壹、出國目的

為執行 114 年度科發基金補助計畫「淨零之農林剩餘資材多元開發與技術擴散」項下之「提升玫瑰切花採後灰黴病防禦韌性」工作項目，本場派員於 114 年 8 月 1 日至 8 日赴美國夏威夷檀香山參加美國植物病理學會(The American Phytopathological Society, APS)所舉辦之年會(Plant Health 2025)，參與全球植物健康專家齊聚一堂之盛會，共同探討植物健康管理如何應對在全球風險所帶來的挑戰，考察目前世界各國於農業病害上的最新研究與未來方向。本場本次發表論文海報共計 3 篇，分別為「Isolation, Characterization, and Biocontrol Potential of *Pythium oligandrum* in Taiwan」、「UV-Based Photonic Disease Control: Enhancing Plant Health by Suppressing Powdery Mildew and Rust in Grapevines」及「Alternative Non-Pesticide Approaches for Managing Gray Mold in Roses」，藉此分享與交流促進全球植物健康之創新策略。

貳、出國過程

日期	行程	地點	備註
8/1	桃園機場出發至日本轉機	台灣-日本(Japan)	
8/1	自日本直飛夏威夷檀香山國際機場	日本-夏威夷(Hawaii)	
8/2	APS Plant Health 2025	夏威夷檀香山 (Honolulu, Hawaii)	研討會專題演講及論文發表
8/3	APS Plant Health 2025	夏威夷檀香山 (Honolulu, Hawaii)	研討會專題演講及論文發表
8/4	APS Plant Health 2025	夏威夷檀香山 (Honolulu, Hawaii)	研討會專題演講及論文發表
8/5	APS Plant Health 2025	夏威夷檀香山 (Honolulu, Hawaii)	研討會專題演講及論文發表
8/6	當地農產品市場調查暨研討會相關資料整理	夏威夷檀香山 (Honolulu, Hawaii)	
8/7	前往機場並由檀香山飛往日本轉機	夏威夷-日本	
8/8	自日本回台北松山機場	日本-台灣	

參、發表文章內容

P-048

Isolation, Identification, and Characterization of Pythium oligandrum in Taiwan - Chao-Jen Wang[1], Ching-Chung Hsu[1], Yu-Fang Huang[1], Ting-Yao Jiang[2] ([1] Taichung District Agricultural Research and Extension Station, Ministry of Agriculture, Changhua , Taiwan; [2]Agriculture Bureau, New Taipei City Government, Taichung , Taiwan)

Pythium oligandrum has attracted global interest as a promising biocontrol agent however, its presence in field soils in Taiwan has not yet been well documented In this study, 42 soil samples were collected from central Taiwan and plated on PARP medium, yielding 131 aquatic fungal isolates Morphological and molecular analyses identified 32 of these isolates as *P. oligandrum* Representative strains (P21, P34 and P69-2) were tested for efficacy against cucumber damping off (caused by *P. spinosum*) and pea seedling blight (caused by *Rhizoctonia solani*) resulting in an 8.3-63.3% reduction in disease incidence, indicative of strong biocontrol potential. Although direct antagonism was not detected, microscopic observations revealed that these strains coiled around and penetrated the hyphae of *P. spinosum* and *R. solani* suggesting a mycoparasitic mode of action. Moreover, fermentation broth or filtrate of *P. oligandrum* strain P69-2 induced cucumber disease resistance within 48 hours via both salicylic (PAL, PR1a) and jasmonic acid (PR3, LOX1) pathways, whereas strain P34 triggered resistance solely through the jasmonic acid pathway Collectively, these findings confirm the presence of *P. oligandrum* in Taiwan and underscore its potential as a biocontrol resource. Further exploration of its mycoparasitic mechanisms and ability to induce plant defenses will contribute to the development of sustainable crop protection strategies.

P-116

Alternative Non-Pesticide Approaches for Managing Gray Mold in Roses - Pei-Hsin Lo[1], Yen-Hua Chen[1] ([1]Taichung District Agricultural Research and Extension Station, Ministry of Agriculture, Changhua , Taiwan)

Gray mold, caused by Botrytis cinerea, is the most significant disease affecting roses worldwide, causing annual losses estimated to be at least 30% of total production. This pathogen affects roses both in the field and during postharvest stages, reducing the marketability of cut flowers. With the increasing emphasis on sustainable agriculture, reducing chemical pesticide use has become essential. Furthermore, numerous studies have reported that B. cinerea has developed resistance to multiple fungicides, highlighting the need for alternative control strategies. Therefore, this study aimed to evaluate the efficacy of non-chemical treatments, specifically hypochlorous acid (HOCl) and sodium dichloroisocyanurate (NaDCC), in controlling gray mold on roses during the postharvest stage. In this study, inoculated rose petals were treated with different concentrations of these compounds, and disease severity was assessed using a 0-to-5 scale. The results demonstrated that treatment with 150 ppm HOCl and 200 ppm NaDCC significantly suppressed gray mold development on rose petals during the postharvest stage. The mean disease index (MDI) for HOCl treatment was 1.9, while NaDCC treatment resulted in an MDI of 1.5, both significantly lower than the control group (MDI = 4.2). Gray mold caused by B. cinerea is a well-documented issue in floriculture and horticulture. These findings contribute to the expanding body of research on sustainable disease management, demonstrating the potential of HOCl and NaDCC as effective alternatives to conventional fungicides.

P-299

UV-Based Photonic Disease Control: Enhancing Plant Health by Suppressing Powdery Mildew and Rust in Grapevines - Ching Ching Hsu[1], Yung-Feng Ho[1], Chin-Yuan Chang[1], Wen-Pin Yeh[1], Chin-Yuan Chang[1], Chao-Jen Wang[1] ([1]Taichung District Agricultural Research and Extension Station, Ministry of Agriculture, Changhua, Taiwan)

Powdery mildew (*Uncinula necator*) and rust (*Phakopsora euvitis*) are major fungal diseases in greenhouse grape production. Fungicide overuse raises concerns about pathogen resistance and environmental impact. This study evaluates UV-C light as a non-chemical approach to suppress pathogens and reduce fungicide reliance while assessing grapevine leaf tolerance. Controlled experiments tested UV-C (254 nm) on *U. necator* and *P. euvitis* spores, environmental fungi (*Cladosporium oryzae*, *Colletotrichum vineferum*, *Penicillium* sp., *Aspergillus niger*), and grapevine leaves. UV-C at 225 J/m² fully inhibited *U. necator*, while *P. euvitis* required ≥750 J/m². *C. oryzae* and *C. vineferum* were suppressed at 500 J/m², whereas *Penicillium* sp. and *A. niger* needed 1000 J/m². Grapevine leaves tolerated single 900 J/m² exposures without significant damage, but repeated 1500 J/m² doses reduced chlorophyll content and induced yellowing. These findings suggest UV-C effectively suppresses powdery mildew and rust and can integrate with vineyard management to lower fungicide use. A mobile UV-C system for nighttime treatment provides an efficient strategy to complement chemical control, reducing fungicide reliance while maintaining effective disease suppression and supporting sustainable viticulture.

肆、會議主軸

本次主辦為美國植物病理學會(The American Phytopathological Society)，並以“Plant Health“為大會標題，藉由口頭發表、海報發表及促進各國學者間相互討論，提升對於植物健康管理應對全球風險所帶來的挑戰，分享與開發病害健康管理之技術。本次會議共有來自超過 35 個國家（1,100 餘位學者參加），期間舉行 4 場會前工作坊、1 場 keynote speaker、40 場專題報告及 689 則海報展示，內容極為豐富。

伍、重要心得

因為本場僅有 1 位同仁參加，因此無法同時聽取各場次專題，實屬可惜。僅能針對部分的項次進行聽取，以下則針對所聽取四大方向進行說明：

一、大會專題演講：Special Session

（一）基因改造型生物防治劑（Genetically-modified Biocontrol Agents）

本專題聚焦於基因改造型生物防治劑（GM biopesticides）的研發與應用前景。學者在報告過程中指出，微生物型之生物農藥在病害管理上具多重作用機制（如拮抗、超寄生或誘導抗性等），能降低抗藥性風險並兼顧環境安全。然而，現行在田間應用時，往往受限於田間表現不穩定的回饋反應，導致後續推廣受阻。而基因工程目前已被視為提升穩定性與擴展功能的重要途徑，包括：1. 模式解析：透過轉基因改造了解並強化相關的作用機制。2. 功能增強：導入新基因以賦予額外抗性或專一性，如基因驅動（gene drive）或跨物種 RNAi。3. 配方優化：改造菌株以耐受環境壓力、提升定殖與持效性。

同時，美國 USDA-APHIS-BRS 對於可長期存活於環境的 GM 生物體之監管策略亦是持續重視的焦點之一。此議題顯示，目前國外針對未來生物防治技術的提升將結合分子育種、應用微生物學及風險管理等多面向進行。

（二）病原與守護者：聚焦革蘭氏陽性細菌（Pathogens and Protectors: Gram-positive Bacteria on Spotlight）

本專題則是強調革蘭氏陽性細菌在植物健康中所扮演的角色，以有益微生物：如 *Bacillus*、*Streptomyces*、*Paenibacillus* 等為例，其具促進植物生長、誘導抗性與抑制病原能力，已被廣泛應用於 IPM 與生物農藥開發中。另一方面，如 *Clavibacter* 屬則是重要病原菌，其對許多經濟作物造成嚴重危害，且在多國中皆屬於重要檢疫病害，

對全球農業的生產穩定性威脅極大。該報告內容涵蓋最新的致病機制探討、寄主與病原菌間的相互分子作用、傳播途徑以及作物抗病基因等利用策略。此議題凸顯未來研究應同時關注有益菌株的開發與病原菌的防治作用，並在育種、診斷及生物防治領域中發揮整合性作用。

（三）從在地到全球的解方：串聯植物診斷社群以維護植物健康安全（From Local to Global Solutions: Connecting Diagnostic Communities for Plant Health Security）

該場專題則是聚焦於診斷社群在植物健康安全與生物安全威脅防範中的核心地位，強調跨機構與跨領域的協作。在州級與聯邦實驗室則是分別扮演不同的角色，州級實驗室主要是負責早期檢測與快速回應，而聯邦實驗室則專注於受管制病原的確認與相關應對策略。此外，在非營利與產業合作方面，非營利組織乃促進州政府間協調，而產業夥伴則推動診斷技術創新並促進公私合作。至於在人才與職涯發展方面，則是透過分享診斷領域的技術、科學與監管工作機會，提升專業人才的流動與儲備。該議題更凸顯網路上的診斷社群，在國際病害防控網絡中的關鍵作用，並顯示植物健康安全需要科學、監管及產業的三方共同支撐。

二、技術場次：資料驅動的洞察與影像分析（Technical Session：Data-Driven Insights and Imaging）

此領域展示了數據驅動與影像技術在病害監測、早期預測及精準管理的最新進展，以下則分別針對各項次進行說明：

（一）高解析物理建模：利用 FDTD（Finite-Difference Time-Domain）分析，結合 X 光顯像技術，建構葉片結構影像，以建立出可解釋的葉片光散射模型，藉此捕捉植物組織在遭受病原或非病原因素時，組織造成結構退化的改變。

（二）空拍與機器學習預測：以多光譜影像監測草莓冠層葉片的健康與否，並利用 XGBoost 生存模型預測出草莓植株可能遭受土染傳播性病害之高風險區域，藉此提升早期防治效率。

（三）高光譜病原檢測：該研究已成功建立番薯壞死羽葉病毒（sweet potato feathery mottle virus, SPFMV）影像資料庫並結合機器學習（machine learning, ML）技術，利用該流程建立的二元分類模型，準確率超過 85%，進一步分析亦鑑定出與 SPFMV 感染相關的光譜區域，特別是與葉綠素相關的植被指標，可大大降低傳統檢測的勞力成

本。

（四）資料整合與流行病建模：以玉米黑脂病（*Phyllachora maydis*）為例，長期監測並結合病程模型，可有效釐清病害發展三階段（建立期 (< 0.5% severity)、遲滯期(0.5–1%)、指數期（>50%)），推翻傳統自下而上的感染假說。這些成果凸顯 AI、遙測與病理流行病學結合後，能大幅提升病害管理的時效性與精準度。

三、技術場次：作物有害生物綜合管理（Technical Session：Integrated Pest Management (IPM)）

此議題則集中在多策略整合防治的實證研究與應用案例，以下則分別進行相關說明：

（一）微生物群落與幼苗健康：研究種子萌芽至幼苗建立的 spermosphere 微生物組裝過程，確認作物專屬的核心菌群，有助於未來導入或開發促進生長及具抑病特性的微生物種類。

（二）生物誘抗劑與作物產量：虎杖萃取物（giant knotweed extract）對於由病毒引起的葡萄紅斑病（Grapevine red blotch disease），雖僅能輕微降低植株異常症狀，但卻能顯著提升產量，顯示其潛力在於促進生長而非具有直接抑制病毒表現的現象。

（三）病害管理與土壤水分之關聯：在排水不良的田區中，播種期施用殺菌劑（如 azoxystrobin）在改善植株存活及降低病害方面具有關鍵作用，其中溝內（in-furrow）施用方式在排水不良土壤中對立枯絲核菌防治具有優化潛力，顯示出播種期防治的重要性。

（四）覆蓋作物與土壤病害抑制：雖一次性種植小麥或黑麥對草莓根腐病（Macrophomina root rot）抑制有限，但透過該研究顯示該策略可明顯改變土壤微生物結構，因此需長期累積效應才能發揮病害抑制力。整體而言，IPM 研究正朝向結合生物促生、栽培管理與精準化藥劑應用的方向發展。

四、技術場次：新發生與新興病害（Technical Session：New and Emerging Diseases）

本主題涵蓋多種新興或再度崛起的重要病原菌，以下則分別介紹說明之：

（一）耐寒雜交葡萄衰退症：學者於報告中說明，*Fusarium* spp. 為目前耐寒雜交葡萄衰退症造成的主要病原菌群，而非傳統葡萄木質部病害（grapevine trunk disease, GTD），兩者的病原菌種類完全不同，因此亟需重新檢視防治策略與探討輪作對病害可能之影響。

（二）葫蘆科炭疽病再度流行：葫蘆科作物炭疽病（cucurbit anthracnose）在美國東部地區已再度興起，並造成顯著的產量損失且威脅蔬菜生產。初步分析顯示，多個菌株在 QoI 類殺菌劑感受性方面已存在差異，顯示菌株已有變異，因此未來可透過高品質基因組組裝用於種群比較分析與抗藥性監測之用。

（三）奧勒岡州苗圃與溫室產業之疫病菌威脅與管理策略研究：疫病菌屬（*Phytophthora* spp.）仍對生產構成重大威脅，其中以肉桂疫病菌（*P. cinnamomi*）、多食性疫病菌（*P. plurivora*）及近期引入的南方雪松疫病菌（*P. austrocedri*）尤為值得關注。而該研究顯示，*P. plurivora* 已取代 *P. cinnamomi* 成為優勢種。且數十年來，疫病菌主要仍以廣譜性防治手段管理，但隨著殺菌劑抗藥性上升及病原族群轉變，許多現行防治策略已逐漸失效，因此急需研究人員持續投入與重視。

（四）中國東北地區奇異莓花柱端腐病病原鑑定與感染動態研究：該研究確認有 8 種病原真菌，且枝條可能為主要初始接種源，葉斑與樹皮則為次要接種源；在開花期病原菌之分離頻率增加，顯示花期可能為關鍵初始感染時期。該研究釐清了奇異莓花柱端腐病的病原組成與感染生態，且可依此制定出綜合病害管理策略，對於減輕商業生產經濟損失提供了重要依據。

而透過以上的報告，確實反映出全球已出現病原族群結構變化、抗藥性演化及跨作物危害的現象與可能性，確實是全球植物保護所需面臨的重要挑戰。

陸、結論與建議事項

一、加強跨領域技術整合

目前農業試驗所、各區農業改良場及動植物防疫檢疫署等單位，已分別推動「智慧植物保護技術研發與應用計畫」與「病蟲害數位監測預警系統建置」。其中整合 AI 影像辨識、無人機遙測、IoT 環境感測與生物防治資料庫，逐步建構病害「偵測、診斷、防治、回饋」一體化管理流程。目前已有許多研究單位開發出 AI 病徵辨識模型，能應用於水稻稻熱病或飛蝨等病蟲害的早期識別，本場亦針對葡萄露菌病持續投入相關研究，已開發出露菌病辨識模型。建議未來可持續促進植物病理、資料科學、育種與農業工程間之跨域整合，並建立跨單位共享平台，最終形成實時決策支援系統。

二、推動基因改造型生物防治的科學與規範發展

防檢署目前已針對 *Bacillus* spp.和 *Trichoderma* spp.等潛力生物防治菌建立生物製劑安全評估與田間試驗指引，並與國內學研機構（如農試所、臺灣大學及中興大學等）合作，進行基因層級之作用機制分析。雖國內尚未正式核准基因改造型生防菌的田間使用，但基因改造生物體技術已確實為國際發展的趨勢。建議部內未來可推動跨部會合作（衛福部與環境部），並與國內科研單位共同完善試驗規範與國際風險資料比對機制，為未來基改生物防治菌合法應用鋪路。

三、強化病原監測與種群動態研究

國內防檢署於 108 年起，已委託地方縣市政府、農業試驗改良場所及各大學植物教學醫院等單位，建立重要疫病蟲害監測作業方式並持續投入經費支持，定期進行新興病原普查與重要病原菌之抗藥性監測。建議可持續且邀集各試驗單位共同執行，建立開放資料庫供產官學使用。另外，針對高風險病原（如 *Fusarium* spp.、*Phytophthora* spp.及 *Colletotrichum* spp.等），應建立長期流行病學監測計畫以隨時掌握國內疫情樣態。

四、優化整合防治策略

國內針對作物病害之 IPM 策略，目前防檢署已投入多年計畫經費，委託農業試驗單位針對國內重要作物如：番茄、小黃瓜、甜椒…等等，開發重要病蟲害的重要管理策略，透過作物、病原菌及環境組合差異進行區域化與作物專屬化設計，本場亦針對葡萄與甜椒作物，開發出葡萄晚腐病與甜椒病蟲害綜合管理技術。然田間病蟲害相多樣且更迭快速，因此建議防檢署仍需持續投入經費補助相關試驗單位，針對新興病蟲害找尋國內外新穎的研究資材或防治策略，於國內評估使用之可行性。

五、促進國際合作與經驗交流

目前農業部已積極參與國際植物健康與防疫合作網絡，例如亞太植物保護委員會（APPPC）及國際植物保護公約（IPPC）框架下的資訊交流與能力建構計畫。透過與美國農業部（USDA-APHIS）、日本農研機構（NARO）及歐盟 EPPO 等單位之互訪與技術研習，已建立病原分子鑑定標準化、影像監測與流行病模型應用等實務

交流機制。本次參與活動可進一步借鑑國外在高解析影像監測、AI 診斷及流行病預測模型整合應用的成功案例，並將臺灣現有之智慧病害監測資料與生物防治成效納入國際比較研究，以提升我國模式的能見度與可信度。建議未來農業試驗與研究單位可持續推動與國際植物診斷社群及防疫網絡（如 PlantwisePlus、CABI、APS、EPPO）的長期合作，建立跨國病害監測資料交換與共同研究平台，強化跨境病害預警與防疫協調效力，確保農業生產體系之韌性與國際貿易安全。

P-048

Isolation, Identification, and Characterization of *Pythium oligandrum* in Taiwan

Chao-Jen Wang[1] *, Ching-Chung Hsu [1], Yu-Fang Huang [1], Ting-Yao Jiang [2]

[1] Taichung District Agricultural Research and Extension Station, Ministry of Agriculture (MOA), Changhua, Taiwan (Republic of China)

[2] Agriculture Bureau, New Taipei City Government, Taichung, Taiwan (Republic of China)

*Email: chaowang@tcdares.gov.tw/ fusarium999@gmail.com

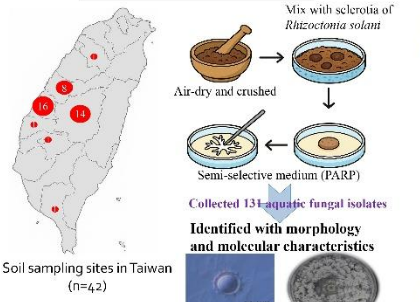
ABSTRACT

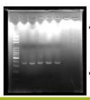
Pythium oligandrum has attracted global interest as a promising biocontrol agent; however, its presence in field soils in Taiwan has not yet been well documented. In this study, 42 soil samples were collected from central Taiwan and plated on PARP medium, yielding 131 aquatic fungal isolates. Morphological and molecular analyses identified 32 of these isolates as *P. oligandrum*. Representative strains (P21, P34, and P69-2) were tested for efficacy against cucumber damping-off (caused by *P. spinosum*) and pea seedling blight (caused by *Rhizoctonia solani*), resulting in an 8.3-63.3% reduction in disease incidence, indicative of strong biocontrol potential. Although direct antagonism was not detected, microscopic observations revealed that these strains coiled around and penetrated the hyphae of *P. spinosum* and *R. solani*, suggesting a mycoparasitic mode of action. Moreover, fermentation broth or filtrate *of P. oligandrum* strain P69-2 induced cucumber disease resistance within 48 hours via both salicylic (PAL, PR1a) and jasmonic acid (PR3, LOX1) pathways, whereas strain P34 triggered resistance solely through the jasmonic acid pathway. Collectively, these findings confirm the presence of *P. oligandrum* in Taiwan and underscore its potential as a biocontrol resource. Further exploration of its mycoparasitic mechanisms and ability to induce plant defenses will contribute to the development of sustainable crop protection strategies.

Introduction

Although most members of the genus *Pythium* are soil-borne pathogens, *Pythium oligandrum* is a striking exception. It colonises plant roots asymptomatically, entwines and lyses the hyphae of fungal and oomycete pathogens, and simultaneously primes host defences. Since its first description in 1930, the species has been isolated from tomato, cucumber, sugar beet and many other crops, suppressing disease in at least sixteen crop-pathogen systems. Curated strains remain unavailable in Taiwan, and only a few early studies (1993, 2000) reported indigenous isolates with hyperparasitic, disease-mitigating activity. To bridge this gap, the present study will survey agro-ecosystems in central Taiwan, recover native *P. oligandrum* strains, characterise their antagonistic and elucidate the underlying biocontrol mechanisms to advance sustainable crop protection.

Materials & Methods

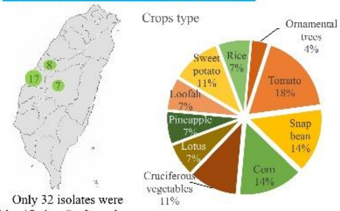




- The internal transcribed spacer (ITS) sequence was queried against the NCBI nucleotide database using BLAST.
- *P. oligandrum* specific primers: P_OLIG_F1/P_OLIG_R04 (Godfrey *et al*., 2003)

Results

Isolates number and crops type



Only 32 isolates were identified as *P. oligandrum*

Biocontrol Efficacy

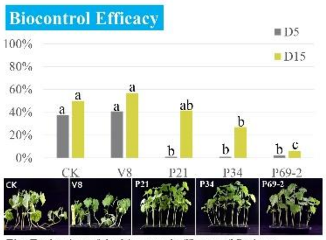


Fig. Evaluation of the biocontrol efficacy of *Pythium oligandrum* against Pythium-induced damping-off disease in cucumber (*Cucumis sativus*) seedlings.

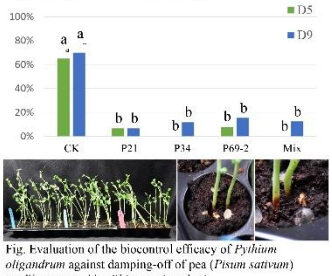
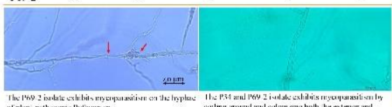


Fig. Evaluation of the biocontrol efficacy of *Pythium oligandrum* against damping-off of pea (*Pisum sativum*) seedlings caused by *Rhizoctonia solani*.

Mechanisms- Mycoparasitism

Table. Evaluation of the hyperparasitic capability of *Pythium oligandrum* against common plant pathogens

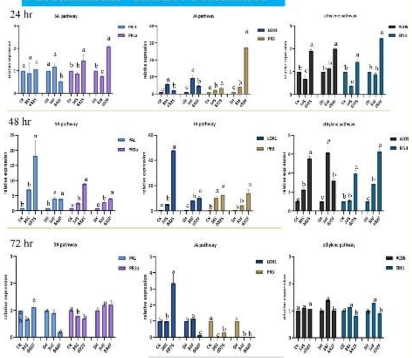
	Pythium	*Rhizoctonia*	*Phytophthora*	*Phytopythium*	*Fusarium*
P34		–			
P69-2	+	–	–	–	–



The P69-2 isolate exhibits mycoparasitism on the hyphae of plant-pathogenic Pythium sp.

The P34 and P69-2 isolate exhibits mycoparasitism by coiling around and colonizing both the exterior and interior of *Rhizoctonia solani* hyphae.

Mechanisms- Induce resistance



Conclusions

1. Indigenous *Pythium oligandrum* occurred in 32/131 isolates from 42 central-Taiwan soils; it is common in conventional fields yet highly fungicide-sensitive, so routine drenches can negate its protection.
2. Strains P21, P34, P69-2 lowered cucumber damping-off and pea blight by 8–63 % and triggered crop-specific SA- and/or JA-mediated defences within 48 h.
3. All isolates coiled around and penetrated *P. spinosum* and *Rhizoctonia solani*; this hyperparasitic phenotype provides a rapid microscopic screen for elite strains and highlights *P. oligandrum*'s promise for sustainable disease control.

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Alternative Non-Pesticide Approaches for Managing Gray Mold in Roses

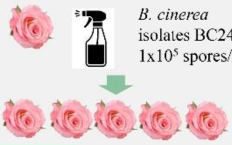
Pei-Hsin Lo, Yen-Hua Chen
Taichung District Agricultural Research and Extension Station, Ministry of Agriculture, Changhua, Taiwan
loph@tcdares.gov.tw

Introduction

Gray mold, caused by *Botrytis cinerea*, is the most significant disease affecting roses worldwide, causing annual losses estimated to be at least 30% of total production. This pathogen affects roses both in the field and during postharvest stages, reducing the marketability of cut flowers. With the increasing emphasis on sustainable agriculture, reducing chemical pesticide use has become essential. The objectives of this study were: (1) to establish a platform for gray mold disease assessment, (2) to evaluate the efficacy of non-chemical treatments, specifically hypochlorous acid (HOCl) and sodium dichloroisocyanurate (NaDCC), in controlling gray mold on roses during the postharvest stage.

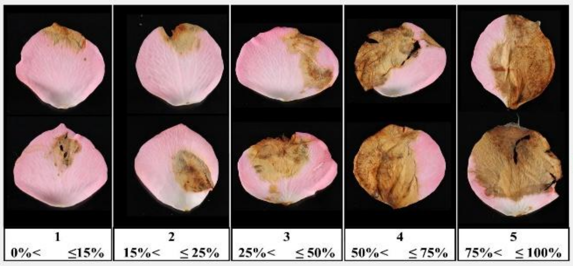
Materials and Methods

B. cinerea inoculation



Treatments

- 150 ppm hypochlorous acid (HOCl)
- 200 ppm sodium dichloroisocyanurate (NaDCC)
- Water
- Untreated



Disease index 0-5 scale

Mean disease index (MDI)
$$= \sum (Ni \times i) / Nt$$

Ni diseased petals,
i disease scale,
Nt total petals

Results

Quantification of the disease

To quantify gray mold on rose petals, disease area and disease incidence are commonly used. In this study, disease area was quantified using ImageJ and classified into a 0–5 scale. Disease severity was further assessed using the mean disease index (MDI). The results showed that MDI values exhibited similar trends in disease progression. Although disease incidence is also a common approach to quantify gray mold, it may not always accurately reflect the actual progression or severity of the disease. Therefore, in this study, evaluation based on the mean disease index was considered the most suitable method for assessing gray mold severity on rose petals.

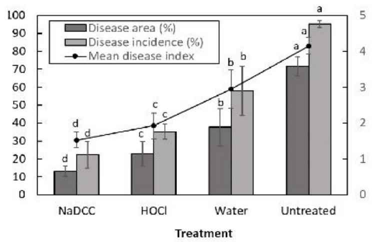


Fig. 1. Disease assessment of gray mold in roses using disease area, disease incidence, and mean disease index (MDI).

The effect of alternative non-pesticide on controlling gray mold in Rose

After spraying the spore suspension of *B. cinerea* isolate BC2401r and dipping the rose petals into solutions of non-pesticide materials, 200 ppm NaDCC and 150 ppm HOCl, the disease severity was assessed. Five days after inoculation, the results demonstrated that treatment with 200 ppm NaDCC and 150 ppm HOCl significantly suppressed gray mold development on rose petals during the postharvest stage.

The mean disease index (MDI) for the NaDCC treatment was 1.5, while the HOCl treatment resulted in an MDI of 1.9. Both values were significantly lower than those of the untreated control (MDI = 4.2) and the water-treated control group (MDI = 3.0). These findings suggest that NaDCC and HOCl are promising alternatives for controlling postharvest gray mold.

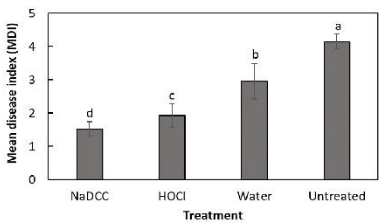


Fig. 2. Efficacy of 200 ppm sodium dichloroisocyanurate (NaDCC) and 150 ppm hypochlorous acid (HOCl) in controlling gray mold on roses.

Conclusion

Gray mold caused by *B. cinerea* is a well-documented issue in floriculture and horticulture. These findings contribute to the expanding body of research on sustainable disease management, demonstrating the potential of HOCl and NaDCC as effective alternatives to conventional fungicides.

UV-Based Photonic Disease Control: Enhancing Plant Health by Suppressing Powdery Mildew and Rust in Grapevines

Ching Ching Hsu[1], Yung-Feng Ho[1], Chin-Yuan Chang[1], Wen-Pin Yeh[1], Chin-Yuan Chang[1], Chao-Jen Wang[1]
[1] Taichung District Agricultural Research and Extension Station, Ministry of Agriculture (MOA), Changhua, Taiwan (Republic of China)
*Email: hsuching@tcdares.gov.tw/ helianthus02@gmail.com

Abstract

Powdery mildew (*Uncinula necator*) and rust (*Phakopsora euvitis*) are major fungal diseases in greenhouse grape production. Fungicide overuse raises concerns about pathogen resistance and environmental impact. This study evaluates UV-C light as a non-chemical approach to suppress pathogens and reduce fungicide reliance while assessing grapevine leaf tolerance. Controlled experiments tested UV-C (254 nm) on *U. necator* and *P. euvitis* spores, environmental fungi (*Cladosporium oryzae, Colletotrichum vineferum, Penicillium sp., Aspergillus niger*), and grapevine leaves. UV-C at 225 J/m² fully inhibited *U. necator*, while *P. euvitis* required ≥750 J/m². *C. oryzae* and *C. vineferum* were suppressed at 500 J/m², whereas *Penicillium sp.* and *A. niger* needed 1000 J/m². Grapevine leaves tolerated single 900 J/m² exposures without significant damage, but repeated 1500 J/m² doses reduced chlorophyll content and induced yellowing. These findings suggest UV-C effectively suppresses powdery mildew and rust and can integrate with vineyard management to lower fungicide use. A mobile UV-C system for nighttime treatment provides an efficient strategy to complement chemical control, reducing fungicide reliance while maintaining effective disease suppression and supporting sustainable viticulture.

Introduction

Powdery mildew (*Uncinula necator*) and rust (*Phakopsora euvitis*) are two of the most prevalent fungal diseases affecting greenhouse grape production in Taiwan. Conventional disease management relies heavily on chemical fungicides, leading to issues such as labor intensity, environmental impact, and the emergence of fungicide-resistant strains. In light of increasing demand for sustainable and residue-free agriculture, this study investigates the potential of ultraviolet-C (UV-C) light as a non-chemical strategy for pathogen suppression. The system developed—termed the Photonic Pest Suppression System (PPSS)—integrates targeted UV-C exposure with nighttime mobile treatment, aiming to reduce fungicide reliance while maintaining effective disease control.

Materials and Methods

1. UV-C light at 254 nm was provided by a low-pressure mercury lamp. To assess pathogen suppression, conidia of powdery mildew (*Uncinula necator*) cultured for 18–20 days were spread onto water agar (WA) plates. After 30 minutes of dark adaptation, the plates were exposed to UV-C doses of 0, 25, 45, 90, 113, and 225 J/m². Germination rates were measured 24 hours later by counting 400 spores per plate.
2. Environmental fungi, including *Cladosporium oryzae, Colletotrichum vineferum, Penicillium sp.*, and *Aspergillus niger*, were tested using spore suspensions (10^4 CFU/mL) plated on WA. After dark adaptation, the plates were exposed to 0, 250, 500, 1000, 2000, or 4000 J/m². Colony counts were recorded after 2–3 days of incubation at 28°C and 90% humidity.
3. To evaluate leaf tolerance, grapevine leaf discs were placed on moist filter paper in Petri dishes and exposed to single (2000–5000 J/m²) or repeated (1000–2500 J/m² for two days) UV-C doses. After 7 days of incubation at 22°C, leaf damage was visually assessed, and chlorophyll content was measured to evaluate physiological effects.

Results

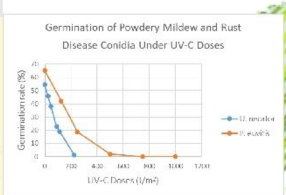
■ Spore Suppression – Powdery Mildew
UV-C irradiation significantly reduced *U. necator* spore germination in a dose-dependent manner. A single dose of 225 J/m² achieved near-complete inhibition within 24 hours.

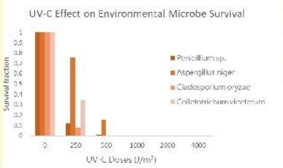
■ Spore Suppression – Rust
P. euvitis spores were more tolerant to UV-C. A dose of 500 J/m² suppressed over 90% of germination, and 750 J/m² achieved full inhibition.

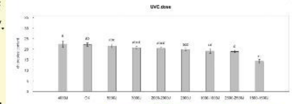
■ Environmental Fungi Inactivation
Among environmental fungi, 1000 J/m² UV-C completely suppressed colony growth. At 500 J/m², only *Aspergillus niger* showed partial survival (~15%), while *Penicillium* sp.and *C. oryzae*, were fully inhibited.

■ Leaf Tolerance – Visual Damage
No visible necrosis or browning was observed at single doses up to 900 J/m². Leaves remained visually healthy.

■ Leaf Tolerance – Chlorophyll Impact
Single-dose treatments did not significantly reduce chlorophyll content. However, repeated exposures—particularly 1500–1500 J/m² and above—led to marked chlorophyll loss and visible yellowing, indicating cumulative stress effects.

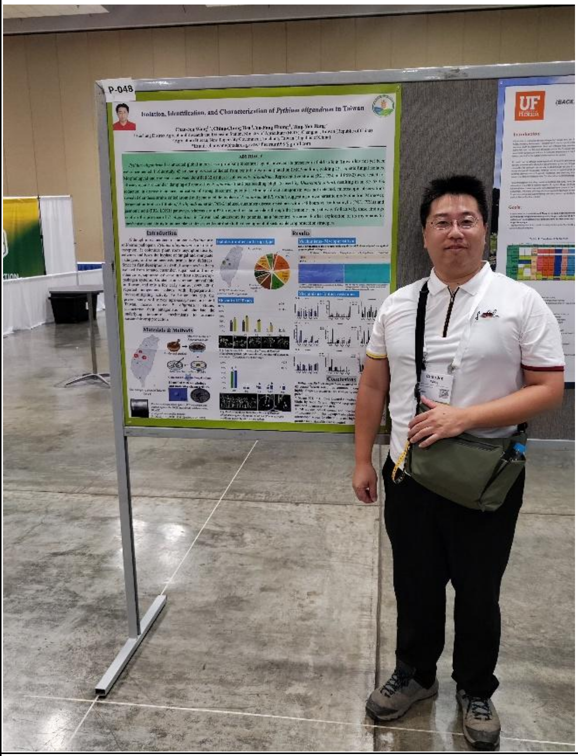




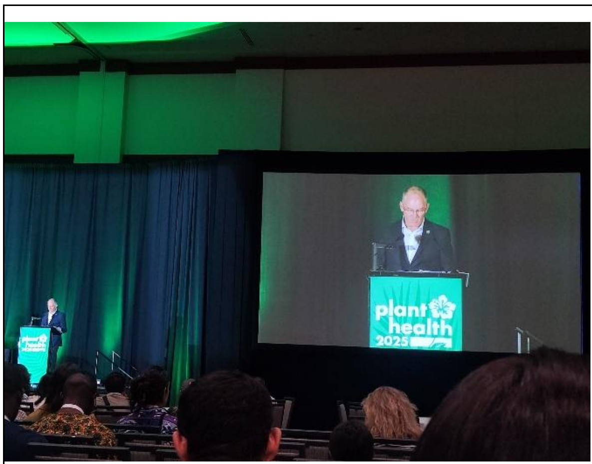


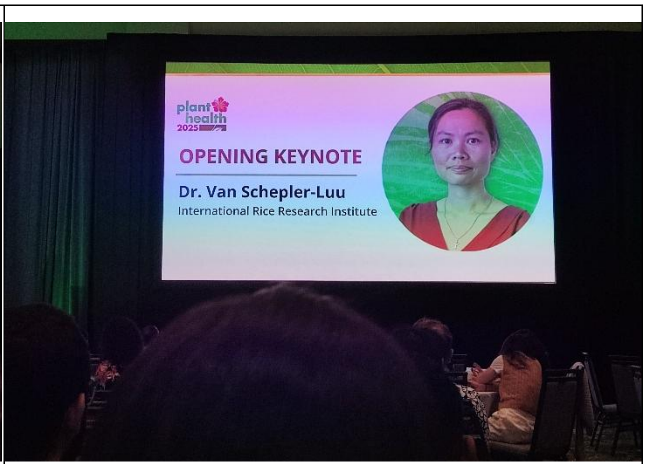
Conclusions

UV-C irradiation effectively suppressed key grapevine pathogens, with complete inhibition achieved at defined dosage thresholds. Grapevine leaves tolerated single exposures without visible damage, though repeated high doses reduced chlorophyll content. To enhance practicality, this approach has been integrated into a mobile autonomous platform for nighttime operation. The system offers a non-chemical, residue-free strategy that complements fungicide use and supports more sustainable and automated vineyard management.



圖：筆者於海報展示（左）與報名處（右）留影。





圖：筆者於大會開場、大會專題及技術專題演講聽留影。

圖、筆者於農夫市集與一般賣場調查當地水果樣態及常見病害（可觀察到木瓜炭疽病與洋香瓜炭疽病）。