Development Goals, SDGs)等與農林業部門之間的聯繫與發展動態，對我國研擬氣候變化之相關農林業政策與行動方案至關重要。就會議所得，建議國內可規劃建構多元、穩定及高效率之生質廢棄資材回收管理系統，提供永續綠能供需、落實農業循環、實現與提高農業循環經濟產值，亦有利森林資源之活化與農山村再生。
- 本所與花蓮林管處之平地森林志工於11月10日在大農大富園區舉辦「食物森林操作暨野生動物監測實務工作坊」，由植物園組與森林保護組派員講解、並帶領平地森林的志工實際操作關於食物森林的栽植及監測相機的架設技巧。
- 福山研究中心分別於11月19日至20日及12月13日至14日，協助新北市政府高灘地管理處辦理濕地珍水志工增能活動，共124人參加。透過水資源與生態教育課程訓練，提升知識及技能。
- 為活化林地使用、推展公眾參與森林經營模式，本所林業經濟組於11月26日至27日在高雄市桃源區寶山二集團地區的原住民保留地、洪國華先生之農牧用地，以共享經濟觀念辦理「共享林地創意發想營」。邀請20位自願參與森林經營者及周遭有興趣開放共享的林地地主，進行林地勘查，並以此地為例共同討論森林經營的型態與其可能性。此活動以配合林地財產權開放及管理權釋出為長遠目標，希望引入社會大眾或公民團體，與林主共同來設定經營目標，並提供多元化森林生態系統服務。

12 DEC

- 本所與國立臺灣工藝研究發展中心於12月13日，在森林研究大樓12樓共同舉行「2017年國際天然染研討會」，內容主要係為介紹目前日本、韓國及臺灣天然染產業之發展現況，探討產業推動之策略，邀請產學相關專家及有興趣之民眾前來參與，共140人報名，旁聽者眾。
- 12月15日至107年2月14日於台北植物園南門町三二三展出「來自森林的禮物—小徑材及枝梢材創意木工藝童玩展」，此展係利用森林撫育修剪下來的枝梢材與小徑材，經由簡單裁切、鑽孔、及組裝後成為適合小朋友的木玩具，此展可讓民眾瞭解森林資源，進而支持使用臺灣的林產品，參展人次1萬5千餘人。

- 本所於12月20日舉行國家林木種原庫揭牌啟用典禮，林木種源庫正式啟用；種源庫除了持續推動本土植物種原資源的保存利用外，未來更將全力發展各項林木生物技術；同時朝向分子育種的目標前進，希望可以有效率的培育臺灣優良林木，建造更健康優質的臺灣森林。
- 本所與臺北市政府、荒野保護協會、國立臺灣大學昆蟲學系等單位合作，於12月29日於本所國際會議廳辦理「臺北市公園生態化研討會」，期望對於都市公園的經營管理，能由以往景觀、遊憩、休閒等基本需求，提升為達到育樂、環境美化及減少環境空氣汙染等功能，使民眾瞭解都市林的價值，進而達到「生態宜居城市」的目標。
- 本所與木道雲集、長物志木工藝術工作室及臺灣義田公益協會，於12月29日至107年2月25日在台北植物園欽差行臺共同舉行「賞心悅木—木道雲集聯展」，此係展出15位木藝師之作品，包含家具及車床木藝等約60件，展覽呈現森林資源和林木利用的多種可能性，更為現代都會生活注入自然質樸、萬物和諧的意境，活動總計約2萬人次參觀。

Major events

JANUARY—DECEMBER 2017

JANUARY

- On Jan. 8 to 10 and 16, the 2016 year-end review and 2018 preplanning sessions were held. A ten-member experimental forest council consisted of Director General Y. Star Huang, Profs. Ming-Jer Tsai of NTU and Yen-Hsueh Tseng of Natl. Chung Hsing University and TFRI researchers visited Lienhuachih, Chungpu, Liouguei, Fushan Research Centers and the Hsin-siang Nursery. Through on-site inspection and review to enhance the management efficiency of the experimental forests and to strengthen the research and demonstrative functions.
- On Jan. 19 to May 28, the TFRI cooperated with the National Science and Technology Museum in Kaohsiung and held a special exhibition of “Forest and me—sustainability · age · inquiry.” The exhibition engage real scene, interactive multimedia and theatrical rendition of the themes such as “Sustainable management of forest,” “The aging traces of tree rings,” and “Resource utilization you asked.” The contents and items of the exhibition were provided by the Divisions of Forest Utilization, Forest Chemistry and Wood Cellulose staff. In the exhibition interim, Dr. Chen-lung Ho gave a lecture on “An inner world of trees—extraction of essential oils and their application in livelihood.” The theme linked with people through application of forest to livelihood and also the healing and therapeutic of spirit to demonstrate the importance of urban forestry.

FEBRUARY

- In order to restore the damaged forestland which suffered devastation during the 2009 Typhoon Morakot, the Liouguei Research Center in February invited Prof. Yau-Lun Kuo of Natl. Pingtung University of Science and Technology to inspect the sites of landslide along the Dou-na Hot Spring flow area of the experimental forest. The survey results indicated that at present, the flora were mostly in an early stage of succession. To foster the growth of superior forest, Prof. Kuo suggested that suitable afforestation species should be planted to increase the sapling survival rates of such landslide areas of adverse environment.
- The Lienhuachih Research Center cooperated with Natl. Tsinghua University, Dr. Cecilia Koo Botanic Conservation Center etc. and hosted on Feb. 8 to 10 an “Ecologic course for the future earth” study camp. A total of 30 students who came from Tsinghua University, National Taiwan University, Tunghai University and other private sector, partake the course. The course content encompassed academic research, ethics of ecology and interpretive industrial practicalities. Through group discussion and on-site practice to allow the student a rich learning experience.
- On Feb. 18, Chief of Lienhuachih Research Center, Mr. Hsui led staff to inspect forestland and ancient foot trails so as to fully understand the conditions of the forest and its boundary. The party followed an ancient marriage trail which was used for centuries by the early Hakka settlers, from the No. 1 water measuring weir of Hsin-shan forest road the party proceeded upstream and penetrated a primary forest to the west-bound afforestation marker, after surpass the mountain top and proceeded to exit the forest, connecting to Tu’s garden of Nankang village, Kuoshing Township. The total trail was about 2.5 km. While in the forest, they were reminiscing the ancient history while planning for the future forest management and forestland custodian role and direction.

MARCH

- Took advantage of recession period of March, the Fushan Research Center undertook the task of cleaning the aquatic pond with center staff, ecological conservation volunteers, a team led by Prof. Chyng-Shyan Tzeng of Tsinghua University, Ilan County Cooperative Mid-way Der-an School teachers and students. A habitat-friendly practice was undertaken to preserve the original conditions and to reduce disturbances to animals and plants. A total of 15 work days were spent, and about 12 tonnes of aquatic weeds were removed to restore the aquatic pond to a clean, comfortable environment.

- The woodwork science classroom of the TFRI initiated on March 3. Through the instilling of the woodwork science classroom, we hope to become a base for R&D novel domestic timber and bamboo products, and to be an educational platform of woodwork arts, providing parent-children education activities. The classroom also cooperated with the Natl. Science and Technology Museum to promote a series of domestic wood utilization activities. A hundred children and parents were invited to experience the pleasure of the woodwork.
- The TFRI in responding to the Arbor Day activities; cooperated with the Environmental Protection Bureau of Hsinchu City, Wu-tong Foundation, Taiwan Railway Co. Hsinchu Train Station, Hongli Biochemical Technology Inc. etc. and hosted a “Take a sapling to travel” activity on March 9 at the Hsinchu Station. The activity provided 1,000 of the 5 indigenous tree saplings which were placed in biodegradable handbags to be dispatched to the general public. The TFRI staff on site provided inquiry service regarding plant raising, tending and information on how to take care the saplings, so that tree survival rate could be increased and attaining the objective of carbon reduction and air quality improvement.
- On March 10, The Taimalee Research Center, together with Jhiben Workstation, Forestry Bureau; Da-wang Elementary School; Taimalee Township Office; Taitung Environmental Education Center and Jingchenshan Recreational Area, held a “Planting trees + protecting Taiwan” seedling donation activity at Da-wang Elementary School. The activities included a concert under an autumn maple tree; exchanging used invoices or waste batteries for tree seedlings, planting trees, love of tree promotion, special produces display and sale, DIY and environmental educational question challenges etc. A total of 2,000 seedlings were distributed with eager participation of the general public. The collected invoices were donated to the Life Conservationist Association of Taitung County and Taiwan Pangolins Conservation Association to foster public welfare.
- The interpretive volunteers of the Hengchun Research Center conducted transit training to Jhiben Forest Recreational Area and Taimalee Research Center. The training aimed to enhance the knowledge of the volunteers toward plants of Jhiben Area. Chief of Taimalee Center, Dr. I-hsin Liu, Dr. Yi-bin Fang, and assistant researcher Chun-yuan Huang introduced the conservation achievements of the center and shared their experience in forest resources survey.

APRIL

- In order to promote professional tree knowledge and training of ISA internationally certified arboriculture professional, the TFRI cooperated with Taiwan Arboriculture Society, and Horticulture and Landscape Dept. of Natl. Taiwan University to engage weekends of April and May and hold at TFRI and Luodong Forest District an arboriculture course. Each of the session admitted 50 students and professional courses were given by ISA certified tree climbers and TFRI staff, the course, including the final exam lasted a total of 80 hours.
- On April 25, the TFRI together with Agricultural Bureau of Kaohsiung City held a precious old trees protection symposium so that the public shall understand the present status and health of the precious old trees in the municipality, and to have professional discussion on the pests and diseases prevention and arboricultural technology applications. A total of 140 persons took part in the activity.

MAY

- On May 5, Lienhuachih Research Center assisted Changhua County Government and held a “Teachers’ capacity enhancing for environmental education issues” course. Through field visit and practices, the activity aimed to enhance professional capability of environmental education promotional personnel of various schools. The participants came from elementary school teachers and principals for a total of 40 persons. After the course, the students were each given a seedling of Fagaceae family tree. It was hoped that the teachers will bring it back to plant on campus so as to further promote planting of indigenous species.

- On May 9 and 10, Lienhuachih Research Center held the first working session of the 2017 forest therapy base promotion group. The content was planned by Division of Forest Protection and the Center, and through “forestscape therapy trail” and “forest for health trail” two kinds of different therapeutic functions that combined forest food therapy, exercise, aesthetics and personal experience of forestscape livelihood idea. Thus allowing accrument of recreational effect through educational activities during the forest therapy sessions.
- On May 15, the Dean of Handmade Research Institute of University of Sciene and Technology of China, Prof. Shukun Tang, and Prof. Hsien-chi Lee visited the handmade paper laboratory of TFRI. Mr. Jiann-gwo Shyu and a retired member Mr. Kuo-tsai Wang of the Division of Wood Cellulose received the guests and cordial exchanges were made to understand the status of handmade paper in both sides of the strait and professional heritage issues. A “Chinese region handmade paper status” project was initiated as a field survey.
- On May 17, the TFRI Incubation Center together with Taiwan Fishery Research Institute in a bid to gain practical experience, foster exchanges with resident businesses and promoting alliance of different trades held an innovation goalpost learning session of 2017 at the Pingtung Agricultural Biotechnology Park. The party went to Yitai Operational Center for Aquaculture and Jy Lin Trading Com. for a tour. The participants all felt to have learnt much about management of agro-business and the future developments.
- On May 22, Prof. and Dept. Head William Sullivan of Landscape Dept., University of Illinois, and Assistant Prof. Sin-Ae Park of Dept. of Environmental Health Science, Konkuk University, Korea and several domestic and foreign horticultural and landscape scholars partook in the “2017 International Landscape Therapy Conference.” Based on therapeutic theme of agricultural and forestry landscape, pertinent development of domestic and foreign therapeutic landscape caring resources, practices and experiences were presented. A total of 313 persons participated in the conference.
- The Division of Botanical Garden in May discovered bird nest of white-rumped shama (*Copsychus malabaricus*), an invasive species on the COA watch list. This bird was suspected to be escaped pet. After the Division applied to Taipei City Government to remove the bird, the bird was caught and safely relocated on May 25. In the meantime, the public was made aware the correct concept of pet-raising so as to reduce the introduction of alien species.

JUNE

- In order to evaluate the efficacy of forestscape therapy on promotion of physical and spiritual wellbeing, on June 2, the Division of Forest Protection and Fushan Research Center held a one-day forestscape therapy ecological experiencing activity. The research team led youths to immerse in experiencing 5-sense of nature, and used profile of mood states (POMS) to gauge seven emotional genre: tension, rage, weary, sad, ego, vigor and perplex changes before and after participating in the forestscape therapy for the youths. All the participants expressed experiencing gaining of positive energy.
- On June 25 to 30, Dr. Gene-sheng Tung, Head of Division of Botanical Garden and Mr. Huan-yu Lin, Assistant Researcher took parts in the 2017 Annual Conference of Botanic Gardens Conservation International (BGCI). During the conference, they interacted with botanic garden researchers and managers of different countries and presented papers. They presented to conference goers the features of Taiwan’s environmental features and conservation status.
- On June 26 to 29, a third-party certification company empowered by International Forest Stewardship Council (FSC™) went to Lienhuachih Research Center for the annual review. The review was smoothly passed. This was the second time since 2016 when Lienhuachih first obtained a forest management (FM) certificate of the national forest to pass the review.

JULY

- On July 14 to 28, the library of TFRI held a “second-hand books exchange” activity at the Technical Service Building. Through sharing and reutilization of second-hand book resources, the activity aimed to promote appreciation of our endowment and to further habit of reading in the institute. This year, a total of 1,680 books were mustered and nearly 200 person-times took parts in the exchange. In addition, at TFRI and research centers a total of 9 book drifting stations were setup to let books be adrift. In the year, 357 books were drifted.
- On July 22 to Aug. 31, the TFRI held a “Forest · Live” special exhibition at the Chung Hsing Culture Creative Park of Ilan County. The show aimed to instill in the public the close-nit relationship between forestry research and our live. The exhibition was organized by the staff of Divisions of Forest Utilization, Forest Chemistry and Wood Cellulose, and was based on research results on the themes of 6 great timber species, utilization of wood and bamboo charcoals, environmentally friendly wood, 29 postures of trees, forest aromatherapy, oil tea Camelia seed oil, mosquito repellent based on plant material, and woodcraft studies etc. for the general public to view and experience.

AUGUST

- On Aug. 3, the Liouguei Research Center invited Dr. Chun-kuei Liao to the center and taught R language to center staff and volunteers. With regards to the vast amounts of data collected in field work, the language allows integration, statistics and analyses works and facilitates the production of clear and understandable tables and charts. Researchers thus can have a great tool for their study and the students were satisfied with the session.
- On Aug. 5 to Oct. 15, TFRI held a “Learning creativity from tradition” bamboo craft special exhibition by Mr. Cheng-tsung Feng at 323 Nanmending, inside Taipei Botanical Garden. In the interim, lectures and workshops were also held. Works of Mr. Feng applied traditional techniques and wisdom to novel design. The workshops, on the other hand, engaged natural material from the Botanical Garden for craftwork. The participating public could thus experience the beauty of hand-on traditional craftwork. The special exhibition drew 14,000 person-times of visitors and the workshops had 60 participants.
- On Aug. 11 to Sept. 17, the TFRI together with Taiwan Yi-tian Public Welfare Association, Xin-chang Erhu Art, and Woodpecker Workshop held at the guesthouse of imperial envoy a “Kuo-chang Sung Erhu Master and Bon-han Liu woodcraft creations show.” This event showcased Erhu master Mr. Sung’s handmade erhu, and woodworking arts of woodcraftsman Mr. Liu. Four promotional activities were held in the interim. In total about 11,000 person-times visited the show, which let people to profoundly understand beauty of woodcraft and thus held forest closer to mankind.
- On Aug. 24 to 26, the experimental forest management group of TFRI visited Taimalee, Liouguei, and Hengchun Research Centers to conduct business inspections of 2017 experimental forest demonstrative management project.
- On Aug. 25, at Kentington Resort, the TFRI signed a memorandum of cooperation with Kenting National Park Administrative Office, Ecological Tourism Promotional Association of Manjhou Township. In the future, the “No. 1 mother tree garden” of Li-der Nursery, Hengchun Research Center of TFRI shall combine force with “Manjhou ancient trail” of Manjhou Township to promote on-site ecological tour in a bid to realize the Satoyama Initiative and to activate the cultural memory of local community.
- On Aug. 26 and 27, Lienhuachih Research Center together with the Society of Wildness held an ecological

study camp and frogs survey training corp. A total of 38 persons attended. Through surveying, the students learnt frogs and their ecological niches, thus enhancing the research concept of the students, practical filed practice capability and sense of environmental protection.

- On Aug. 31 to Sept. 1, Convener of the Control Yuan, Ms. Jen-hsiang Chang led five members of the Control Yuan and accompanied by an entourage of Deputy Minister Mr. Chang-liang Ong, visited Fushan Research Center. The Director General Dr. Y. Star Huang, Deputy Chief of Forestry Bureau Dr. Hong-chi Yang, and Deputy Chief of Dept. of International Mr. Jia-jung Lin presented briefings of TFRI and Forestry Bureau to the visitors about current business models and compliance to the New Southward Initiative of agriculture of the government and conducted exchanges and discussions. After the meeting, the Control Yuan members gained a great impression and heaped praises after touring the ecological environment and its in-situ conservation of the flora and fauna.

SEPTEMBER

- On Sept. 7 and 8, TFRI together with Chinese Forestry Association and Natl. Ilan University held at TFRI a “Conservation and utilization of forest resources symposium.” The content of the symposium included 5 general themes of propagation of seedlings, tree genetics, forest products utilization, silvicultural technologies and forest ecology. A total of 42 professional papers were presented. In addition to the domestic professionals, 11 teachers and students of Fujian Agriculture and Forestry University also participated. The symposium fostered better understanding of bilateral forest resources and management models across the strait.
- On Sept. 9 to 17, the TFRI co-hosted with the Experimental Forest Administration Office of Natl. Chung Hsing University the 10th “Bamboo culture festival” activities at Hui-Sun Forest, Nantou County. Supported by Divisions of Silviculture, Forest Utilization, and Lienhuachih Research Center, setup exhibition stalls of “wood and bamboo workshop display” and “Understory economy” to respectively introduce woodcraft and wood culture promotional results of TFRI, and the regulations of sustainable management of understory economy.
- On Sept. 10 and 27, the Chungpu Research Center in a bid to promote safety agriculture and friendly tilling policy held at Chiayi Environmental Protection Forest Research Center, Chiayi City; and Sze-hu Coastal Botanical Garden, Sze-hu Township, Yunlin County the “Food-agriculture educational promotional course.” Through the instillation of the activity, the general public and school teachers were led to recognize non-toxic culturing concept of plants, and basic methods of caring for plants. A total of 172 persons attended the two sessions.
- On Sept. 18 to 22 represented by Dr. John Chin-shien Wu, Senior Researcher took part in the 2017 IUFRO 125th anniversary conference at Freiburg, Germany. The congress had 5 themes, including: (1) forest for people; (2) forests and climate change; (3) forests and forest-based products for a greener future; (4) biodiversity, ecosystem services and biological invasion; and (5) forest, soil and water interactions. The conference drew 2,100 participants from 89 countries, gathered together to exchange the newest forest science research achievement and insights.
- On Sept. 23 to 27, in a bid to promote bonsai art and culture and to develop multifaceted forest plant therapeutic function, together with Plant and Tree Medicine Society of Taiwan, and Taipei Bonsai Association, TFRI co-hosted a “2017 Chinese bonsai exhibition” at the Guest House of Imperial Envoy, Taipei Botanical Garden. On display there were 16 items of fancy stone works and bonsais. In addition, on Sept. 24, at the 12th Fl. international conference hall of forest research building, a symposium on “bonsai art techniques” was held with 150 aficionados participated.
- On Sept. 23 to 29, Mr. Yen-chang Chen, a division head of TFRI and General Secretary of Chinese Forestry Association, Mr. Dai Chang, a division head of Forestry Bureau and professors from various universities formed a delegation of 12 persons and flew to Chongqing, China to attend the “2017 Cross-strait forestry

forum” hosted by Forestry Association of China. The themes of forum were forest management, with subthemes of plantation management, illegal timber interdiction and control, and forest certification. Fourteen scholars from cross-the-strait presented papers. Before the forum, the party visited Jingyunshan, Nanshan, Bishan, Szemienshan of Chongqing City, and the Three-Gorge Dam area of Wanchou regions. Their experiences on afforestation, forest conservation, and protection of soil and water resources were items that we can learn from.

- On Sept. 28 to 30, the TFRI in a bid to promote agricultural technology and establishing an international products chain trading platform, held the “2017 Asia-Pacific agricultural technology exhibition—Taiwan agricultural technology image hall,” at Taipei World Trade Center Nankang Exhibition Hall. The exhibition was hoping to expand Taiwan’s agricultural technology in the “New Southward” policy opportunities. The exhibition emphasized 10 important technological products industry. The Divisions of Technical Services and Forest Protection matched with a tree brown root rot rapid inspection kit which could be applied to diagnose and control diseases conditions monitoring, allowing strengthened interdiction and prevention. The technology had drawn one transfer to a private business.
- On Sept. 28 to 30, in order to showcase innovation and transferable technologies and the opportunity to enhance international promotion of agricultural technologies, as well as to hasten product commercialization of agricultural technological R&D results, TFRI took parts in the “2017 Taipei international invention and technological trading show.” The Divisions of Technical Services, Silviculture, Botanical Garden and Lienhuachih Research Center matched with 4 items of technological achievements, including high temperature drying technique of log sections; cultivation and harvesting of *Taxus* strains possessing cosmetic and skin care function; germplasm restoration park establishment for *Cinnamomum kanehirae*; and method of establishing a rich-production model of newly planted *Camellia brevistyla* garden. During the exhibition, a Taiwan yew stage show was held to successfully attained promotion of the results.
- On Sept. 30, the Taipei Botanical Garden of TFRI held a “exploration of plants—hundred years of glory” ceremony to commemorate the commencement of Taipei Herbarium and stele restoration of Pere Faurie and Dr. Hayata. This ceremony formally announced the completion of restored herbarium and restoration and remodeling of two very important memorial steles. Furthermore, on Oct. 21 to Nov. 14, new books on “Bunzo Hayata” and “Pere Urbain Jean Faurie” were presented.

OCTOBER

- In response to the world animal day of Oct. 4, the Division of Forest Protection, TFRI with Asia Environmental Protection Association, and Taipei Municipal Government established a “Taipei world animal day, Central protection of animal and trees action” activities. The TFRI setup two booths on “insect biodiversity” and “tree health inspection team.” Participating citizens took parts in the activity could be induced to be curious about forest protection pertinent knowledge and caring of natural ecology.
- On Oct. 11 to 18, the Director General Dr. Y. Star Huang led a group to Freistaat Bayern, Germany for a visit. The objectives were on sustainable agriculture, animal husbandry, forest management, landscape protection of the Black Forest region. They examined the cases of revitalization of the traditional agroforestry. Through exchange and interaction with local organizations, useful information was collected. And on Oct. 12, a bilateral cooperative MOU was signed with the Deputy Direction Dr. Peter Sturm of Bavarian Academy for Nature Conservation and Landscape Management to promote ecosystem management education and research.
- In view that on-line sale has advantages of rapid transmission, strong promotional effect, and can further increase youths to engage on on-line purchases, the agricultural innovation incubation center of TFRI held a press conference at Jing-an shop of food safety, using novel e-commerce sales model to display several good quality products of incubational businesses. The general public was invited to taste on-site and purchase the products.

- On Oct. 17 to 20, the TFRI together with Taisugar Co. and Natl. Chi Nan University held a plain afforestation mid- and late-stage tending workshop at the Oushilin Afforestation site, Puli Taisugar Park. The workshop invited small-diameter logs design competition teams, afforestation staff of various townships and persons interested in related activity to participate as a working holiday mode. TFRI staff led the practical operation, gave tending techniques and management concept on how to produce forestland of superior health. A total of 40 persons attended.
- On Oct. 21, the TFRI together with National Education Radio and Soundscape Association of Taiwan held a “On the lotus pond, sound record a dream” soundscape experience activity. The event replayed “Listening to forest,” a cooperative product with TFRI which was initiated along the lotus pond. Twenty years of environmental education broadcasting on the “Natural footnotes” program was also played. Through the activity, we’ve learnt how early botanists discovered natural history of Taiwan flora; listening to the study of soundscape ecologic studies and return to the lotus pond side to the soundscape. Through this activity, the participating public gained a deeper experience of various sounds of the botanical garden. Seventy-four persons attended.
- On Oct. 23 and 24, the Hengchun Research Center assisted Water Resources Agency Northern District to held environmental educational course in the Hengchun Tropic Botanical Garden. Through the interpretive guided tour, the staff of the agency learnt southern uplifted coral atoll’s geology and flora and fauna ecology. They also visited Gangkou Workstation to see the cultivated and preserved special and rare trees there.
- On Oct. 29 to Nov. 2, the Director General Dr. Y. Star Huang and Division head Mr. Yen-chang Chen and Director General of Forestry Bureau, Mr. Hua-ching Lin flew to Seoul, Korea to attend the “fourth APEC meeting of forestry ministers.” In the meeting, efforts to increase forest covers in Asia Pacific regions were discussed in order to achieve the 2020 forest cover goals; how to strike at illegal timber harvest and the related trade issue cooperation, as well as ecotourism and forestry welfare and the future of forest outlooks were also discussed. After the meeting the party also visited Samsung Innovation Museum and Korean Folk Village.
- On Oct. 30 to Nov. 4, represented by assistant researcher Mr. Chia-chen Wu, TFRI took part in the executive committee meeting of Asia Pacific Associations of Forestry Research Institutes (APAFRI) and the 10th International Conference Traditional Forestry Knowledge and Culture in Asia held in Seoul, Korea. In the executive meeting, in addition to international exchanges, compilation and review of annual report on completed and preparing important meetings were conducted. The follow-up symposium was for the purpose of forestry culture and knowledge exchange

NOVEMBER

- On Nov. 4 to 18, Division head Dr. Jiunn-cheng Lin and two other persons together with other agricultural and forestry research personnel took parts in the United Nations Framework Convention on Climate Change UNFCCC) 23rd Conference of the Parties (COP 23), together with 13th Convention Member Parties (CMP 13) and 2nd Paris Agreement (CMA1-2) rolled in one at Bonn, Germany. The emphasis of the conference focused on upon nationally determined contributions (NDCs) the conditions of execution and development, the rulebook draft contents of Paris Agreements, sustainable development goal (SDGs), and liaisons and developmental trends of among agriculture and forestry sectors. These are critical to our establishing agricultural and forestry policies and action plans to cope with climate change. Based on the conference insights, we proposed to construct multiple, stable and highly efficient biomass waste resources recycling management system, to provide green energy sustainably, to consolidate agricultural recycling, to realize and enhancing agricultural recycling economy which are conducive to the activation and vitalization of mountainous agricultural villages.
- On Nov. 10, the TFRI and the plain forest volunteers of Hualien Forest District of Forestry Bureau held a “Food forest operation and wildlife monitoring practicality workshop” at Danongdafa afforestation area. Staffs from Divisions of Botanical Garden and Forest Protection were dispatched to interpret and lead plain forest volunteers

on practical operations of planting of food forest and techniques of setting up of monitoring cameras.

- On Nov. 19 to 20, and Dec. 13 to 14, Fushan Research Center in two occasions assisted High Riverbank Construction Management Office, New Taipei City to handle capacity enhancing activities for wetland water protection volunteers. A total of 124 persons attended. Through the water resources and ecologic education course training, participants increased their knowledge and capability.
- In order to activate forestland use, promote public participation in forest management model, on Nov. 26 and 27, the Division of Forest Economy held at an aboriginal reserve, Baoshan Second Group Region, Taoyuan Zone, Kaohsiung City, and Mr. Kuo-hwa Hong's pastoral land a "Shared forestland creative thinking camp" based on the concept of shared economy. The camp invited volunteer to participate in forest management and 20 forestland owners interested in sharing to proceed with forestland survey, and using the land as an example to mutually discuss forms and possibilities of shared forest management. The objective of the activity is to match with the opening of forestland property right and release of management authority so as to attract social public or citizen's group to mutually set up management goals and thus providing multifaceted forest ecosystem services.

DECEMBER

- On Dec. 13, the TFRI together with Natl. Taiwan Craft Research and Development Institute co-hosted a "2017 International natural dyeing symposium," at the 12th Fl. International conference hall, TFRI. The main contents introduced natural dyeing developments in Japan, Korea and Taiwan, explored industrial promoting strategies. Academic and industrial experts in the field and interested general public were invited to participate. A total of 140 persons registered for the event.
- From Dec. 15 to Feb. 14, 2018, the TFRI held a "Gifts from the forest—small diameter logs and twigs for creative wooden toy show" at 323 Nanmending, Taipei Botanical Garden. The show used pruning and small-diameter logs from forest tending and through simple cutting, drilling, and assembling to create wooden toys suitable for children. The show allowed people to understand forest resource and support further Taiwan's forest products. The participants were estimated to be 15,000 persons.
- On Dec. 20, the opening ceremony of National Tree Germplasm Bank was held, and the bank was formally activated. The bank, in addition to persistently promoting preservation and utilization of indigenous plant germplasm resources, in the future, they'll be used for various tree biotechnological developments, and thrust toward molecular genetics goals. We hope to efficiently cultivate superior trees for establishing healthier Taiwan forests.
- On Dec. 29, the TFRI cooperated with Taipei Municipal Government, the Society of Wildness, the Dept. of Entomology, NTU etc. held a "Symposium for ecologicalization of Taipei City parks," at the international conference Hall, TFRI. The symposium wanted to refocus management of municipal parks from the former basic demands of landscaping, recreation and relaxation to attain educational, entertaining, environmental beautification and abatement of environmental air pollution functions. So that the general public shall understand the values of urban forest and eventually reach the goal of "ecologically suitable to live city."
- From Dec. 29 to Feb. 25, 2018, the TFRI together with Woody Crafts Gathering, the Records of Splendid Objects Studio, and Taiwan Yi-Tian Welfare Association held at the Guest House of Imperial Envoys, Taipei Botanical Garden an exhibition of "Pleasant woodworks—woody crafts combined exhibition." The exhibition displayed 15 works of wood craft masters, including furniture and lathed wood crafts for a total of 60 works. The exhibition demonstrated the multiple possibilities of forest resources and wood utilization, which infused natural elegance to the modern municipal living and exerted globally harmonized mode. The activity drew twenty thousand visitors.

國內外學者專題演講

日期	講 題	演講者	職稱	服務機關
05/10	環境監測展望：中央山脈汙染物長程傳輸研究	蘇銘千博士	教授	東華大學自然資源與環境學系
05/11	附生植物和它們的產地—Tree Project的前世今生	Dr. Jennifer Sanger & Steven Pearce	生態學博士	澳洲塔斯馬尼亞大學
12/04	日本人工林林業機械化之經驗	酒井秀夫 教授	名譽教授	日本東京大學
12/04	日本之森林生質能源	吉田美佳 博士	特別研究員	日本筑波大學

科技研究專題演講

日期	講 題	演講者	職稱	服務機關
01/23	臺灣穗花杉有用品系選育與利用	鍾振德	副研究員	育林組
01/23	具綠美化潛能稀有樹木之蒐集與復育	楊正釗	副研究員	植物園組
03/27	藥用植物種源蒐集及利用	李沛軒	助理研究員	蓮華池研究中心
03/27	生物技術應用於植物種質的保存	張淑華	研究員	育林組
05/01	臺灣松露之栽培與產業化研究	陳正豐	副研究員兼主任	太麻里研究中心
05/01	蛀食性林木蟲害之監測、鑑定及防治技術之建立	汪澤宏	副研究員	森林保護組
06/05	無損壞技術應用於腐朽損害樹木的檢查及評估	林振榮	研究員兼組長	森林利用組
06/05	不同生長基質種植牛樟菇之成分比較	張東柱	研究員	森林保護組
07/03	高經濟林產品生產鏈關鍵技術之研發	何政坤	研究員兼組長	育林組
07/03	國內主要木竹產品消費流向分析	陳溢宏	聘用助理研究員	林業經濟組
09/25	臺灣主要實木產品進口運輸之碳排放量估算	林俊成	研究員兼組長	林業經濟組
09/25	山村地景對物種、群聚及生物多樣性效應評估	葛兆年	研究員兼組長	森林保護組
10/30	紙質文物加速老化與自然老化相關性之研究	徐健國	助理研究員	木材纖維組

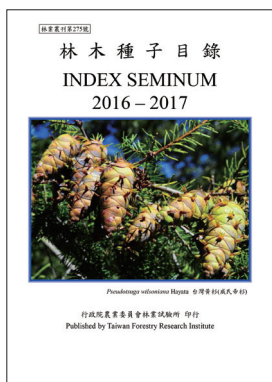
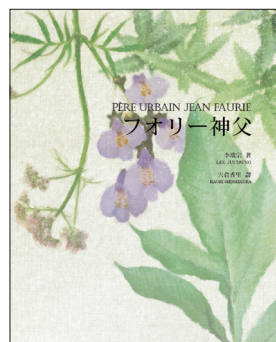
科技研究專題演講

日期	講 題	演講者	職稱	服務機關
10/30	林木枝葉生產森林精油之研究	葉若鋆	助理研究員	木材纖維組
12/04	林產經濟振興策略規劃計畫	邱祈榮	副所長	副所長室
12/04	太麻里研究中心臺灣水鹿族群監測	劉一新	研究員兼主任	福山研究中心
12/25	牛樟種子苗育苗造林體系之建立	楊正釗	副研究員	植物園組
12/25	山葵健康種苗之育成與栽培技術之研發	黃怡菁	副研究員	育林組

出版品

圖書類 | 林業叢刊

刊號	題名	作者	出版日
271	早田文藏BUNZO HAYATA (中文版)	大場秀章 (汪佳琳譯)	4月
272	早田文藏BUNZO HAYATA (日語版)	大場秀章	4月
273	佛里神父 Père Urbain Jean Faurie (中文版)	李瑞宗	4月
274	佛里神父 Père Urbain Jean Faurie (日語版)	李瑞宗 (穴倉香里譯)	4月
275	INDEX SEMINUM 2016-2017 林木種子目錄 2016-2017	楊正釗	6月
276	2017森林集水區研討會	曾俊偉、陳乃維	6月
277	行政院農業委員會林業試驗所105年度年報	林業試驗所年報編輯委員會	11月
279	浮雲有紙藝	徐健國	12月

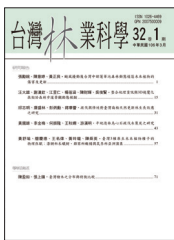




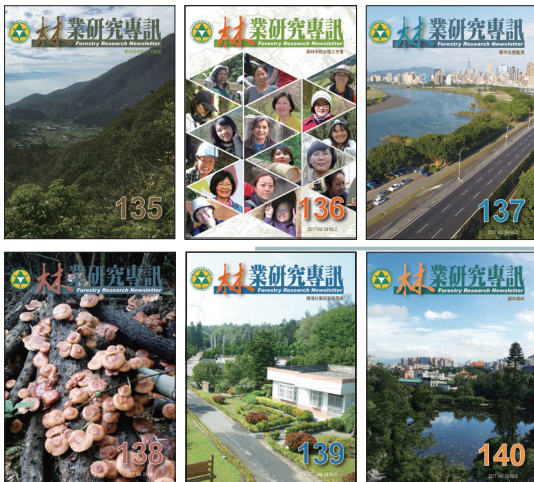
非圖書類 | 推廣摺頁

刊號	題名	作者	出版日
139	林業試驗所臺北植物園腊葉館(中)	林鴻志、董景生	3月
140	林業試驗所臺北植物園腊葉館(英)	林鴻志、董景生	3月
141	林業試驗所臺北植物園腊葉館(日)	林鴻志、董景生	3月
142	樹木風險評估	吳孟玲	9月
143	樹木健康評估	吳孟玲	9月
144	室內美化及空氣改善之原生植物開發	張乃航	11月
145	森林管理有認證 森林功能有保障	林裕仁	12月

非圖書類 | 期刊



刊名	卷期(總號)	總編輯	出版日
台灣林業科學	32卷1期	林朝欽	3月
	32卷2期	林朝欽	6月
	32卷3期	林朝欽	9月
	32卷4期	林朝欽	12月
林業研究專訊	24卷1期	林裕仁	2月
	24卷2期	林裕仁	4月
	24卷3期	林裕仁	6月
	24卷4期	林裕仁	8月
	24卷5期	林裕仁	10月
	24卷6期	林裕仁	12月



非圖書類 | 影音光碟



題名	製片/策劃	出版日
林業試驗所106年度技術影片 走入山林輕旅行—秘境扇平 搶救銀葉板根 松材線蟲大解密 增華之裝	陳燕章	12月

技術移轉案件

技術名稱	單位	創作人	件數	授權種類	年限
樹木危險性的檢查及診斷技術—應力波2D檢測技術	利用組	林振榮	3	非專屬	5
樹木注射技術	森林保護組	吳孟玲	2	非專屬	5
節能省工之苦茶籽冷乾法	植物園組	楊正釗	1	非專屬	2
臺灣紅豆杉種子苗培育技術	植物園組	楊正釗	2	非專屬	2
具護膚機能之低毒性紅豆杉品系繁殖與栽培採收技術	育林組	何政坤	3	非專屬	5
木藝創作組裝材料包及成品	經濟組	王培蓉	1	非專屬	2
提高小果油茶異交率促進果實生產之優良家系新植技術	蓮華池研究中心	許俊凱	2	非專屬	2
牛樟優良組織培養品系(A1)	育林組	何政坤	1	非專屬	5
山葵種子貯藏及整齊實生苗之促成栽培技術	育林組	黃怡菁	1	非專屬	3
牛樟種質復育園的建立	植物園組	楊正釗	0	非專屬	4
原木段之高溫乾燥技術	技術服務組	李銘鐘	0	非專屬	5
新植小果油茶園之豐產模式建立技術	蓮華池研究中心	許俊凱	0	非專屬	5
肉桂醛型土肉桂繁殖與肉桂醛及黃酮類生產利用技術	育林組	何政坤	0	非專屬	5
冷榨苦茶油優化製程	植物園組	楊正釗	0	非專屬	3

106年植物品種權案件

品種權名稱	核准國家	單位	品種權人	核准字號	權利期間
臺紅3號	中華民國	育林組	行政院農業委員會林業試驗所	農授糧字第1061041803B號	106年11月7日至 131年11月6日

106年產學合作案件

計畫名稱	單位	主持人	執行期間
伽羅木醇型土肉桂降憂鬱及降血糖與血脂之機能性產品開發	蓮華池研究中心	許原瑞	106年1月1日至 106年12月31日

台灣林業科學

作者	英文題目	中文題目	頁數
張勳婉、陳意婷 黃正良	Damage and Regeneration of Trees in the Liehuachih Forest Dynamics Plot in Central Taiwan after Typhoons Disturbance	颱風擾動後臺灣中部蓮華池森林動態樣區木本植物的傷害及更新	32(1): 1-14
汪大雄、謝漢欽 江昱仁、楊蓓涵 陳財輝、吳俊賢	Integration of Geographic Information with 3D Visualization Technologies for Dynamic Simulations of Forest Trail Landscapes	整合地理資訊與3D視覺化技術於森林步道景觀動態模擬	32(1): 15-30
邱志明、唐盛林 彭炳勳、蔣華蕾	Effects of Thinning and Pruning on the Growth of Naturally Regenerated Yellow Cypress (<i>Chamaecyparis obtusa</i> var. <i>formosana</i>) Stands	疏伐與修枝對臺灣扁柏天然更新林生長效應之研究	32(1): 31-42
黃國雄、李金梅 何振隆、王秋嫻 游漢明	Study of Charcoal Making with <i>Michelia compressa</i> Thinned Wood from Afforestation on the Plains	平地造林烏心石疏伐木製炭之研究	32(1): 43-55
黃舒瑜、簡慶德 王名偉、黃玲瓏 陳舜英	Physical Dormancy in Seeds of Three Native Woody Species in Taiwan: <i>Rhus succedanea</i> (Anacardiaceae), <i>Thespesia populnea</i> (Malvaceae), and <i>Colubrina asiatica</i> (Rhamnaceae)	臺灣3種原生木本植物種子的物理休眠：漆樹科木蠟樹、錦葵科繖楊與鼠李科亞洲濱棗	32(1): 57-70
陳盈如、張上鎮	Distribution and Characteristic Comparisons of the Endemic Cypresses in Taiwan	臺灣檜木之分布與特徵比較	32(1): 71-86
陸象豫	Estimation of the Ability of a Forest Watershed to Conserve and Regulate Water by a Baseflow Approach	以基流量推估森林集水區之水資源涵養功能	32(2): 111-9
鄧書麟、傅昭憲 張坤城、楊倩如 黃瓊逸	Population Genetic Variations of <i>Calophyllum inophyllum</i> in Taiwan and on Nearby Islands	臺灣與鄰近島嶼瓊崖海棠族群遺傳變異與親緣關係之研究	32(2): 145-57
謝漢欽、林謙佑 汪大雄、鍾智昕 黃俊元	Comparison of Formosat-2 Savi And Gla Lai in Estimating Stand Volume of <i>Fraxinus</i> Afforestation	福衛二號光譜土壤調整植生指數與地測葉面積指數於光蠟樹材積推估之比較	32(2): 159-75
林俊成、林幸樺 潘薇如、賴進益 林裕仁	The Predicaments of and Revitalizing Strategies for Nantou County's Zhushan Bamboo Industry	南投縣竹山地區竹產業現狀困境與未來發展策略	32(3): 177-89

台灣林業科學

作者	英文題目	中文題目	頁數
林俊成、陳溢宏 王培蓉、陳幸君 吳孟珊	An Estimation of Carbon Emissions by Taiwan's Major Imported Solid Wood Products	臺灣主要實木產品進口運輸之碳排放量估算	32(3): 191-201
謝漢欽、鍾智昕 黃俊元	Using the NDVI and Mean Shift Segmentation to Extract Landslide Areas in the Lioukuei Experimental Forest Region with Multi-temporal Formosat-2 Images	應用NDVI植生指標與平均值調整影像分割法於崩裸地萃取—以六龜試驗林地區多期福衛二號影像為例	32(3): 203-22
林美峰、蘇聲欣 黃俐雯、陳建文 鄭美如、王相華	Tree Leaf Choice by Formosan Reeve's Muntjac in Relation to Nutrient Content	樹木葉片營養成分對臺灣山羌攝食選擇的影響	32(3): 237-49
鄭美如、陳建文 葉耕帆、謝君謙 陳燕章、張勳婉	Observations of the Phenology of <i>Mitrastemon kanehirai</i> and Animals that Visited It During the Reproductive Season with a Network Camera	以網路攝影機監測菱形奴草繁殖期的物候現象及來訪動物	32(3): 251-57
杜清澤、黃菊美	Recovery Rate of Organic Carbon by the Walkley-Black Procedure – Non-calcareous Taiwan Forest Soils as Examples	Walkley-Black法分析土壤有機碳之回收率—以臺灣非石灰質森林土壤為例	32(3): 259-65
楊正釧、郭幸榮	Germination and Storage Behavior of Seeds of <i>Camellia brevistyla</i> (Hay.) Coh.-Stuart	短柱山茶種子的發芽與儲藏性質	32(4): 267-81
張淑華、陳芬蕙 陳怡蓓、蔡錦瑩 陳媁、黃芷雲 呂汶玲、何政坤	Induction, Culture, and Taxane Production of Crown Galls and Hairy Roots of <i>Taxus sumatrana</i> (Miq) de Laub	南洋紅豆杉之腫瘤細胞及毛狀根誘導、培養與紫杉烷類生產	32(4): 283-97
林裕仁、姚聖潔 潘薇如、林柏亨	An Investigation of Woody Wastes of the Wood Processing Industry in Yilan County and Its Reuse Assessment	宜蘭縣木材加工業木質廢料調查分析暨再利用評估之研究	32(4): 349-60

其他學術期刊

作者	題目	書名期刊	卷(期)、頁碼、審查編號	TCCC/SCI/EI
黃勁暉、蔡明哲、 <u>傅春旭</u> <u>林介龍</u> 、李鎧彤	Two Newly Recorded Hypogeous Fungi in Taiwan— <i>Endogone flammicorona</i> and <i>Sclerogaster compactus</i>	Fung. Sci.	32(1): 027-030	其它
Yu-Ting Chiu, Anthony Bain <u>鄧書麟</u> , Yi-Chiao Ho Wen-Hsuan Chen, Hsy-Yu Tzeng	Effects of Climate Change on a Mutualistic Coastal Species: Recovery from Typhoon Damages and Risks of Population Erosion	PLoS ONE	12(10): e0186763	SCI
Kou-Hsiang Hung Chia-Hung Lin, <u>朱麗萍</u>	Tracking the Geographical Origin of Timber Using DNA Fingerprinting: a Study of the Endangered Species <i>Cinnamomum kanehirae</i> in Taiwan	Holzforschung	DOI: https://doi.org/10.1515/hf-2017-0026	SCI
周世瑤、張祖亮、 <u>黃怡菁</u> 陳右人、阮素芬	氮素濃度對三種香蜂草生長、精油產量及成分之影響	臺灣園藝	63(2): 99-115	其它
王君璋、李金龍、陳右人 阮素芬、 <u>黃怡菁</u>	小西氏石櫟(<i>Pasania konishii</i> (Hay.) Schottky)無性繁殖初探	臺灣園藝	63(3): 177-182	其它
<u>洪昆源</u> 、 <u>傅昭憲</u> 、 <u>蔡景株</u>	臺灣各縣市105年度植樹節活動之探討	環境與管理研究	17(2): 53-63	其它
<u>王益真</u> 、 <u>何振隆</u>	生質精煉工業之發軔	漿紙技術	21(4): 35-37	其它
<u>彭元興</u> 、余世宗、 <u>徐健國</u>	臺灣常見手工紙紙品介紹	漿紙技術	21(4): 23-30	其它
<u>何振隆</u>	Studies on the Quality and Reaction Properties Enhancement of Dissolving Pulp	Taiwan TAPPI Journal	21(3): 27-34	其它
周珊沂、 <u>許富蘭</u> 、張上鎮 陳育涵、張惠婷	肉桂酸類衍生物抗黴菌活性之評估	中華林學季刊	50(4): 381-391	其它
<u>湯適謙</u> 、簡誠穎、郭添枝	多功能木材收穫機械臂之力學分析	林產工業	36(3)	其它
Joseph A. LaManna Scott A. Mangan, Alfonso Alonso Norman A. Bourg, <u>張勵婉</u> Warren Y. Brockelman Sarayudh Bunyavejchewin, etc.	Plant Diversity Increases with the Strength of Negative Density Dependence at the Global Scale	Science	356: 1389-1392	SCI

其他學術期刊

作者	題目	書名期刊	卷(期)、頁碼、審查編號	TCCC/SCI/EI
R. Stouthamer, P. Rugman-Jones P. Q. Thu, A. Eskalen, <u>陸聲山</u> <u>施欣慧</u> , <u>汪澤宏</u> , T. Thibault J. Hulcr, B. H. Jordal	Tracing the Origin of a Cryptic Invader: Phylogeography of the <i>Euwallacea fornicatus</i> (Coleoptera: Curculionidae: Scolytinae) Species Complex	Agricultural and Forest Entomology	19(4): 366-375	SCI
<u>汪澤宏</u> , R. A. Beaver, J. Hulcr	A New Species of Ambrosia Beetle, <i>Urocorthylus fanii</i> , from Taiwan (Coleoptera: Curculionidae: Scolytinae: Corthylini)	Japanese Journal of Systematic Entomology	23(1): 53-56	其它
<u>汪澤宏</u> , J. J. Cherng D. H. Kavanaugh	First Records for <i>Cyclosomus inustus</i> Andrewes (Coleoptera: Carabidae: Cyclosomini) for Taiwan, with Notes on Habitat and Behavior	Proceedings of the California Academy of Sciences (Series 4)	64: 107-16	其它
M. Balke, J. Bergsten, <u>汪澤宏</u> L. Hendrich	A New Genus and two New Species of Southeast Asian Bidessini as well as New Synonyms for Oceanian Species (Coleoptera, Dytiscidae)	ZooKeys	647: 137-151	SCI
<u>黃裕星</u> 、 <u>劉則言</u> 、 <u>莊鈴木</u> <u>洪挺軒</u> 、 <u>張東柱</u> 、 <u>吳孟玲</u> <u>陳昭翰</u>	樹木靈芝病害快速PCR分子檢測技術建立	中華林學季刊	50(4): 393-407	其它
Wei-Tao Jin, Andre Schuiteman Mark W. Chase, Jian-Wu Li <u>鐘詩文</u> , Tian-Chuan Hsu Xiao-Hua Jin	Phylogenetics of Subtribe Orchidinae s.l. (Orchidaceae; Orchidoideae) Based on Seven Markers (Plastid matK, psaB, rbcL, trnL-F, trnH-psba, and Nuclear nrITS, Xdh): Implications for Generic Delimitation	BMC Plant Biology	DOI: 10.1186/s12870-017-1160-x.	SCI
Yosuke Matsuda Takashi Uesugi, Tsai-Wen Hsu <u>陳建帆</u>	Mycorrhizal Fungi Associated with Taiwanese <i>Pyrola morrisonensis</i> (Ericaceae) in a Naturally Regenerated Forest	Taiwania	62(4): 399-406 DOI: 10.6165/tai.2017.62.399	SCI
林雋軼, L. Chang, Y.-H. Lin H.-J. Cheng, <u>吳孟玲</u> T.-H. Hung	Biological and Molecular Characterization of Citrus Tatter Leaf Virus in Taiwan	Plant Pathology (2017)	10.1111/ppa.12806	SCI
Kristin Vanderbilt John H. Porter, <u>陸聲山</u> Nic Bertrand, <u>林朝欽</u> , etc.	A Prototype System for Multilingual Data Discovery of International Long-Term Ecological Research (ILTER) Network data	Ecological Informatics	40: 93-101	SCI
<u>陳財輝</u> 、 <u>李宗宜</u> 、 <u>汪大雄</u>	日本魚附林和臺灣漁業保安林	臺大實驗林研究報告	31(4): 265-274	其它
<u>鍾智昕</u> 、 <u>塗三賢</u> 、 <u>黃倬英</u> <u>楊德新</u> 、 <u>林振榮</u>	The Use of Spectroscopy to Determine the Properties and Evaluation of Extruded Tea Leafplastic Composites	Journal of Tropical Forest Science	29(4): 428-437	SCI

其他學術期刊

作者	題目	書名期刊	卷(期)、頁碼、審查編號	TCCC/SCI/EI
郭礎嘉、曾喜育、曾彥學 胡元璋	臺灣中部常綠闊葉林小尺度植物種類豐富度的決定因子	中華林學季刊	50(3): 279-308	其它
陳建帆、陳柏豪、楊勝任	臺灣松柏目種球形態特徵研究	國立臺灣博物館學刊	70(2): 9-43	其它
林哲緯、陳建帆、楊宗愈	The New Species of <i>Phyllagathis</i> (Trib. Sonerileae, Melastomataceae) from Sarawak, Borneo	Phytotaxa	302(3): 201-228	SCI
陳建帆、蕭清泉、陳柏豪 楊勝任	臺灣新歸化菊科植物—方莖鹵地菊	臺灣生物多樣性研究	19(3): 173-178	其它
邱志明、唐盛林、鍾智昕 彭炳勳	疏伐處理對臺灣杉人工林木材年輪構造與碳含量之影響	林產工業	印刷中	其它
田玉娟、王相華	泰雅族原住民運用臺灣赤楊於混農林生產的傳統知識	中華林學季刊	50(4): 365-379	其它
王震哲、張藝翰 邱文良、劉和義	Two New Species of <i>Microlepia</i> (Dennstaedtiaceae, Polypodiopsida) from Thailand.	Phytotaxa	29(4): 428-437	SCI
張乃航、黃中宜	三種殼斗科橡實之澱粉研究	中華林學季刊	50(4): 325-339	其它
葉文琪、陸聲山	New Record of the genus <i>Zethus</i> Fabricius from Taiwan, with the Description of <i>Z. taiwanus</i> sp. nov. and a Key to the Species of <i>Trimaculatus</i> -group (Hymenoptera: Vespidae: Eumeninae)	Zootaxa	4324(3): 529-540	SCI
汪大雄、羅仁甫、張妙華 古宇任、葉晉宇、王兆桓	宜蘭地區臺灣肖楠人工林分表直徑分布生長模式	中華林學季刊	50(2): 159-172	其它
鍾智昕、林振榮	Determining Ideal Timing of Row Thinning for a <i>Cryptomeria japonica</i> Plantation Using Event History Analysis	Forests	DOI: 10.3390/f8030077 8(3): 77-	SCI
Tao Fujiwara, Ayumi Uehara Tsukasa Iwashina Sadamu Matsumoto, 張藝翰 Yasuyuki Watano, Yi-Shan Chao	Allotetraploid Cryptic Species in <i>Asplenium normale</i> in the Japanese Archipelago, Detected by Chemotaxonomic and Multi-locus Genotype Approaches	American Journal of Botany	DOI: //doi.org/10.3732/ajb.1700141	SCI
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徐光平、何振隆	開發MIT的特殊機能紙—格拉辛紙	23(6): 98-101
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洪昆源、吳芯慧、蔡景株、洪州玄	泛論植物防蚊及產品進化	23(6): 109-113
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研討會報告

作者	研討會名稱	論文題目	主辦單位
<u>蘇聲欣</u>	國家公園科研成果與林試所觀摩研討會	林試所森林動態樣區研究經驗	內政部營建署、林業試驗所
<u>許原瑞</u>	2017兩岸林業基層人員交流研討會	林業優良種苗建立與育苗	中華林學會、中國林學會
<u>董景生</u>	國家公園科研成果與林試所觀摩研討會	原民傳統植物計畫	內政部營建署、林業試驗所
<u>傅春旭</u>	日・韓・台の国際シンポジウム(Symposium)「八重山の聖なる森「御嶽林」を守る」	八重山の御嶽と保全~南根腐病を中心に	東アジアの「伝統の森」文化誌準備委員
<u>董景生</u> 、 <u>鐘詩文</u> 、 <u>陳建帆</u> 、 <u>邱祈榮</u>	國際天然染研討會	臺灣植物色素現況及具有潛力之天然色素植物	林業試驗所、國立臺灣工業研究發展中心
<u>朱麗萍</u>	福建植物學年會暨閩臺學術研討會	樟科樟屬植物牛樟之分類研究及應用	福建省植物學會
<u>楊正釗</u>	林業試驗所中埔研究中心第12屆環境保護林經營管理研討會	臺灣重要原生殼斗科造林樹種的種子採收、發芽與育苗	林業試驗所中埔研究中心
<u>楊正釗</u>	油料作物研發成果發表研討會	傳統日曬與新開發節能省工冷乾法對苦茶籽乾燥效益之比較	農委會農糧署
<u>楊正釗</u>	油料作物研發成果發表研討會	螺旋與油壓榨油法對臺灣產苦茶籽榨油率之初步統計	農委會農糧署
<u>張俊文</u> 、 <u>林思民</u>	2017年動物行為生態研討會	環境噪音是否為兩棲類鳴叫聚集之參考依據	中山大學
<u>劉則言</u>	金門地區林木健康管理及風險評估研討會	林木病害防治管理	行政院農業委員會林業試驗所、金門縣林務所
<u>張俊文</u> 、 <u>林思民</u>	第五屆兩棲爬行動物研討會	沒錢買設備怎麼在研究上脫魯!?試試用手機進行聲景監測	嘉義大學
<u>許竹君</u> 、 <u>張俊文</u> 、 <u>許富雄</u>	第五屆臺灣兩棲爬行動物研討會	天候因子與蛙類鳴叫活動的關係:溫度、溼度與降雨的重要性	嘉義大學生物資源學系
<u>鄭美如</u> 、 <u>邱祈榮</u> 、 <u>鍾智昕</u> 、 <u>詹為巽</u> 、 <u>陳建文</u> 、 <u>張哲彰</u> 、 <u>陳乃維</u> 、 <u>張尊堡</u> 、 <u>王盧正</u>	新農業－2017臺灣智慧農業機械國際研討會	生物炭料源供應決策支援系統	農林產業節能機械研發中心
<u>顧文君</u> 、 <u>傅春旭</u>	中華林學會106年森林資源永續發展研討會	奇楠沉香指紋圖譜分析之研究	中華林學會
<u>陳俞甯</u> 、 <u>林志憲</u> 、 <u>李志璇</u> 、 <u>楊德新</u>	2017中華林產事業協會學術論文暨研究成果研討會	我國熱處理木質板材之發展現況與應用	中華林產事業協會

研討會報告

作者	研討會名稱	論文題目	主辦單位
洪昆源、黃裕星、林振榮 陳舜英	2017生物醫學聯合會	Effects of Forest Healing Ingredients on Nerve Cells	臺灣生物化學及分子生物學會、中華細胞及分子生物學會、臺灣毒物學學會、臺灣藥理學學會等
林俊成、吳孟珊、詹為巽	新農業—臺灣智慧農業機械國際研討會	Icoiam 2017Taiwan 籌備委員會	國內研討會—論文宣讀
何振隆、何惠彤、蘇裕昌	生農環境及多樣性學門研討會	非木纖維以四氫呋喃醇溶劑製漿法製備溶解級紙漿	科技部
鍾振德	2017兩岸林業基層人員交流研討會	臺灣林木育種研究與發展	中華林學會、中國林學會
許祐薰、汪澤宏、林仲平	2017年動物行為生態研討會	體型越大的豆娘具有較高的交配成功機會與較長的壽命：以中華珈蟪為例	國立中山大學
楊建宏、張勵婉、范素瑋	Annual Meeting of Ecological Society of America	The Net Effect of Large Trees on Slope Stability is Positive—a Result Based on a Big Data Analysis	
張勵婉、王巧萍、王培蓉	2017性別與科技國際會議	臺灣林業從業人員性別比例變化和林業經營政策與森林科學研究的關係	
Joseph A. LaMan, 張勵婉	Annual Meeting of Ecological Society of America	Negative Density Dependence Contributes to Global Patterns of Plant Biodiversity	
汪大雄、鍾智昕、謝漢欽 湯適謙	第十屆海峽兩岸森林經理學術研討會	蓮華池地區臺灣肖楠人工林林木尖削度模式之建立	宜蘭大學森林自然資源系
彭炳勳、邱志明	中華林學會106年森林資源永續發展研討會	非破壞檢測技術應用於高雄市特定紀念樹木白千層材質衰退及風險評估	中華林學會，國立宜蘭大學森林暨自然資源學系
Jian-Hong Yang, 張勵婉 范素瑋	International Workshop on N2O Emissions in Various Ecosystems: Site-Based Research and Global Synthesis	Large Trees Reduce the Occurrence of Landslides and Protect Small Trees from Landslides	
林裕仁、邱祈榮	新農業—2017臺灣智慧農業機械國際研討會	Feedstock Supply and Products Management of Biochar	國立虎尾科技大學
湯適謙	新農業—2017臺灣智慧農業機械國際研討會	Development and Promotion of Forestry Machinery and Operational Techniques in Taiwan	國立虎尾科技大學
林裕仁、潘薇如、姚聖潔	中華林學會106年森林資源永續發展研討會	木質能源於戰備時期替補糧食供氣燃料使用之評估	中華林學會

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作者	研討會名稱	論文題目	主辦單位
邱志明、 <u>彭炳勳</u>	第十二屆環境保護林經營管理研討會	樹木風災受害類型與處理對策—以莫蘭蒂颱風為例	林業試驗所中埔研究中心
<u>楊蒼叡</u> 、 <u>楊正釗</u>	第十二屆環境林經營管理研討會	牛樟扦插苗及實生苗之造林生長表現初探	林業試驗所中埔研究中心
<u>黃勁暉</u> 、 <u>李鎧彤</u> 、 <u>張東柱</u> <u>莊鈴木</u> 、 <u>傅春旭</u>	珍貴老樹保護研討會	以傳統培養配合分子檢測來診斷樹木靈芝病害	林業試驗所 高雄市政府農業局
<u>傅春旭</u> 、 <u>張東柱</u> 、 <u>姚瑞禎</u> <u>林俊成</u> 、 <u>邱予柔</u> 、 <u>林玟鈞</u> <u>尹華文</u>	珍貴老樹保護研討會	殺菌劑施用對樹木褐根病之防治效果評估	林業試驗所 高雄市政府農業局
<u>陳致麗</u> 、 <u>林建堯</u> 、 <u>莊鈴木</u> <u>張詠怡</u>	臺灣松露資源研討會	日本生之松原松露經營管理報導	林業試驗所
<u>林芳瑜</u> 、 <u>郭純德</u> 、 <u>陳正豐</u> <u>區詠軒</u>	臺灣松露資源研討會	日本彩虹松原松露經營管理初探	林業試驗所
<u>蔡明哲</u> 、 <u>林介龍</u>	臺灣松露資源研討會	火冠豆松露與緻密硬皮腹菌之介紹	林業試驗所
<u>黃勁暉</u> 、 <u>李鎧彤</u> 、 <u>張東柱</u> <u>蔡明哲</u>	臺灣松露資源研討會	臺灣腔塊菌與疣孢大團囊菌之介紹	林業試驗所
<u>李鎧彤</u> 、 <u>黃勁暉</u> 、 <u>蔡明哲</u> <u>林介龍</u> 、 <u>林芳瑜</u>	臺灣松露資源研討會	溪頭松露的發現與介紹	林業試驗所
<u>黃勁暉</u> 、 <u>李鎧彤</u> 、 <u>蔡明哲</u> <u>傅春旭</u> 、 <u>林文薇</u>	臺灣松露資源研討會	雲杉松露的發現與介紹	林業試驗所
<u>林介龍</u> 、 <u>蔡明哲</u> 、 <u>姚瑞禎</u> <u>黃勁暉</u> 、 <u>傅春旭</u>	臺灣松露資源研討會	臺灣地區松露初探	林業試驗所
<u>鍾智昕</u> 、 <u>邱祈榮</u> 、 <u>黃俊元</u>	第十二屆環境保護林經營管理研討會	應用衛星影像Data Cube進行植生復育監測之探討	林業試驗所中埔研究中心
<u>王經文</u> 、 <u>廖天賜</u> 、 <u>陳忠義</u> <u>陳明男</u>	2017光合作用與植物生理研討會	紅海欖及海茄苳在兩種CO ₂ 濃度下光合作用和葉綠素螢光特性	國立臺灣大學園藝暨景觀學系、澳登堡股份有限公司、Heinz Walz GmbH
<u>何政坤</u>	2017年第八屆熱帶林業研討會	林下經濟可行性研究成果與實施探討	國立屏東科技大學森林系
<u>王相華</u> 、 <u>黃俐雯</u>	中華林學會106年森林資源永續發展研討會	臺灣山羌在福山植物園展示區的攝食行為	中華林學會
<u>黃俊元</u> 、 <u>陳芬蕙</u> 、 <u>謝漢欽</u> <u>歐書寰</u> 、 <u>陳朝圳</u> 、 <u>陳建璋</u>	第十二屆環境保護林經營管理研討會	利用微地形發展木麻黃直播造林技術之研究	林業試驗所中埔研究中心
<u>王培蓉</u>	「獎勵造林的經營利用」論壇	枝梢材的多元利用	南投縣政府

研討會報告

作者	研討會名稱	論文題目	主辦單位
王培蓉、林俊成	農林防災計畫成果發表會	南投縣山村社會社經脆弱度與社區對自然危害風險承受與調適評估	農業試驗所
林萬峻、羅盛峰、塗三賢	中華林學會106年森林資源永續發展研討會	探討市售木材塑膠複合材經戶外與加速耐候試驗後之性質比較	中華林學會
何雅齡、廖宇廣	中華林學會106年森林資源永續發展研討會	著生杜鵑之微體繁殖	宜蘭大學
邱祈榮	第十二屆環境保護林經營管理研討會	金門森林風損評估之研究—以莫蘭蒂颱風為例	中埔研究中心
林朝欽	International Symposium on Development of Integrated Network Management System on Ecological Informatics	Ecoinformatics: a New Paradigm for LTER Research	Kyungpook National University, South Korea
張怡萱、吳進益、劉癸君	第十二屆環境保護林經營管理研討會	中港園區公共綠帶植栽固碳評估報告	中埔研究中心
鄧書麟、傅昭憲、黃正良、楊雅蓊、黃瓊逸	第十二屆環境保護林經營管理研討會	雲林沿海地區農地造林適生樹種之選拔	中埔研究中心
鄧書麟、傅昭憲、李育潔	第十二屆環境保護林經營管理研討會	踐踏對嘉義樹木園土壤硬化與地被植物之衝擊	中埔研究中心
蔡景株、洪昆源、傅昭憲	第十二屆環境保護林經營管理研討會	臺灣原生植物在盆栽應用之探討	中埔研究中心
詹明勳、傅昭憲、鄧書麟、曾冠頤	第十二屆環境保護林經營管理研討會	嘉義植物園土壤硬實對肯四氏南洋杉生長與風險評估之研究	中埔研究中心
張琮柏、林育慧、張怡萱、劉癸君、林瑞進	第十二屆環境保護林經營管理研討會	木麻黃根瘤內放射菌多樣性及共生微生物對其吸收重金屬之影響	中埔研究中心
謝漢欽、鍾智昕、黃俊元	International Conference on Earth Observations & Natural Hazards 2017	Using the NDVI and Mean Shift Segmentation to Extract Landslide Areas in the Lioukuei Experimental Forest Region with Multi-temporal Formosat-2 Images	越南科技學院地理研究所
謝漢欽、潘巍中、鍾智昕、黃俊元	第十二屆環境保護林經營管理研討會	應用多期Landsat光譜指標監測全島海岸防風林生長狀況	林業試驗所中埔研究中心
謝漢欽、鍾智昕	106年中華林學會森林資源永續發展研討會	崩場地時空分布對不同土地利用地景生態結構之影響—以臺中市武陵地區多期福衛二號影像為例	中華林學會、國立宜蘭大學森林暨自然資源學系
謝漢欽、潘巍中、黃俊元	第十屆海峽兩岸森林經理學術研討會	應用多期Landsat™光譜指標監測桃竹苗海岸防風林生長狀況	宜蘭大學森林暨自然資源學系

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謝漢欽、林謙佑、汪大雄 鍾智昕、黃俊元	ICEO & SI 2017 (201年地球觀測及社會衝擊研討會)	Comparison of Formosat-2 SAVI and GLA LAI in Estimating Stand Volume of Fraxinus Afforestation	國立宜蘭大學
謝漢欽	2017 森林集水區經營研討會	應用多元空間資訊製作水里溪集水區崩塌潛勢圖	行政院農業委員會林業試驗所
陳芬蕙、何政坤、杜清澤	「農林氣象災害風險指標建置及調適策略之研究」計畫成果發表會	山村農林業之生態經營對氣象災害調適策略之研究	農業試驗所
段人涵、蔡明哲、李金梅 林柏亨、林振榮、顧文君	中華林學會106年森林資源永續發展研討會	樹木腐朽情形與反應機制個案討論—以樟樹為例	中華林學會、國立宜蘭大學森林暨自然資源學系
李金梅、林振榮、何振隆 黃國雄	中華林學會106年森林資源永續發展研討會	常用進口商用木材之基本性質	中華林學會、國立宜蘭大學森林暨自然資源學系
游漢明、陸象豫、胡元璋 曾俊偉、鍾智昕	「農林氣象災害風險指標建置及災害調適策略之研究」計畫成果發表會	山村區域農林土地利用型態對水土資源保育影響之研究	行政院農業委員會農業試驗所
陳財輝	第十二屆環境保護林經營管理研討會	臺灣的衛生保健保安林	林業試驗所中埔研究中心
林奂宇	「農林氣象災害風險指標建置及調適策略之研究」計畫成果發表會	山村災害潛勢與土地利用現況之空間整合分析	農業試驗所
鄧書麟、傅昭憲、黃瓊逸 李育潔	中華林學會106年森林資源永續發展研討會	中華林學會106年森林資源永續發展研討會	中華林學會
鍾安晴、龔冠寧、陳永修 周富三、林文智	中華林學會106年森林資源永續發展研討會	多納崩塌地之樹種及小苗組成	中華林學會
鍾智昕、黃俊元、詹為巽 林奂宇、邱祈榮	中華林學會106年森林資源永續發展研討會	Datacube衛星影像資料監測太麻里溪中下游17年NDVI動態變化	中華林學會
林振榮、鍾智昕	2017臺日韓「森林永續經營管理」研討會	Effects of Delayed Thinning on Diameter Growth of Cryptomeria Japonica Plantation	National Institute of Forest Science
鍾智昕、彭炳勳、林謙佑 謝漢欽、邱志明	第十屆海峽兩岸森林經理學術研討會	以UAV監測肖楠人工林疏伐前後之琳份冠層變化	宜蘭大學
王培蓉、邱祈榮、林俊成	106年森林資源永續發展研討會	私有林經營的整合模式	中華林學會
王培蓉、孫銘源	106年森林資源永續發展研討會	人人都可以成為林主：林地的使用權共享模式	中華林學會

研討會報告

作者	研討會名稱	論文題目	主辦單位
劉則言、吳孟玲	106年森林資源永續發展研討會	都市林健康檢查與病蟲害研究：以金門珍貴樹木為例	中華林學會、國立宜蘭大學森林暨自然資源學系
張淑華、蔡錦瑩、吳家禎、陳媁、何政坤	中華林學會106年森林資源永續發展研討會	牛樟藻膠包埋芽體之溫室生長	中華林學會
吳家禎、陳芬蕙、徐中芃	中華林學會106年森林資源永續發展研討會	臺灣原生珍珠蓮母樹資源調查之初探－以臺北市北投區湖山里為例	中華林學會
詹為巽、林俊成、林柏亨、林伯峰	106年森林資源永續發展研討會	運用共詞分析探討我國近年林學研究趨勢	中華林學會
黎光秦、陳子英、林奐宇	中華林學會106年森林資源永續發展研討會	宜蘭縣大白蘭崁地區臺灣水青岡適應性經營與保育	中華林學會
林奐宇, Christie Quon 邱祈榮	中華林學會106年森林資源永續發展研討會	Application of Land Use Inventory Data and Random Forest Method in Population Density Estimation of Rural Areas	中華林學會
林奐宇、胡哲明、黎光秦、陳子英	中華林學會106年森林資源永續發展研討會	運用動態局部迴歸方法建置高解析度氣候模式及其生態應用	中華林學會
范義彬、洪州玄	第12屆環境保護林經營管理研討會	環境保護林重要害蟲－黑角舞蛾生態探究	林業試驗所
徐健國	再造風華－東方繪畫與天然媒合材臺日國際學術研討會	從纖維特性談紙張成紙性質	臺灣東海大學美術學系、日本 桃山學院大學
陳姿吟、范義彬、陳子英	106年森林資源永續發展研討會	蝶類在授粉生物學之重要性研究－以金花石蒜為例	中華林學會、林務局、宜蘭大學
邱志明	106年度行道樹與造林木修剪及維護管理暨常見病蟲害防治研討會	行道樹及造林木修剪及維護管理	苗栗縣政府農業處
吳孟玲、劉則言	2017植栽及樹木之健檢與醫療研討會	金門地區樹木病蟲害調查與風險評估研究	行政院農業委員會林業試驗所、臺灣大學生農學院實驗林管理處、臺灣植物及樹木醫學學會

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作者	研討會名稱	論文題目	主辦單位
劉則言、吳孟玲	2017植栽及樹木之健檢與醫療研討會	金門地區老樹健康檢查	行政院農業委員會林業試驗所、臺灣大學生農學院實驗林管理處、臺灣植物及樹木醫學學會
徐孟豪、黃裕星、劉則言、吳孟玲	2017植栽及樹木之健檢與醫療研討會	樹木注射技術研發與應用	行政院農業委員會林業試驗所、臺灣大學生農學院實驗林管理處、臺灣植物及樹木醫學學會
傅春旭	106年度臺灣松露資源研討會	臺灣松露資源之研究	行政院農業委員會林試驗所
張東柱	106年度臺灣松露資源研討會	臺灣食藥用真菌資源之研究	行政院農業委員會林試驗所
許富蘭、汪澤宏、許俊凱、陳芬蕙、楊甯喻	臺灣食品科學技術學會	儲存過程對苦茶油氧化安定性及微量活性成分之影響	臺灣食品科學技術學會
Hui-Ting Chang, Mei-Ling Chang, Chun-Ya Lin, Yan-Ting Chen, 吳家禎, 何政坤, Shang-Tzen Chang	5 th International Phytocosmetics and Phytotherapy Congress	Effects on Antidepressant and Motor Coordination Activities of Linalool-type Cinnamomum Osmophloeum Leaf Oil in Mice	Hellenic Society of Cosmetology
王培蓉、孫銘源、張凱雯	2017中華民國環境教育學會第27屆環境教育學術暨實務交流國際研討會	森林幣—以共享經濟創造公眾參與森林事業方案	環境教育學會
汪大雄	2017 SFEM永續森林生態系經營國際研討會	Investigation of Patch Thinning Effect on Stand Growth on Sugi Plantation (Cryptomeria Japonica) in Zenlen Area Taiwan	National Institute of Forest Science, Korea
柳雨德、吳家禎、林世宗	2017 森林資源保存與利用研討會	以微衛星體分子標誌進行臺灣山櫻花遺傳多樣性的探討	林業試驗所、中華林學會、宜蘭大學
董景生	6 th Global Botanic Gardens Congress	Seed Saving & Participatory Preservation : to Establish Ethnobotanical Gardens through Citizen Science Pratices in Bunun Tribe of Taiwan(No.55)	BGCI
何政坤	2017台糖公司論壇平地造林未來規劃及利用	結合菇木業與生技業創造林木利用之價值	台灣糖業股份有限公司
劉恩好、邱祈榮、林俊成	2017森林資源保存與利用研討會	林業部門溫室氣體減量行動方案規劃	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
胡正恆、何可蕙、王星哲、吳茹安、陳芬蕙	2017森林資源保存與利用研討會	新店大葉種生態茶成長與林下樹蛙蝌蚪棲留	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學

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作者	研討會名稱	論文題目	主辦單位
<u>張勵婉</u> 、 <u>郭耀綸</u> 、 <u>林易養</u>	2017森林資源保存與利用研討會	蓮華池森林不同空間分布樹種的耐旱性	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
<u>林文智</u> 、 <u>邱祈榮</u> 、 <u>陳財輝</u> <u>陳永修</u> 、 <u>周富三</u> 、 <u>龔冠寧</u>	2017森林資源保存與利用研討會	六龜試驗林臺灣杉人工林清查及後續經營建議	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
<u>杜清澤</u> 、 <u>黃菊美</u>	2017森林資源保存與利用研討會	不同土壤改良措施之休耕農地上相思樹初期生長之比較	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
<u>陳芬蕙</u> 、 <u>汪澤宏</u> 、 <u>何政坤</u>	2017森林資源保存與利用研討會	檳榔下混植牛樟初期與蟲害關係之探討	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
<u>王培蓉</u> 、 <u>盧勇仁</u> 、 <u>葛兆年</u> <u>張凱雯</u>	2017森林資源保存與利用研討會	臺灣林蔭咖啡對生物多樣性之影響——一個昆蟲相的觀察報告	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
<u>顧文君</u> 、 <u>馬復京</u> 、 <u>林柏亨</u> <u>洪聖峰</u> 、 <u>朱紀實</u>	2017森林資源保存與利用研討會	八種植物萃取物防曬性能之評估	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
<u>何政坤</u> 、 <u>許原瑞</u> 、 <u>張淑華</u> <u>陳盈如</u> 、 <u>黃芷雲</u>	2017森林資源保存與利用研討會	伽羅木醇型土肉桂栽培生產精油與黃酮類之研究	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
<u>馬復京</u> 、 <u>何政坤</u> 、 <u>張淑華</u> <u>游漢明</u>	2017森林資源保存與利用研討會	林下段木木耳栽培實例探討	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
<u>邱祈榮</u> 、 <u>曹盛祥</u>	2017森林資源保存與利用研討會	林下段木香菇栽培實例探討	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
<u>張淑華</u> 、 <u>許原瑞</u> 、 <u>何政坤</u> <u>陳永修</u> 、 <u>陳盈如</u> 、 <u>王德華</u> <u>陳媁</u> 、 <u>廖淑女</u> 、 <u>施佩含</u>	2017森林資源保存與利用研討會	利用幼齡相思樹與桉樹製作太空包培養香菇	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
<u>吳家禎</u> 、 <u>張淑華</u> 、 <u>何政坤</u>	2017森林資源保存與利用研討會	Genome-wide Insertion/Deletion Marker Discovery for Closely Related Plant Species: a Case study in <i>Cinnamomum micranthum</i> Hayata	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
<u>何政坤</u> 、 <u>張淑華</u>	2017森林資源保存與利用研討會	土肉桂品種性狀檢定之研發	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
<u>陳舜英</u> 、 <u>許原瑞</u> 、 <u>簡慶德</u>	2017森林資源保存與利用研討會	臺灣八角種子的形態生理休眠	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學

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作者	研討會名稱	論文題目	主辦單位
洪聖峰	2017森林資源保存與利用研討會	毛柿自然結子表現及主要傳粉者推測	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
胡元璋、許俊凱、郭礎嘉、游漢明	2017森林資源保存與利用研討會	臺灣溫帶常綠闊葉林優勢樹種小苗更新之研究	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
黃怡菁、傅春旭、陳柏勳、何政坤、黃裕星	2017森林資源保存與利用研討會	苗齡和容器大小對山葵基本生長特質之影響	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
鍾振德、葉翠華、李玉珍、簡慶德	2017森林資源保存與利用研討會	臺灣水青岡無性繁殖	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
張淑華、何政坤、蔡錦瑩、吳家禎、陳媾	2017森林資源保存與利用研討會	紅豆杉細胞與牛樟芽體之低溫與超低溫保存	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
陳財輝、李宗宜	2017森林資源保存與利用研討會	麻竹分株法及高壓法更新生長及產筍量比較	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
詹為巽、林俊成、邱祈榮	2017森林資源保存與利用研討會	邱邱量表於柳杉生長評估及疏伐規劃應用	行政院農業委員會林業試驗所
彭炳勳、邱志明	中華林產事業協會學術論文暨研究成果研討會	以非破壞檢測技術評估白千層腐朽劣化研究	中華林產事業協會、國立中興大學森林學系
湯適謙、蔡佳彬、汪大雄	第十屆海峽兩岸森林經理學術研討會	平地造林混農林經營後光蠟樹幼齡林之林木生長	國立宜蘭大學森林暨自然資源學系
湯適謙、邱志明、卓志隆、陳瑋旋、葉大裕	第十屆海峽兩岸森林經理學術研討會	應用工作研究的方法探討臺灣針葉樹人工林之疏伐作業效率及成本分析	國立宜蘭大學森林暨自然資源學系
林振榮、林柏亨、李志璇	第十屆海峽兩岸森林經理學術研討會	Detection of Decay Damage in Taiwan Incense Cedar Living Trees by Nondestructive Evaluation	宜蘭大學
王虹婷、邱祈榮、林俊成、詹為巽	第十屆海峽兩岸森林經理學術研討會	重大天然災害產物損失對農業及整體經濟影響－以2016年霸王級寒流為例	宜蘭大學森林暨自然資源學系
劉恩好、林俊成、邱祈榮、詹為巽	第十屆海峽兩岸森林經理學術研討會	植林碳匯小規模方法學研擬	宜蘭大學森林暨自然資源學系
王培蓉、葛兆年、吳孟珊、張凱雯	第十屆海峽兩岸森林經理學術研討會	以咖啡做為農林混植的保育策略－臺灣新興咖啡莊園經營分析	宜蘭大學森林暨自然資源學系
詹為巽、林俊成、王培蓉、吳孟珊	第十屆海峽兩岸森林經理學術研討會	利用共詞分析探討非法伐採研究現況	宜蘭大學森林暨自然資源學系

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作者	研討會名稱	論文題目	主辦單位
<u>王培蓉</u> 、 <u>吳孟珊</u> 、 <u>詹為巽</u> <u>陳溢宏</u>	第十屆海峽兩岸森林經理學術研討會	私有林經營的活化策略－森林融資工具的介紹	宜蘭大學森林暨自然資源學系
<u>林俊成</u> 、 <u>王培蓉</u> 、 <u>吳孟珊</u> <u>陳溢宏</u>	第十屆海峽兩岸森林經理學術研討會	可疑非法木材及貿易之國家風險評估	宜蘭大學森林暨自然資源學系
<u>徐韻茹</u> 、 <u>林俊成</u> 、 <u>王培蓉</u> <u>陳溢宏</u>	第十屆海峽兩岸森林經理學術研討會	由美國雷斯法案修正案看木材合法性推動	宜蘭大學森林暨自然資源學系
<u>陳溢宏</u> 、 <u>林俊成</u> 、 <u>吳孟珊</u> <u>詹為巽</u>	第十屆海峽兩岸森林經理學術研討會	臺灣原竹生產流向及進出口現況分析	宜蘭大學森林暨自然資源學系
<u>林俊成</u> 、 <u>王培蓉</u> 、 <u>吳孟珊</u> <u>陳溢宏</u>	第十屆海峽兩岸森林經理學術研討會	南投縣社會經濟脆弱度與農業天然災害分析	宜蘭大學森林暨自然資源學系
<u>吳家禎</u> 、 <u>陳芬蕙</u> 、 <u>許俊凱</u> <u>許富蘭</u>	油料作物成果發表會	苦茶油DNA分子鑑定技術開發	社團法人臺灣農業科技資源運籌管理學會
<u>劉則言</u> 、 <u>吳孟玲</u> 、 <u>施欣慧</u> <u>莊鈴木</u> 、 <u>汪澤宏</u>	106年度油料作物成果發表暨研討會	油茶炭疽病菌分離與檢測流程	臺灣農業科技資源運籌管理學會
<u>許原瑞</u>	2017林園療癒暨園藝福祉研討會	林園療癒之理念與實踐	林業試驗所、臺灣園藝福祉推廣協會
<u>許富蘭</u>	油料作物成果發表會－106年度成果發表暨研討會	製程對小果苦茶油品質之影響	行政院農業委員會農糧署
<u>林俊成</u>	第十屆海峽兩岸森林經理學術研討會	綠色經濟概念下之永續森林經營思維	宜蘭大學
<u>林俊成</u>	油料作物成果發表會 106年度成果發表暨研討會	油茶栽培經濟效益分析	農糧署
<u>陳建文</u>	2017臺灣植物分類學會年會暨植物多樣性與系統分類研討會	植物影像鑑定	臺灣植物分類學會
<u>林裕仁</u> 、 <u>姚聖潔</u> 、 <u>潘薇如</u> <u>林柏亨</u>	2017中華林產事業協會學術論文暨研究成果研討會	宜蘭縣木材加工業木質廢料調查與利用評估	中華林產事業協會
<u>龔冠寧</u> 、 <u>鍾安晴</u> 、 <u>林文智</u> <u>周富三</u> 、 <u>陳永修</u>	2017森林資源保存與利用研討會	多納林道崩場地樹木的組成與空間分佈	行政院農業委員會林業試驗所、中華林學會、國立宜蘭大學
<u>吳孟玲</u> 、 <u>石佳蓉</u>	2017農林景觀之療癒國際研討會	療育長照景觀環境設計 Therapeutic Landscape Design in Long-term Care Settings	行政院農業委員會林業試驗所
<u>吳孟玲</u>	2017樹木褐根病防治管理研討會	褐根病快速檢測技術與可食地景規劃	行政院農業委員會林業試驗所

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作者	研討會名稱	論文題目	主辦單位
<u>傅春旭</u>	2017樹木褐根病防治管理研討會	邁隆燻蒸法案例	行政院農業委員會林業試驗所
<u>邱志明</u>	第八屆海峽兩岸森林保育經營學術論壇	紅檜與臺灣扁柏林分自我疏伐之探討	臺灣森林休憩保育協會、吉省學福建黑龍江主辦單位：臺灣森林休憩保育協會、吉省學福建黑龍江
<u>邱志明</u> 、 <u>彭炳勳</u> 、 <u>鍾智昕</u>	2017森林資源保存與利用」研討會	屏東地區平地造林颱風災害類型之探討	林業試驗所育林組
<u>邱志明</u> 、 <u>孫銘源</u> 、 <u>唐盛林</u> 、 <u>彭炳勳</u> 、 <u>鍾智昕</u>	第十屆海峽兩岸森林經理學術研討會	六龜地區臺灣杉人工林不同疏伐策略碳吸存效應	宜蘭大學
<u>邱志明</u> 、 <u>鍾智昕</u> 、 <u>唐盛林</u> 、 <u>彭炳勳</u>	2017臺日韓「森林永續經營管理」研討會	Analysis of the Self-thinning and Growth for Different Stand Density in Taiwan Cryptomerioides Plantations	National Institute of Forest Science (NIFoS), Korea Society of Forest Management and Information (KSFMI), Research Center for Advanced Forest Technology (RCAFT)
<u>陳芬蕙</u> 、 <u>劉秋芳</u> 、 <u>王瑞章</u> 、 <u>許俊凱</u> 、 <u>丁昭伶</u> 、 <u>葉永銘</u>	油料作物成果發表會	油茶栽植示範點資訊	社團法人臺灣農業科技資源運籌管理學會
<u>胡顯琮</u> 、 <u>塗三賢</u> 、 <u>張豐丞</u>	2017中華林產事業協會學術論文暨研究成果研討會	以有限元素法預測定向粒片板之靜曲性質	中華林產事業協會
<u>劉則言</u> 、 <u>吳孟玲</u>	2017樹木褐根病防治管理研討會	褐根病的環境友善療法	林業試驗所
<u>吳孟玲</u>	2017農林景觀之療癒國際研討會	都市可食綠資源利用研究 (Research on the Utilization of Edible Green Resources: Study Protocol of Case Studies)	行政院農業委員會林業試驗所
<u>林俊成</u>	2017 WING產官學研策略論壇	臺灣森林產業之發展	臺中市政府
<u>董景生</u>	106年國家公園保育成果與經營管理研討會	從里山到里海的公民參與	海洋國家公園管理處
<u>Hui-Feng Chen</u> <u>Yuan-Ming Lee</u> , <u>何振隆</u> <u>Kuo-Feng Hua</u>	The 32 th Joint Annual Conference of Biomedical Science	Anti-inflammatory Activities of Fraxinus Formosana Hayata Wood Vinegar in Macrophages	The Taiwan Society for Biochemistry and Molecular Biology
<u>王豐仁</u> 、 <u>曾俊偉</u>	2017森林集水區經營研討會	蓮華池地質敏感區位地質特性與崩坍潛勢之研究	林業試驗所集水區經營組
<u>葉若鑒</u> 、 <u>劉彭敏</u> 、 <u>黃歆耘</u> 、 <u>李鴻麟</u>	2017中華林產事業協會學術論文暨研究成果研討會	利用海藻酸鈣晶球包覆精油及其釋放性之研究	中華林產事業協會

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作者	研討會名稱	論文題目	主辦單位
葉若鑒、 <u>李金梅</u> 、莊念潔 程梓源、陳品妍、李鴻麟	2017中華林產事業協會學術 論文暨研究成果研討會	國產疏伐材應用於擴香棒之研 究	中華林產事業協會
<u>顧文君</u> 、 <u>林柏亨</u> 、朱紀實	2017中華林產事業協會學術 論文暨研究成果研討會	八種萃取物防曬性能之研究	中華林產事業協會
<u>林柏亨</u> 、 <u>林振榮</u>	2017中華林產事業協會學術 論文暨研究成果研討會	臺灣肖楠烏木基本性質初探	中華林產事業協會
<u>林振榮</u> 、 <u>林柏亨</u> 、 <u>鍾智昕</u>	2017中華林產事業協會學術 論文暨研究成果研討會	肖楠土埋木七千年的木材樹輪 密度特徵	中華林產事業協會
<u>林振榮</u> 、 <u>葛兆年</u> 、 <u>林柏亨</u>	2017中華林產事業協會學術論 文暨研究成果研討會	應力波斷面影像法檢測五色烏 築巢木的個案調查	中華林產事業協會
<u>林柏亨</u> 、 <u>顧文君</u> 、 <u>林伯峰</u> <u>林振榮</u>	2017中華林產事業協會學術 論文暨研究成果研討會	臺灣肖南烏木基本性質初探	中華林產事業協會
胡子恒、卓志隆、 <u>湯適謙</u> <u>蕭宇哲</u>	2017中華林產事業協會學術 論文暨研究成果研討會	60年生肖楠人工林收穫作業之 集材作業量與生產費用評估	中華林產事業協會、國 立中興大學森林學系
<u>林俊成</u> 、 <u>陳溢宏</u> 、 <u>林裕仁</u>	第八屆海峽兩岸森林保育經 營學術論壇	臺灣原竹生產與加工流向分析	臺灣森林休憩保育協會
<u>林奐宇</u> , Wei-Chun Chao Chang-Fu Hsieh Tze-Ying Chen Jer-Ming Hu	XIX International Botanical Congress	The Warmest Fabitat where Plants Linger on?	International Association of Botanical and Mycological Societies (IABMS)
<u>林奐宇</u> 、 <u>董景生</u> 、 <u>黃裕星</u> <u>胡哲明</u>	6 th Global Botanic Gardens Congress	Plant Conservation and Progress on GSPC 2020 by Botanical Gardens in Taiwan	BGCI
<u>陳盈如</u> , Ya-Lun Huang Ting-Feng Yeh Shang-Tzen Chang	IUFRO 125 th Anniversary Congress	Volatiles Released from Chamaecyparis Formosensis and Chamaecyparis Obtusa var. Formosana in Response to Light Intensity and Growth Temperatures	IUFRO
<u>趙怡珊</u> 、 <u>黃曜謀</u>	2017臺灣植物分類學會年會 暨植物多樣性與系統分類研 討會	Spore Morphology and Its Implication in Infrageneric Classification of Pteris (Pteridaceae)	臺灣植物分類學會
<u>林奐宇</u> 、 <u>胡哲明</u>	2017年植物多樣性與系統分 類研討會	利用局部動態迴歸方法產製臺 灣山區高解析度氣候數值及其 生態應用	臺灣植物分類學會
<u>何政坤</u>	安全機能性產品產業價值鏈 之優化整合與加值推動計畫 產學媒合會	伽羅木醇型土肉桂降憂鬱及降 血糖與血脂之機能性產品開發	臺灣經濟研究院生物科 技產業研究中心

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作者	研討會名稱	論文題目	主辦單位
陸聲山、林朝欽	International Symposium on “Development of Integrated Network Management System on Ecological Information”	Applications of Unmanned Aerial Vehicles (UAV) for the Inventory of Urban Trees	韓國長期生態研究網 (KLTER)
陸聲山	2017年動物行為生態研討會	三種蝶蠟之生態功能與人工飼養之初探	國立中山大學
陸聲山	2017年動物行為生態研討會	烏胸馬蜂 <i>Polistes tenebricosus</i> (膜翅目：胡蜂科) 越冬前聚集與群飛觀察紀錄	國立中山大學
黃育萱、黃曜謀、劉以誠、郭立園、張藝翰、許天銓、洪信介	2017臺灣植物分類學會年會暨植物多樣性與系統分類研討會	臺灣產聖蕨屬之分類研究	臺灣植物分類學會
傅念澤、黃于禎禧、郭傑仁、郭傑仁、關永才、黃志堅	2017動物行為生態研討會	努力鳴叫有回報：面天樹蛙雌偏好選擇較長頻繁的鳴叫聲	國立中山大學
許富蘭, Shen-Shih Chiang, Chiung-Feng Liou, Sheng-Yang Wang	The 67 th Annual Meeting of Japan Wood Research Society in Fukuoka	Ameliorating Effects of Hypertension and Vascular Function by <i>Camellia Brevistyla</i> (Hayata) Coh. Stuart Seed Pomaces Ethanol Extract in L-name Treated Mice.	The Japan Wood Research Society
胡正恆、趙國容、陳芬蕙、宋國彰	2017年動物行為生態研討會	墾丁三處低地森林在季風效應下對哺乳動物相的影響	國立中山大學生物科學系昆蟲生態與演化研究室
戴于琪、鄧書麟、張坤城、呂福原	中華易之森林植物研究協會106年學術研討會	臺灣玉葉金花屬(茜草科)一新雜交種之分類研究	中華易之植物森林研究學會
吳孟玲、劉則言	2017林園療癒暨福祉研討會	林園療癒綠資源及長照產業發展	行政院農業委員會林業試驗所、臺灣園藝福祉推廣協會
吳孟玲	106受保護樹木管理實務研討會	受保護樹木健康管理與養護	行政院農業委員會林業試驗所

其他推廣刊物

作者	題目	書名期刊	卷(期) 頁碼、審查編號
<u>吳孟玲</u> 、 <u>劉則言</u>	金門縣林木病蟲害防治手冊2	金門縣林木病蟲害防治手冊2	全冊
<u>張東柱</u> 、 <u>傅春旭</u>	樹病學	樹病學	全冊
<u>傅春旭</u>	樹木致災風險簡易評估	福田樹木保育季刊	2017(12): 12-15
<u>許原瑞</u>	土肉桂	農業試驗所特刊	203: 78-79
<u>何振隆</u> 、 <u>趙國評</u> <u>花國鋒</u>	山胡椒精油成分及生物活性之探討	豐年雜誌	67(6): 84-93
<u>董景生</u>	森林產業與保育：尋訪里山生態系	科學發展	529: 42-46
<u>楊正釗</u>	牛樟種質復育園的建立	行政院農業委員會農業技術 交易網電子期刊	151
<u>楊正釗</u>	牛樟種質復育園的建立	2017臺北國際發明暨技術交 易展農業館成果專刊	19
<u>楊正釗</u>	育苗用小果油茶種子的處理、保存與發芽	農業世界	411: 17-22
<u>徐嘉君</u>	爬上東亞最高的樹：臺灣杉	國家地理雜誌	193: 38-51
<u>張東柱</u>	幾種食藥用真菌之介紹	農業世界雜誌	410: 12-19
<u>傅春旭</u> 、 <u>黃勁暉</u> <u>李鎧彤</u> 、 <u>林文薇</u>	一連串的意外驚喜－臺灣松露的發現與期許	科學月刊	576: 904-907
<u>黃怡菁</u>	山葵的新生產栽培模式	農業產學合作計畫成果專刊	32-33

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作者	題目	書名期刊	卷(期) 頁碼、審查編號
陳錦桐、葉若璽	菇類的藍色經濟－咖啡渣	農業世界	411: 39-44
劉則言、吳孟玲 施欣慧、莊鈴木 汪澤宏	油茶炭疽病菌分離與檢測技術之建立	農業世界	412: 18-22
汪澤宏	臺灣的蜻蛉系列介紹－多棘晏蜓	農業世界	410: 71-74
汪澤宏	臺灣的蜻蛉系列介紹－勾蜓科與彩翅勾蜓科	農業世界	405: 87-91
汪澤宏	臺灣的蜻蛉系列介紹－春蜓科(下)	農業世界	402: 65-71
何政坤	具護膚機能之紅豆杉品系與栽培採收技術－ 農業館	2017臺北國際發明暨技術交 易展農業館成果專刊	5
傅春旭、黃勁暉 李鎧彤、林文薇	期待臺灣松露產業的來臨	農業世界	410(10): 20-25
鐘詩文	臺灣原生植物全圖鑑第四卷	臺灣原生植物全圖鑑	全冊
陳志輝、鐘詩文	臺灣原生植物全圖鑑第三卷	臺灣原生植物全圖鑑第三卷	全冊
傅春旭、劉芳孜	「珍貴老樹健康調查」－以彰化縣老樹為例	臺灣林業	43(4): 61-68
汪大雄、陳財輝	談日本2012年原木價格暴落	臺灣林業	43(5): 81-89
龔冠寧	喝野生茶有什麼不對？	科技報導	11月號
范義彬	來自南洋的資源植物－麵包樹	農業世界	411: 84-89

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<u>林俊成</u> 、 <u>徐韻茹</u>	美國雷斯法案修正案對推動臺灣木材及其製品進口合法性之借鏡	臺灣林業	43(3): 25-33
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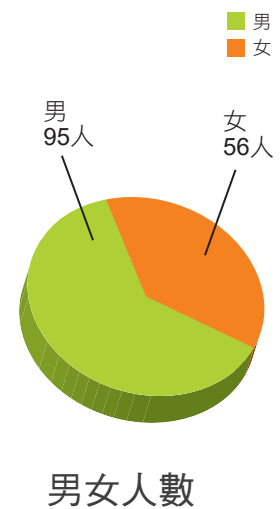
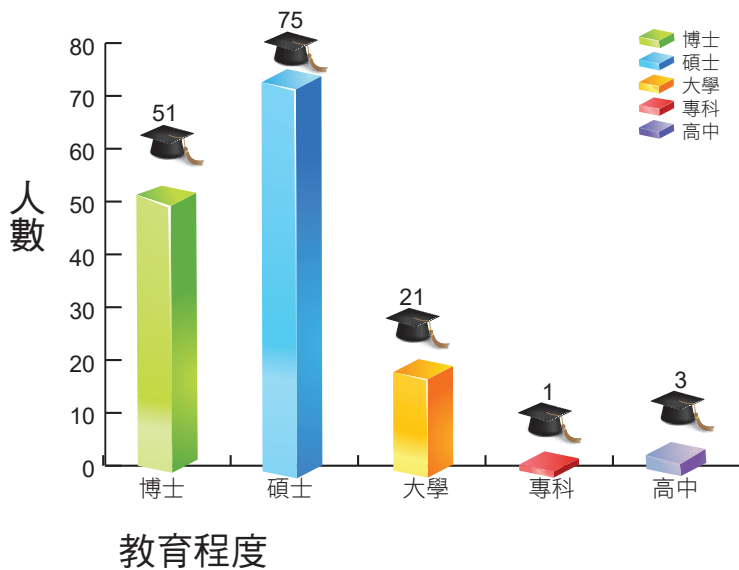
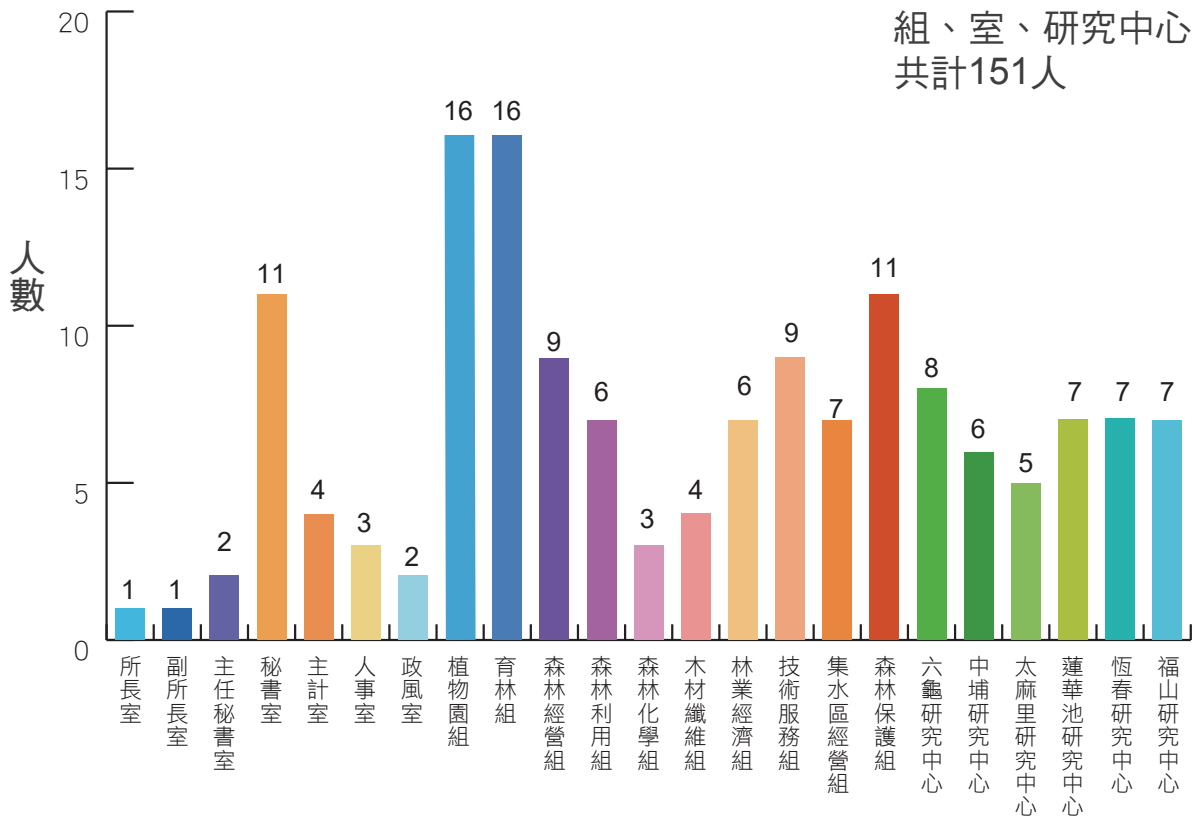
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人力資源

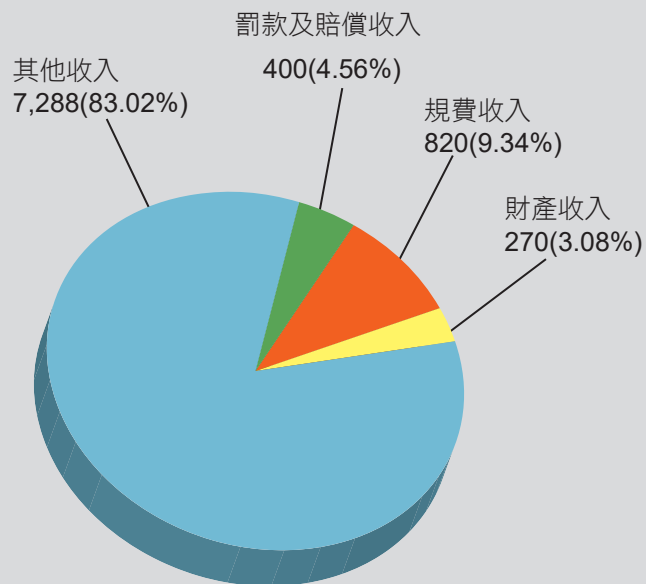




財務預決算

(一)106年度預算

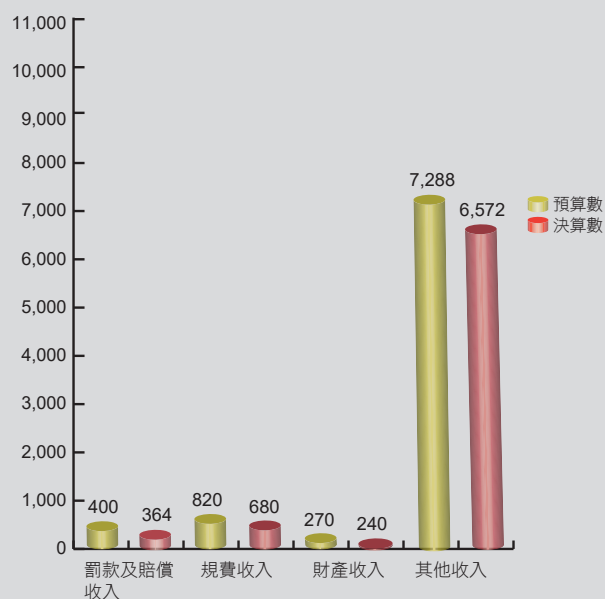
- 1.歲入：本年度歲入預算數8,778千元，較上年度8,755千元增列23千元，其主要內容如圖1。
- 2.歲出：本年度歲出預算數531,678千元，較上年度637,068千元減列105,390千元，其主要內容如圖2。



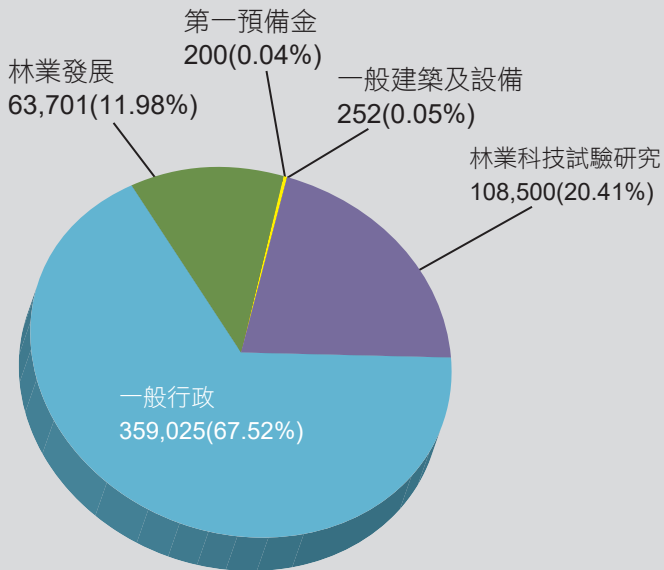
▲ 圖1. 106年度歲入預算主要內容 (單位：千元)

(二)106年度決算

- 1.歲入：本年度歲入預算數8,778千元，決算數7,856千元，執行率89.50%，其主要內容如圖3。
- 2.歲出：本年度可支用預算數531,678千元，決算數528,338千元，執行率99.41%，其主要內容如圖4。



▲ 圖3. 106年度歲入預算執行情形 (單位：千元)



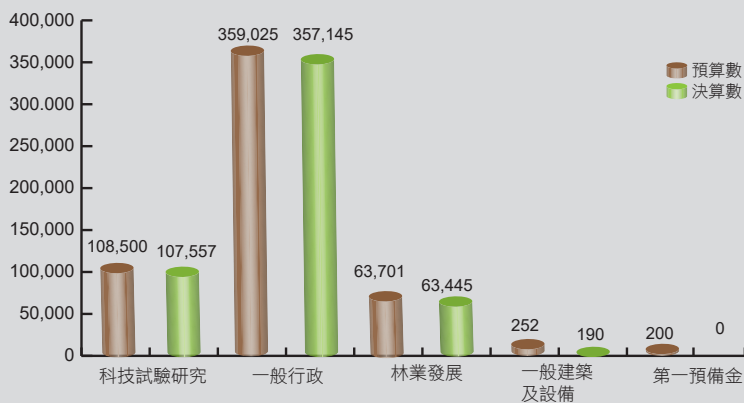
▲ 圖2. 106年度歲出預算主要內容 (單位：千元)

(三)106年度科技部補助計畫經費

本年度辦理科技部補助計畫經費9,177千元，執行數9,152千元，執行率99.73%。

(四)106年度代辦計畫經費

本年度辦理代辦計畫經費22,807千元，執行數21,813千元，執行率95.64%。



▲ 圖4. 106年度歲出預算執行情形 (單位：千元)

2017 Annual Report

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