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粗腳姬捲葉蛾雌腹末萃取液中之酯類及醇類化合物對性費洛蒙主成分乙酸(*Z*)-8-十二烯-1-基酯((*Z*)-8-dodecen-1-yl acetate, *Z*8-12:Ac)誘蟲之影響

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摘 要

本試驗以六角形木質轉盤生物檢定法及田間誘蟲試驗，釐清經化學鑑定粗腳姬捲葉蛾(*Cryptophlebia ombrodelta* (Lower))雌腹末萃取液中之酯類及醇類化合物乙酸(*E*)-8-十二烯-1-基酯((*E*)-8-dodecen-1-yl acetate, *E*8-12:Ac)、乙酸 1-十二酯(1-dodecyl acetate,1-12:Ac)、乙酸 1-十四酯(1-tetradecyl acetate, 1-14:Ac)、乙酸 1-十六酯(1-hexadecyl acetate, 1-16:Ac)、乙酸 1-十八酯(1-octadecyl acetate, 1-18:Ac)、(*Z*)-8-十二烯-1-醇((*Z*)-8-dodecen-1-ol, *Z*8-12:OH)、(*E*)-8-十二烯-1-醇((*E*)-8-dodecen-1-ol, *E*8-12:OH)、1-十二醇(1-dodecanol, 1-12:OH)、1-十八醇(1-octadecanol, 1-18:OH)等 9 個成分對性費洛蒙主成分乙酸(*Z*)-8-十二烯-1-基酯((*Z*)-8-dodecen-1-yl acetate, *Z*8-12:Ac)誘蟲活性之影響。結果顯示 *Z*8-12:Ac 以 1000 μg 裝載於紅色橡皮帽之誘蟲效果最佳；*Z*/*E*8-12:Ac 不同比例配方以 *Z*8-12:Ac/*E*8-12:Ac =100~96/0~4 對粗腳姬捲葉蛾之誘蟲效果較佳，當 *E*8-12:Ac 達 6%時，誘蟲效果顯著降低。因此以 *Z*8-12:Ac/*E*8-12:Ac=96/4 爲基礎，再混合不同比例之其他 8 種成分進行試驗。結果顯示混合 1-12:OH、1-18:OH、1-14:Ac、1-16:Ac、1-18:Ac 對誘餌之誘蟲活性無影響。混合 1-12:Ac 比例爲 30、40 時，田間試驗顯示其總誘蟲數(13、14 隻)較其他配方者(3~7 隻)爲高。混合不同比例之 *Z*8-12:OH 者於田間誘蟲結果其總誘蟲數(9~22 隻)約 3 倍多於未含者(3、4 隻)。混合不同比例之 *E*8-12:OH 於田間誘蟲結果其總誘蟲數(17~22 隻)均較未含者(1 隻)爲高。由以上誘蟲結果顯示粗腳姬捲葉蛾性費洛蒙組成分含有 *Z*8-12:Ac、*E*8-12:Ac、*Z*8-12:OH、及 *E*8-12:OH 等 4 個成分。

關鍵詞：粗腳姬捲葉蛾(*Cryptophlebia ombrodelta* (Lower))、乙酸(*Z*)/(*E*)-8-十二烯-1-基酯、(*Z*)/(*E*)-8-十二烯-1-醇

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前　言

粗腳姬捲葉蛾(*Cryptophlebia ombrodelta* (Lower))屬鱗翅目、捲葉蛾科(Lepidoptera: Tortricidae)。分布於台灣、華南、華北、日本、馬來西亞、印度、澳洲、夏威夷及大洋洲等地。爲害寄主有胡桃、荔枝、羅望子、楊桃、皇帝豆、阿勃勒(臘腸樹)、橙、豆科之決明屬及合歡屬等(Ironside, 1974; Lingappa and Siddappaji, 1981; Ho, 1985; Jones, 1994a, b; McQuate *et al.*, 2000)。粗腳姬捲葉蛾的危害狀主爲鑽入果實中取食，致使果實內含蟲糞，造成果實畸形、落果，影響果實品質與產量。在澳洲及夏威夷，粗腳姬捲葉蛾主要危害荔枝和胡桃，有荔枝果蛀蟲(litchi fruit moth)及胡桃果蛀蟲(macadamia nut borer)之稱。在夏威夷，以輻射檢疫 sapindaceous fruits 上之 *Cryptophlebia* spp.，使用 250 Gy 強度即可達檢疫目標(Follett and Lower, 2000)。另夏威夷荔枝及龍眼出口以 49℃熱水浸漬處理 20 min 檢疫果實蠅的方法，對 *C. illepida*, and *C. ombrodelta* 亦可達到完全檢疫之目標(Follett and Sanxter, 2001)。於澳洲曾報導胡桃因其危害損失率高達 60%。於印度報導其亦能危害羅望子，有羅望子果蛀蟲(tamarind fruit borer)之稱，由於鑽入果實危害的習性，藥劑防治不易(Lingappa and Siddappaji, 1981; Jones, 1994a, b)。

多篇報導顯示乙酸(*Z*)-8-十二烯-1-基酯((*Z*)-8-dodecen-1-yl acetate, *Z*8-12:Ac)爲粗腳姬捲葉蛾性誘引劑(Mitchell, 1973; Ando *et al.*, 1977; Hwang *et al.*, 1987)。本研究前篇報導粗腳姬捲葉蛾雌蟲腹末萃取液中醇及酯類化合物經鑑定含 *Z*8-12:Ac、乙酸(*E*)-8-十二烯-1-基酯((*E*)-8-dodecen-1-yl acetate, *E*8-12:Ac)、乙酸 1-十二酯(1-dodecyl acetate, 1-12:Ac)、乙酸 1-十四酯 (1-tetradecyl acetate, 1-14:Ac)、乙酸 1-十六酯(1-hexadecyl acetate, 1-16:Ac)、乙酸 1-十八酯(1-octadecyl acetate, 1-18:Ac)、(*Z*)-8-十二烯-1-醇((*Z*)-8-dodecen-1-ol, *Z*8-12:OH)、(*E*)-8-十二烯-1-醇((*E*)-8-dodecen-1-ol, *E*8-12:OH)、1-十二醇(1-dodecanol, 1-12:OH)、1-十八醇(1-octadecanol, 1-18:OH)等 10 個成分，其比例爲 96/4/30/5/5/5/10/1/2/1；其中僅成分 *Z*8-12:Ac 對粗腳姬捲葉蛾具誘蟲活性，爲粗腳姬捲葉蛾性費洛蒙主成分(Hung *et al.*, 2007)。本研究配製多種性費洛蒙配方，以轉盤生物檢定法與田間誘蟲試驗，釐清粗腳姬捲葉蛾性費洛蒙其他組成分，並進一步探討其他九個成分對粗腳姬捲葉蛾性費洛蒙主成分 *Z*8-12:Ac 誘蟲之影響，作爲研發其誘引有效配方提供參考使用。

材料與方法

一、試驗蟲源

試驗所需之粗腳姬捲葉蛾係採自彰化縣八卦山地區楊桃園，於 25 ± 2℃、70 ± 5% RH 及 12 小時光照期之養蟲室內，以玉米人工飼料大量繁殖(Hung and Hwang, 1991; Hung *et al.*, 1998)，於蛹期分雌、雄後，置於養蟲室內，待成蟲羽化供作試驗蟲源。

二、化學標準品來源與誘餌配製

供試化合物：1-12:Ac、1-12:OH、*Z*8-12:Ac、*E*8-12:Ac、*Z*8-12:OH、*E*8-12:OH、1-14:Ac、1-16:Ac、1-18:Ac、1-18:OH 等其來源與純度如表一。供試誘餌之配製係將供試配方注於橡皮帽(美國 Aldrich 公司，產品編號分別爲 Z12,435-4)。

表一　粗腳姬捲葉蛾性費洛蒙誘餌配方化合物之來源與純度

Table 1. Sources and purities of the chemical compounds for research of a sex pheromone lure of *Cryptophlebia ombrodelta*

Standard compounds (abbreviation)	Chinese name	Source (purity, %)
1-dodecyl acetate (1-12:Ac)	乙酸 1-十二酯	Aldrich Chemical Company, Milwaukee, WI, USA (97%)
1-dodecanol (1-12:OH)	1-十二醇	Lancaster Synthesis, Lancashire, UK (97%), Fluka Chemie AG, Buchs, Switzerland (99.5%)
(*Z*)-8-dodecen-1-yl acetate (*Z*8-12:Ac)	乙酸(*Z*)-8-十二烯-1-基酯	Sigma Chemical Co., St. Louis, MO, USA (95%, 96.8%), Instituut voor Planteziektenkundig Onderzoek (IPO) (› 99%), Shin-Etsu Chemical Co., City, Japan (96.06%)
(*E*)-8-dodecen-1-yl acetate (*E*8-12:Ac)	乙酸(*E*)-8-十二烯-1-基酯	Sigma Chemical Co., St. Louis, MO, USA
(*Z*)-8-dodecen-1-ol (*Z*8-12:OH)	(*Z*)-8-十二烯-1-醇	Chemtech B. V., Ltd., the Netherlands (93%), IPO (› 99%)
(*E*)-8-dodecen-1-ol (*E*8-12:OH)	(*E*)-8-十二烯-1-醇	Synthesized from (*E*)-8-dodecen-1-yl acetate, Chemtech B. V., Ltd., the Netherlands (94%)
1-tetradecyl acetate (1-14:Ac)	乙酸 1-十四 酯	Synthesized from 1-tetradecanol
1-hexadecyl acetate (1-16:Ac)	乙酸 1-十六酯	Synthesized from 1-hexadecanol
1-octadecyl acetate (1-18:Ac)	乙酸 1-十八酯	Tokyo Chemical Industry Co., Tokyo, Japan (99%)
1-octadecanol (1-18:OH)	1-十八醇	Lancaster Synthesis (97%)

三、六角型木質網箱轉盤生物檢定試驗

六角型轉盤生物檢定法之設計，係參考花姬捲葉蛾性費洛蒙檢定方法(Hung *et al.*, 1999)，於溫度 25 ± 2℃、70 ± 5% RH 及 12 小時光照周期之走入式生長箱或自然條件下之實驗室中進行。於邊長 50 cm 及高 50 cm 之六角型木質網箱內釋放 300~500 隻雄蟲，再於網箱每側中央位置開一直徑 9 cm 之孔洞上，插入內含不同配方誘餌之布丁杯(上蓋直徑爲 9.5 cm、下底直徑爲 8.0 cm。今一股份有限公司)誘蟲器，布丁杯內面開有 5 個約 0.6 cm 的方形孔洞，讓反應的雄蟲可進入布丁杯內；將前述六角型木質網箱置於電動轉盤上，轉盤轉速設定爲 0.67 rpm。每次試驗於燈亮後開始試驗，4 小時後觀察記錄進入布丁杯誘蟲器之雄蟲數。每次試驗均含有空白誘蟲器爲對照組。試驗所得誘蟲數換算爲百分率，經 $\sin^{-1}\sqrt{x}$ 轉值，行變方分析及鄧肯氏測驗比較各處理之差異性。

四、田間誘蟲試驗

田間誘蟲試驗係於彰化縣員林鎮社頭鄉楊桃果園及南投縣南崗荔枝園中進行。試驗時，將性費洛蒙誘餌置於翼型黏膠式誘蟲器之上蓋(臺灣甲富股份有限公司)，誘蟲器懸掛於離地約 150 cm 高的楊桃樹枝條上，誘蟲器間距離 10~15 m，每 1~2 週觀察記錄誘蟲數並輪調位置。

五、不同日齡粗腳姬捲葉蛾雄蛾對費洛蒙之反應

以含 1 mg 之 *Z*8-12:Ac (Shin-Etsu Chemical Co.)之紅色橡皮帽性費洛蒙誘餌，

置於布丁杯誘蟲器中，再裝置於木質網箱轉盤上，分別釋放 0、1、2、4、5 日齡雄成蟲 100~150 隻，進行六角型木質網箱轉盤生物檢定，經 24 hr 觀察紀錄誘蟲數，並數算剩下的蟲數，以計算再捕率(誘蟲數/總蟲數×100)。本試驗每日齡 3 重複。

六、不同劑量 *Z*-8-12:Ac 裝載於紅色橡皮帽對粗腳姬捲葉蛾之誘引試驗

配製含 *Z*8-12:Ac (IPO)不同劑量分別爲 0.1、1、10、100、1000 μg 之誘餌，依前述六角型木質網箱轉盤生物檢定法，試驗不同劑量下 *Z*8-12:Ac 對粗腳姬捲葉蛾雄蟲之誘引性。本試驗 10 重複。

七、不同比例 *Z*/*E*8-12:Ac 性費洛蒙配方對粗腳姬捲葉蛾之誘引試驗

配製含不同比例 1 mg *Z*/*E*8-12:Ac，分兩次試驗進行六角型木質網箱轉盤生物檢定，測試不同比例 *Z*/*E*8-12:Ac 對粗腳姬捲葉蛾之誘引性。兩次試驗處理別分別爲第一次試驗：*Z*/*E*8-12:Ac＝100/0、99.5/0.5、98/2、96/4、0/100。第二次試驗：*Z*/*E*8-12:Ac＝100/0、96/4、94/6、92/8、0/100。本試驗以空白者爲對照組，第一次試驗及第二次試驗分別重複 10 及 9 次。

八、誘餌 *Z*/*E*8-12:Ac = 96/4 混合其他成分不同比例配方對粗腳姬捲葉蛾之誘引試驗

以 *Z*/*E*8-12:Ac = 96/4 爲主，配製含其他 8 種成分不同比例之配方誘餌，進行六角型木質網箱轉盤生物檢定及田間誘蟲試驗。六角型木質網箱轉盤生物檢定方法如上所述，以空白爲對照組。田間誘蟲試驗除(一)*Z*8-12:OH 影響：第一次試驗於 1997 年 9 月 19 日至 1997 年 11 月 4 日於南投縣南投市荔枝果園進行，每週調查一次並輪調各處理位置，連續調查 6 次。其餘田間試驗均於 2001 年 3 月 1 日至 2001 年 6 月 4 日於彰化縣員林鎮楊桃果園進行田間誘蟲試驗，測試含其他 8 種成分不同比例之配方誘餌對粗腳姬捲葉蛾之誘蟲效果。試驗時，將不同配方誘餌置於翼型黏膠式誘蟲器中，每 10-14 日調查一次並輪調各處理位置，連續調查 7 次。一重複。本試驗分別進行以下試驗：

(一)*Z*8-12:OH 之影響：本試驗進行兩項試驗，第一次試驗配製 *Z*8-12:Ac/*E*8-12:Ac/*Z*8-12:OH = 96/4/0、96/4/10、96/4/40、96/4/80、96/4/160 等誘餌配方，六角型木質網箱轉盤生物檢定測試 12 次。田間誘蟲試驗於南投縣南投市荔枝果園進行，四重複。第二次試驗配製 *Z*8-12:Ac/*E*8-12:Ac/*Z*8-12:OH = 96/4/0、96/4/5、96/4/10、96/4/20、96/4/30 等誘餌配方，進行田間誘蟲試驗及六角型木質網箱轉盤生物檢定測試 6 次，並以配方 *Z*8-12:Ac/*E*8-12:Ac/*Z*8-12:OH = 96/4/10 及空白組爲對照。

(二)*E*8-12:OH 之影響：配製 *Z*8-12:Ac/*E*8-12:Ac/*E*8-12:OH = 96/4/0、96/4/1、96/4/2、96/4/5、96/4/10 等誘餌配方，進行田間誘蟲試驗及六角型木質網箱轉盤生物檢定測試 6 次。本試驗以配方 *Z*8-12:Ac/*E*8-12:Ac/*E*8-12:OH = 96/4/1 及空白組爲對照。

(三)1-12:OH 之影響：配製 *Z*8-12:Ac/*E*8-12:Ac/1-12:OH = 96/4/0、96/4/2、96/4/5、96/4/10、96/4/20 等誘餌配方，進行田間誘蟲試驗及六角型木質網箱轉盤生物檢定測試 5 次。本試驗以配方 Z8-12:Ac/*E*8-12:Ac/1-12:OH = 96/4/2 及空白組爲對照。

(四)1-18:OH 之影響：配製 *Z*8-12:Ac/*E*8-12:Ac/1-18:OH = 96/4/0、96/4/1、96/4/2、96/4/5、96/4/10 等誘餌配方，進行田間誘蟲試驗及六角型木質網箱轉盤生物檢定測試 6 次。

表二　以六角型木質轉盤檢定不同日齡粗腳姬捲葉蛾雄蛾對費洛蒙之反應

Table 2. Catches of male *Cryptophlebia ombrodelta* moths of different ages in traps baited with a red septum loaded with 1 mg of *Z*8-12:Ac/*E*8-12:Ac = 96/4 with a turntable bioassay[1)]

Male moth age	Mean no. of moths captured	Percent (%) of moths recaptured
0 day old	36.0 ± 9.0	38.0 ± 4.8
1 day old	52.3 ± 20.2	52.0 ± 23.1
2 days old	28.7 ± 22.7	24.2 ± 25.2
4 days old	4.5 ± 6.6	3.1 ± 4.2
5 days old	0.3 ± 0.6	0.3 ± 0.6

[1)] The mean ± S.D. was derived from three replications.

本試驗以配方 *Z*8-12:Ac/*E*8-12:Ac/1-18:OH = 96/4/1 及空白組爲對照。

(五)1-12:Ac 之影響:配製*Z*8-12:Ac/*E*8-12:Ac/1-12:Ac = 96/4/0、96/4/10、96/4/20、96/4/30、96/4/40 等誘餌配方，進行田間誘蟲試驗及六角型木質網箱轉盤生物檢定測試 8 次。本試驗以配方 *Z*8-12:Ac/*E*8-12:Ac/1-12:Ac = 96/4/30 及空白組爲對照。

(六)1-14:Ac 之影響:配製*Z*8-12:Ac/*E*8-12:Ac/1-14:Ac = 96/4/0、96/4/2、96/4/5、96/4/10、96/4/20 等誘餌配方，進行田間誘蟲試驗及六角型木質網箱轉盤生物檢定測試 5 次。本試驗以配方 *Z*8-12:Ac/*E*8-12:Ac/1-14:Ac = 96/4/5 及空白組爲對照。

(七)1-16:Ac 之影響:配製*Z*8-12:Ac/*E*8-12:Ac/1-16:Ac = 96/4/0、96/4/5、96/4/10、96/4/20、96/4/30 等誘餌配方，進行田間誘蟲試驗及六角型木質網箱轉盤生物檢定測試 14 次。本試驗以配方 *Z*8-12:Ac/*E*8-12:Ac/1-16:Ac = 96/4/5 及空白組爲對照。

(八)1-18:Ac 之影響:配製*Z*8-12:Ac/*E*8-12:Ac/1-18:Ac = 96/4/0、96/4/2、96/4/5、96/4/10、96/4/20 等誘餌配方，進行田間誘蟲試驗及六角型木質網箱轉盤生物檢定測試 11 次。本試驗以配方 *Z*8-12:Ac/*E*8-12:Ac/1-18:Ac = 96/4/5 及空白組爲對照。

結　果

一、不同日齡粗腳姬捲葉蛾雄蛾對費洛蒙之反應

不同日齡粗腳姬捲葉蛾雄蛾對費洛蒙之反應結果如表二。以 0、1、2 日齡雄蟲對費洛蒙顯示較佳的反應效果，再捕率分別爲 38.0、52.0、24.2%，平均誘蟲數分別爲 36.0、52.3、及 28.7 insect/replicate (表二)。因此，本試驗之生物檢定皆取 0~2 日齡雄蟲供作試驗蟲源。

二、不同劑量 *Z*8-12:Ac 裝載於紅色橡皮帽對粗腳姬捲葉蛾之誘引性

*Z*8-12:Ac 不同劑量對粗腳姬捲葉蛾之誘引性試驗結果顯示，以劑量爲 1000 μg 之誘餌對粗腳姬捲葉蛾具顯著性誘引力，誘蟲百分率高達 90.5%；劑量 10 μg 者以下即無誘蟲效果 (F = 178.8506, d.f. = 54, p = 0.000000*) (表三)。

三、不同比例 *Z*/*E*8-12:Ac 性費洛蒙配方對粗腳姬捲葉蛾之誘引性

Z/*E*8-12:Ac 不同比例性費洛蒙配方對粗腳姬捲葉蛾之誘引性試驗結果顯示如表四。由兩次試驗結果顯示單成分 *E*8-12:Ac 對粗腳姬捲葉蛾不具誘引性。第一次試驗結果顯示 *Z*/*E*8-12:Ac 不同比例配方 100/0、99.5/0.5、

表三　以六角型木質轉盤檢定 *Z*8-12:Ac 不同劑量裝載於紅色橡皮帽對粗腳姬捲葉蛾之誘引力

Table 3. Catches of male *Cryptophlebia ombrodelta* moths in traps baited with a red septum loaded with different dosages of *Z*8-12:Ac with a turntable bioassay

Dosage of *Z*8-12:Ac (μg)	Total male moths caught	Percent (%) of total male moths caught[1)]
1000	255	90.5 ± 9.4 a
100	23	9.5 ± 9.4 b
10	0	0 c
1	0	0 c
0	0	0 c
Blank	0	0 c

[1)] The mean ± S.D. was derived from ten replications. Data were transformed to arc sin$\sqrt{\text{x}}$ prior to analysis; means followed by the same letter do not significantly differ at the 5% level according to Duncan's multiple range test.

表四　以六角型木質轉盤檢定 *Z*8-12:Ac/*E*8-12:Ac 不同比例性費洛蒙配方對粗腳姬捲葉蛾之誘引力

Table 4. Catches of male *Cryptophlebia ombrodelta* moths in traps baited with a red septum loaded with 1 mg of different ratios of *Z*8-12:Ac and *E*8-12:Ac with a turntable bioassay

Pheromone components (%)		Total moths caught	Percent (%) of males caught[1)]
*Z*8-12:Ac	*E*8-12:Ac		
1st trial			
100	0	232	23.2 ± 8.0 a
99.5	0.5	223	24.2 ± 7.7 a
98	2	233	24.8 ± 8.3 a
96	4	261	27.8 ± 8.9 a
0	100	0	0 c
Blank		0	0 c
2nd trial			
100	0	238	40.8 ± 13.7 a
96	4	203	31.9 ± 12.2 a
94	6	99	13.3 ± 11.9 b
92	8	99	14.0 ± 10.8 b
0	100	0	0 c
Blank		0	0 c

[1)] The mean ± S.D. was derived from ten and nine replications in the first and second trials, respectively. Data were transformed to arc sin$\sqrt{\text{x}}$ prior to analysis; means followed by the same letter do not significantly differ at the 5% level according to Duncan's multiple range test.

98/2、96/4 對粗腳姬捲葉蛾之誘蟲百分率介於 23.2~27.8%，不具顯著性差異；其與配方 0/100 及空白對照組具顯著性差異(F = 112.3698, d.f. = 54, p = 0.000000*)。第二次試驗結果顯示配方 *Z*/*E*8-12:Ac = 100/0 與 96/4 對粗腳姬捲葉蛾之誘引性較佳，與配方 94/6 及 92/8 者具顯著性差異(F = 31.67663, d.f. = 48, p = 0.000000*)。由本試驗結果顯示當 *E*8-12:Ac 達 6% 時，誘蟲效果顯著降低。本試驗結果顯示 *Z*/*E*8-12:Ac = 96/4 爲其誘蟲臨界比例，而粗腳姬捲葉蛾雌蟲腹末萃取液中其 *Z*/*E*8-12:Ac = 96/4。因此，以下的試驗以 *Z*/*E*8-12:

表五　以六角形木質轉盤及田間誘蟲試驗檢定 *Z*8-12:Ac/*E*8-12:Ac/*Z*8-12:OH 不同比例性費洛蒙配方對粗腳姬捲葉蛾之誘引力

Table 5. Catches of male *Cryptophlebia ombrodelta* moths in traps baited with a red septum loaded with 1 mg of different ratios of *Z*8-12:Ac/*E*8-12:Ac = 96/4 and *Z*8-12:OH with a turntable bioassay and field tests

Pheromone components			Turntable bioassay		Field test (total moths caught)[2]	
*Z*8-12:Ac	*E*8-12:Ac	*Z*8-12:OH	Total moths caught	Percent (%) of males captured[1]	*C. ombrodelta*	*Cydia notanthes*
The first trial						
96	4	0	166	33.3 ± 22.2 a	3	1
96	4	10 (CK)	215	21.3 ± 20.4 a	15	18
96	4	40	221	26.1 ± 16.9 a	13	25
96	4	80	74	10.1 ± 12.9 b	9	35
96	4	160	33	9.2 ± 17.7 b	13	49
Blank (CK)			0	0 c	1	0
The second trial						
96	4	0	53	14.2 ± 10.9 a	4	1
96	4	5	53	18.2 ± 12.1 a	14	2
96	4	10 (CK)	92	19.8 ± 14.2 a	11	4
96	4	20	70	18.8 ± 13.4 a	22	7
96	4	30	123	27.9 ± 16.3 a	22	25
Blank (CK)			2	1.2 ± 2.5 b	0	0

[1] The mean ± S.D. was derived from 12 and six replications in the first and second trials, respectively. Data were transformed to arc sin$\sqrt{x}$ prior to analysis; means followed by the same letter do not significantly differ at the 5% level according to Duncan's multiple range test.

[2] The first trial with four replications was conducted in litchi orchards in Nantou from 19 Sept. to 4 Nov. 1997, and the second trial with one replication was conducted in a carambolla orchard in Yuanlin Township, Changhua County from 1 Mar. to 4 June 2001.

Ac = 96/4 爲基礎，再探討由雌蟲腹末萃取液鑑定的其他醇及酯類化合物對配方 *Z*/*E*8-12:Ac = 96/4 之誘蟲效果之影響。

四、誘餌 *Z*/*E*8-12:Ac = 96/4 混合其他成分不同比例配方對粗腳姬捲葉蛾之誘引試驗

(一)Z8-12:OH 之影響：

誘餌 *Z*/*E*8-12:Ac = 96/4 混合不同比例 Z8-12:OH 成分不同比例配方對粗腳姬捲葉蛾之誘引效果影響如表五。第一次轉盤生物檢定結果顯示當 Z8-12:OH 比例增至 40 時之配方與對照配方 *Z*8-12:Ac/*E*8-12:Ac/*Z*8-12:OH = 96/4/0、96/4/10 對粗腳姬捲葉蛾誘引性不具顯著性差異；當 *Z*8-12:OH 比例增至 80、160 者，誘蟲數顯著降低(F = 8.69666, d.f. = 66, p = 0.000002*)。田間誘蟲結果顯示以含有 *Z*8-12:OH 配方者，對粗腳姬捲葉蛾誘引總蟲數較多；另亦發現含有 *Z*8-12:OH 配方對花姬捲葉蛾具誘引作用，隨 *Z*8-12:OH 比例增加誘蟲總數增加(表五)。第二次轉盤生物檢定結果顯示 *Z*8-12:OH 比例 5、20、30 與對照配方 *Z*8-12:Ac/*E*8-12:Ac/ *Z*8-12:OH = 96/4/0、96/4/10 對粗腳姬捲葉蛾誘引性不具顯著性差異(F = 3.032928, d.f. = 30, p = 0.024777)。田間誘蟲結果顯示以含有 *Z*8-12:OH 配方者，對粗腳姬捲葉蛾誘引總蟲數較多；如前亦發現當 *Z*8-12:OH 比例爲 30 之配方者對花姬捲葉蛾誘引總蟲數較其他配方者爲多(表五)。由此田

表六　以六角形木質轉盤及田間誘蟲試驗檢定 *Z*8-12:Ac/*E*8-12:Ac/*E*8-12:OH 不同比例性費洛蒙配方對粗腳姬捲葉蛾之誘引力

Table 6. Catches of male *Cryptophlebia ombrodelta* moths in traps baited with a red septum loaded with 1 mg of different ratios of *Z*8-12:Ac/*E*8-12:Ac = 96/4 and *E*8-12:OH with a turntable bioassay and field tests

Pheromone components			Turntable bioassay		Field test (total moths caught)[2]	
*Z*8-12:Ac	*E*8-12:Ac	*E*8-12:OH	Total moths caught	Percent (%) of males captured[1]	*C. ombrodelta*	*Cydia notanthes*
96	4	0	53	14.6 ± 7.7 b	1	4
96	4	1 (CK)	68	23.6 ± 12.2 ab	21	122
96	4	2	45	12.3 ± 5.5 b	22	124
96	4	5	86	26.2 ± 10.8 a	17	153
96	4	10	63	20.4 ± 7.2 ab	18	268
Blank (CK)			8	2.9 ± 3.6 c	0	0

[1] The mean ± S.D. was derived from six replications. Data were transformed to arc sin$\sqrt{x}$ prior to analysis; means followed by the same letter do not significantly differ at the 5% level according to Duncan's multiple range test.

[2] The field test with one replication was conducted in a carambolla orchard in Yuanlin Township, Changhua County from 1 Mar. to 4 June 2001.

表七　以六角形木質轉盤及田間誘蟲試驗檢定 *Z*8-12:Ac/*E*8-12:Ac/1-12:OH 不同比例性費洛蒙配方對粗腳姬捲葉蛾之誘引力

Table 7. Catches of male *Cryptophlebia ombrodelta* moths in traps baited with a red septum loaded with 1 mg of different ratios of *Z*8-12:Ac/*E*8-12:Ac = 96/4 and 1-12:OH with a turntable bioassay and field tests

Pheromone components			Turntable bioassay		Field test (total moths caught)[2]	
*Z*8-12:Ac	*E*8-12:Ac	1-12:OH	Total moths caught	Percent (%) of males captured[1]	*C. ombrodelta*	*Cydia notanthes*
96	4	0	86	23.4 ± 11.7 ab	5	2
96	4	2 (CK)	53	13.0 ± 12.4 abc	7	3
96	4	5	45	11.9 ± 15.5 bc	5	3
96	4	10	65	14.4 ± 16.1 abc	4	1
96	4	20	73	37.2 ± 35.6 a	3	1
Blank (CK)			0	0 c	0	0

[1] The mean ± S.D. was derived from five replications. Data were transformed to arc sin$\sqrt{x}$ prior to analysis; means followed by the same letter do not significantly differ at the 5% level according to Duncan's multiple range test.

[2] The field test with one replication was conducted in a carambolla orchard in Yuanlin Township, Changhua County from 1 Mar. to 4 June 2001.

間試驗結果顯示誘餌中含*Z*8-12:OH成分能增加誘餌對粗腳姬捲葉蛾之誘引力，而室內轉盤試驗結果則差異不顯著。

(二)*E*8-12:OH 之影響：

誘餌 *Z*/*E*8-12:Ac = 96/4 混合不同比例 *E*8-12:OH 成分不同比例配方對粗腳姬捲葉蛾之誘引效果影響如表六。由轉盤生物檢定結果顯示以 *Z*8-12:Ac/*E*8-12:Ac/*E*8-12:OH = 96/4/5 配方者其誘蟲百分率 26.2%，顯著較其他處理間對粗腳姬捲葉蛾之誘引效果爲佳(*F* =

表八　以六角形木質轉盤及田間誘蟲試驗檢定 *Z*8-12:Ac/*E*8-12:Ac/1-18:OH 不同比例性費洛蒙配方對粗腳姬捲葉蛾之誘引力

Table 8. Catches of male *Cryptophlebia ombrodelta* moths in traps baited with a red septum loaded with 1 mg of different ratios of *Z*8-12:Ac/*E*8-12:Ac = 96/4 and 1-18:OH with a turntable bioassay and field tests

Pheromone components			Turntable bioassay		Field test (total moths caught)[2)]	
*Z*8-12:Ac	*E*8-12:Ac	1-18:OH	Total moths caught	Percent (%) of males captured[1)]	*C. ombrodelta*	*Cydia notanthes*
96	4	0	130	30.8 ± 17.7 a	10	35
96	4	1 (CK)	57	18.7 ± 22.5 ab	6	30
96	4	2	102	27.9 ± 16.4 a	0	38
96	4	5	54	15.9 ± 10.9 ab	4	42
96	4	10	20	6.2 ± 8.6 bc	4	50
Blank (CK)			3	0.6 ± 1.0 c	1	0

[1)] The mean ± S.D. was derived from six replications. Data were transformed to arc sin$\sqrt{x}$ prior to analysis; means followed by the same letter do not significantly differ at the 5% level according to Duncan's multiple range test.

[2)] The field test with one replication was conducted in a carambolla orchard in Yuanlin Township, Changhua County from 1 Mar. to 4 June 2001.

9.126728, d.f. = 30, p = 0.000023*)。由田間誘蟲結果顯示配方中含 *E*8-12:OH 者，經三個月的誘蟲總數均較未含者爲多，顯示配方中含 *E*8-12:OH 可增加誘餌對粗腳姬捲葉蛾之誘引性。另亦發現配方中含 *E*8-12:OH 亦可增加誘餌對花姬捲葉蛾之誘引性(表六)。

(三)1-12:OH 之影響：

誘餌 *Z*/*E*8-12:Ac = 96/4 混合不同比例 1-12:OH 成分不同比例配方對粗腳姬捲葉蛾之誘引效果影響如表七。轉盤生物檢定結果顯示配方含 1-12:OH 者以含 20 者其誘蟲百分率 37.2%最高，其與配方 *Z*/*E*8-12:Ac/1-12:OH = 96/4/10 及對照配方 96/4/0、96/4/2 無顯著差異，而與其他配方者具顯著性差異(F = 3.618704, d.f. = 24, p = 0.013992*)。由田間誘蟲試驗結果顯示各配方經三個月對粗腳姬捲葉蛾總誘蟲數極低，且配方中含 1-12:OH 者並無明顯提高誘蟲數(表七)，顯示配方中含 1-12:OH 對誘蟲效果無提升作用。本試驗中亦誘到花姬捲葉蛾，惟數量極少(表七)。

(四)1-18:OH 之影響：

誘餌 *Z*/*E*8-12:Ac = 96/4 混合不同比例 1-18:OH 成分不同比例配方對粗腳姬捲葉蛾之誘引效果影響如表八。轉盤生物檢定結果顯示配方含 1-18:OH 者對誘蟲效果沒有提升，以對照配方 *Z*8-12:Ac/*E*8-12:Ac/1-18:OH = 96/4/0 總誘蟲數最高 130 隻，誘蟲百分率 30.8%也較其他處理者爲高(F = 6.007566, d.f. = 30, p = 0.000578*)。田間誘蟲試驗結果顯示以對照配方 *Z*8-12:Ac/*E*8-12:Ac/1-18:OH = 96/4/0 總誘蟲數最高 10 隻，顯示配方中含 1-18:OH 對誘蟲效果無提升作用。另各配方均有捕抓到花姬捲葉蛾，誘蟲總數 30~50 隻(表八)。

(五)1-12:Ac 之影響：

誘餌 *Z*/*E*-8-12:Ac = 96/4 混合不同比例 1-12:Ac 成分不同比例配方對粗腳姬捲葉蛾之誘引效果影響如表九。轉盤生物檢定結果顯示配方含 1-12:Ac 者對誘蟲效果沒有提升，以對照配方 *Z*8-12:Ac/*E*8-12:Ac/1-12:Ac = 96/4/0 總誘蟲數最高 207 隻，誘蟲百分率 37.6%顯著較其他處理者爲高(F = 10.15792, d.f. = 42,

表九　以六角形木質轉盤及田間誘蟲試驗檢定 *Z*8-12:Ac/*E*8-12:Ac/1-12:Ac 不同比例性費洛蒙配方對粗腳姬捲葉蛾之誘引力

Table 9. Catches of male *Cryptophlebia ombrodelta* moths in traps baited with a red septum loaded with 1 mg of different ratios of *Z*8-12:Ac/*E*8-12:Ac = 96/4 and 1-12:Ac with a turntable bioassay and field tests

Pheromone components			Turntable bioassay		Field test (total moths caught)[2)]	
*Z*8-12:Ac	*E*8-12:Ac	1-12:Ac	Total moths caught	Percent (%) of males captured[1)]	*C. ombrodelta*	*Cydia notanthes*
96	4	0	207	37.6 ± 29.8 a	7	0
96	4	10	28	3.0 ± 3.9 c	3	2
96	4	20	192	27.5 ± 13.7 ab	3	4
96	4	40	126	14.8 ± 11.5 b	13	25
96	4	30 (CK)	164	17.0 ± 15.1 b	14	7
Blank (CK)			1	0.2 ± 0.7 c	0	0

[1)] The mean ± S.D. was derived from eight replications. Data were transformed to arc sin$\sqrt{x}$ prior to analysis; means followed by the same letter do not significantly differ at the 5% level according to Duncan's multiple range test.

[2)] The field test with one replication was conducted in a carambolla orchard in Yuanlin Township, Changhua County from 1 Mar. to 4 June 2001.

表十　以六角形木質轉盤及田間誘蟲試驗檢定 *Z*8-12:Ac/*E*8-12:Ac/1-14:Ac 不同比例性費洛蒙配方對粗腳姬捲葉蛾之誘引力

Table 10. Catches of male *Cryptophlebia ombrodelta* moths in traps baited with a red septum loaded with 1 mg of different ratios of *Z*8-12:Ac/*E*8-12:Ac = 96/4 and 1-14:Ac with a turntable bioassay and field tests

Pheromone components			Turntable bioassay		Field test (total moths caught)[2)]	
*Z*8-12:Ac	*E*8-12:Ac	1-14:Ac	Total moths caught	Percent (%) of males captured[1)]	*C. ombrodelta*	*Cydia notanthes*
96	4	0	53	28.7 ± 20.7 a	3	44
96	4	2	54	26.6 ± 19.7 ab	2	18
96	4	5 (CK)	40	18.1 ± 11.0 ab	6	22
96	4	10	47	16.9 ± 16.1 ab	2	54
96	4	20	26	9.7 ± 11.8 b	1	83
Blank (CK)			0	0 c	0	0

[1)] The mean ± S.D. was derived from five replications. Data were transformed to arc sin$\sqrt{x}$ prior to analysis; means followed by the same letter do not significantly differ at the 5% level according to Duncan's multiple range test.

[2)] The field test with one replication was conducted in a carambolla orchard in Yuanlin Township, Changhua County from 1 Mar. to 4 June 2001.

p = 0.000002*)。田間誘蟲試驗結果顯示以配方 *Z*8-12:Ac/*E*8-12:Ac/1-12:Ac = 96/4/40 及對照配方 96/4/30 者的誘蟲總數較高，分別爲 13 及 14 隻。另配方含 1-12:Ac 者均有捕抓到花姬捲葉蛾，以配方 *Z*8-12:Ac/*E*8-12:Ac/1-12:Ac = 96/4/40 者之誘蟲總數 25 隻較其他處理者爲高(表九)。由本試驗結果顯示配方中含 1-12:Ac，轉盤檢定結果無提升誘蟲效果，田間誘蟲試驗結果以配方含 1-12:Ac 比例 40 及 30(對照配方)者誘蟲數較多(表九)。是否爲誘

表十一　以六角形木質轉盤及田間誘蟲試驗檢定 *Z*8-12:Ac/*E*8-12:Ac/1-16:Ac 不同比例性費洛蒙配方對粗腳姬捲葉蛾之誘引力

Table 11. Catches of male *Cryptophlebia ombrodelta* moths in traps baited with a red septum loaded with 1 mg of different ratios of *Z*8-12:Ac/*E*8-12:Ac = 96/4 and 1-16:Ac with a turntable bioassay and field tests

Pheromone components			Turntable bioassay		Field test (total moths caught)[2)]	
*Z*8-12:Ac	*E*8-12:Ac	1-16:Ac	Total moths caught	Percent (%) of males captured[1)]	*C. ombrodelta*	*Cydia notanthes*
96	4	0	255	22.3 ± 15.5 ab	3	129
96	4	5 (CK)	271	20.9 ± 12.8 ab	1	196
96	4	10	202	15.2 ± 11.5 b	0	210
96	4	20	327	26.1 ± 11.4 a	1	58
96	4	30	215	15.5 ± 9.3 b	0	165
Blank (CK)			0	0 c	1	1

[1)] The mean ± S.D. was derived from 14 replications. Data were transformed to arc $\sin\sqrt{x}$ prior to analysis; means followed by the same letter do not significantly differ at the 5% level according to Duncan's multiple range test.

[2)] The field test with one replication was conducted in a carambolla orchard in Yuanlin Township, Changhua County from 1 Mar. to 4 June 2001.

蟲配方所需，仍須進一步探討。

(六)1-14:Ac 之影響：

誘餌 *Z*/*E*8-12:Ac = 96/4 混合不同比例 1-14:Ac 成分不同比例配方對粗腳姬捲葉蛾之誘引效果影響如表十。轉盤生物檢定結果顯示配方含 1-14:Ac 者對誘蟲效果沒有提升，以對照配方 *Z*8-12:Ac/*E*8-12:Ac/1-14:Ac = 96/4/0 誘蟲百分率 28.7%顯著較其他處理者爲高(F = 5.776058, d.f. = 24, p = 0.001228*)。田間誘蟲試驗結果顯示以對照配方 *Z*8-12:Ac/*E*8-12:Ac/1-14:Ac = 96/4/5 的誘蟲總數較高。各配方均有捕抓到花姬捲葉蛾，以配方 *Z*8-12:Ac/*E*8-12:Ac/1-14:Ac = 96/4/20 者之誘蟲總數 83 隻較其他處理者爲高(表十)。顯示配方中含 1-14:Ac 者對誘蟲效果沒有提升。

(七)1-16:Ac 之影響：

誘餌 *Z*/*E*8-12:Ac = 96/4 混合不同比例 1-16:Ac 成分不同比例配方對粗腳姬捲葉蛾之誘引效果影響如表十一。轉盤生物檢定顯示配方含 1-16:Ac 比例爲 20 者，其誘蟲百分率 26.1%與配方 *Z*/*E*8-12:Ac/1-16:Ac = 96/4/5 及對照配方 96/4/0 無顯著差異，與其他配方者具顯著性差異(F = 18.20268, d.f. = 78, p = 0.000000*)。田間誘蟲試驗結果顯示誘蟲數極低，以對照配方 *Z*/*E*8-12:Ac = 96/4 較高。各配方均能誘到花姬捲葉蛾，以配方 *Z*8-12:Ac/*E*8-12:Ac/1-16:Ac = 96/4/10、96/4/5 經 3 個月總誘蟲數較多，分別爲 210、196 隻，以配方 96/6/20 者最少 58 隻(表十一)。顯示配方中含 1-16:Ac 者對誘蟲效果不會提升。

(八)1-18:Ac 之影響：

誘餌 *Z*/*E*8-12:Ac = 96/4 混合不同比例 1-18:Ac 配方對粗腳姬捲葉蛾之誘引效果影響如表十二。轉盤生物檢定結果顯示配方中含 1-18:Ac 者之誘蟲百分率與對照配方 *Z*8-12:Ac/*E*8-12:Ac/1-18:Ac = 96/4/0 及 96/4/5 者不具顯著性差異(F = 8.740156, d.f. = 58, p = 0.000003*)，顯示配方中含 1-18:Ac 者不會提升其誘蟲效果。田間試驗結果顯示各配方對粗腳姬捲葉蛾經 3 個月的誘蟲總數極低 2~5 隻；各配方均有誘到花姬捲葉蛾，以 *Z*8-12:Ac/*E*8-12:Ac/1-18:Ac = 96/4/5 誘蟲數較多爲

表十二　以六角形木質轉盤及田間誘蟲試驗檢定 *Z*8-12:Ac/*E*8-12:Ac/1-18:Ac 不同比例性費洛蒙配方對粗腳姬捲葉蛾之誘引力

Table 12. Catches of male *Cryptophlebia ombrodelta* moths in traps baited with a red septum loaded with 1 mg of different ratios of *Z*8-12:Ac/*E*8-12:Ac = 96/4 and 1-18:Ac with a turntable bioassay and field tests

Pheromone components			Turntable bioassay		Field test (total moths caught)[2)]	
*Z*8-12:Ac	*E*8-12:Ac	1-18:Ac	Total moths caught	Percent (%) of males captured[1)]	*C. ombrodelta*	*Cydia notanthes*
96	4	0	132	15.8 ± 13.7 a	5	17
96	4	2	251	26.8 ± 15.7 a	2	21
96	4	5 (CK)	189	19.3 ± 13.0 a	3	166
96	4	10	254	25.0 ± 24.6 a	4	2
96	4	20	130	13.1 ± 11.0 a	2	10
Blank (CK)			0	0 b	0	0

[1)] The mean ± S.D. was derived from 11 replications. Data were transformed to arc $\sin\sqrt{x}$ prior to analysis; means followed by the same letter do not significantly differ at the 5% level according to Duncan's multiple range test.

[2)] The field test with one replication was conducted in a carambolla orchard in Yuanlin Township, Changhua County from 1 Mar. to 4 June 2001.

166 隻。顯示配方中含 1-18:Ac 者對粗腳姬捲葉蛾不會提升誘蟲效果。

討　論

有四十多種昆蟲性費洛蒙組成分含有 *Z*8-12:Ac (Kydonieus *et al.*, 1982a, b)，此等昆蟲之性費洛蒙組成分中 *Z*/*E*8-12:Ac 比例有差異，如桃折心蟲 (*Grapholita molesta*) *Z*/*E*8-12:Ac = 100/7 (Cardé *et al.*, 1979)、*Cryptophlebia batrachopa* 爲 99.5/0.5 (Hall *et al.*, 1984)、*C. leucotrata* 爲 10/90 (Newton *et al.*, 1993) 等；而花姬捲葉蛾 (*Cydia notanthes*) 者爲不含 *E*8-12:Ac 的種數 (Hung *et al.*, 2001) 等；而一種胡桃果蛀蟲 *Ecdytolopha torticornis* 其性費洛蒙主成分爲 *E*8-12:Ac (Chamberlain *et al.*, 2003)。由粗腳姬捲葉蛾雌蟲腹末萃取液鑑定結果顯示粗腳姬捲葉蛾含 *Z*8-12:Ac 及 *E*8-12:Ac 兩種成分，其比例約爲 96/4。本試驗由轉盤生物檢定結果顯示 *Z*/*E*8-12:Ac = 96/4 爲其誘蟲臨界比例，故此以 *Z*/*E*8-12:Ac = 96/4 爲基礎，再探討雌蟲腹末萃取液其他醇及酯類化合物對配方 *Z*/*E*8-12:Ac = 96/4 之誘蟲效果之影響。由轉盤生物檢定及田間試驗釐清各成分對 *Z*/*E*8-12:Ac = 96/4 誘蟲之影響，結果顯示配方中含醇類化合物 1-12:OH 與 1-18:OH，及酯類化合物 1-14:Ac、1-16:Ac、1-18:Ac 等成分不會提升誘蟲效果。

商品化的桃折心蟲性費洛蒙誘餌 Orfamone II 含 Z8-12:Ac 及 1-12:OH 對粗腳姬捲葉蛾具誘蟲效果(Sinclair and Sinclair, 1980)。1-12:OH 爲桃折心蟲性費洛蒙成分 *Z*8-12:Ac 之誘蟲協力劑，惟對桃折心蟲雖不具誘引力，卻能促使桃折心蟲之雄蛾有 hairpencil display 之行爲表現(Roelofs *et al.*, 1973; Baker and Cardé, 1979)。1-12:Ac 爲桃折心蟲性費洛蒙成分 *Z*8-12:Ac 之抑制劑 (Roelofs *et al.*, 1973)。本試驗田間誘蟲結果顯示配方中含比例 30 及 40 者總誘蟲數較多。

對粗腳姬捲葉蛾而言，配方中含有 *Z*8-12:OH 者室內轉盤試驗結果與田間誘蟲結

果不同，田間誘蟲結果顯示以配方中含有 *Z*8-12:OH 者明顯增加誘引總蟲數(表五)。Hung *et al*. (1999) 報導不同方法檢定性費洛蒙對花姬捲葉蛾之生物活性顯示在檢定 *Z*8-12:Ac 時，室內轉盤生物檢定方法、風洞檢定法與田間誘蟲試驗取得一致的結果；而檢定複成分 *Z*8-12:Ac/*Z*8-12:OH 者室內轉盤試驗及風洞檢定法結果與田間誘蟲結果不同；在本試驗亦有相似的現象。*Z*8-12:OH 爲桃折心蟲的費洛蒙成分之一，其性費洛蒙誘餌對粗腳姬捲葉蛾具誘引效果 (Sinclair and Sinclair, 1980)。Chang (1995) 比較多種配方對粗腳姬捲葉蛾及 *C*. *illepida* 之誘蟲效果，結果顯示單成分 *Z*8-12Ac 對粗腳姬捲葉蛾具誘引效果，其他單成分 *E*8-12:Ac、*Z*8-12:OH、*Z*7-12:Ac 者則不具誘引效果。含三種成分之桃折心蟲性費洛蒙誘餌 OFM (Bedoukian, *Z*8-12:Ac/*E*8-12:Ac/*Z*8-12:OH = 93/6/1) 對兩者之誘蟲效果均較誘餌含二成分不同比例之 *Z*8-12:Ac/*E*8-12:Ac 爲佳；二成分不同比例之 *Z*8-12:Ac/*E*8-12:Ac 於比例爲 90/10 者對兩者不具誘蟲效果，比例爲 92/8、94/6、96/4、98/2、及 100/0 之誘蟲效果不具顯著差異，以比例爲 94/6 者誘蟲數較多。將 *Z*7-12:Ac 加入桃折心蟲性費洛蒙誘餌 OFM (Bedoukian) 配方成 *Z*-8-12:Ac/ *E*8-12:Ac/*Z*8-12:OH/*Z*7-12:Ac = 93/4/1/2 均提升對兩者之誘蟲效果。由本試驗結果配方中含有 *Z*8-12:OH 者明顯增加配方對粗腳姬捲葉蛾誘引效果，且由其性費洛蒙萃取液中亦含有此成分，顯示 *Z*8-12:OH 爲粗腳姬捲葉蛾費洛蒙成分之一。

配方中含有比例 1~10 之 *E*8-12:OH 成分者於田間試驗明顯提升誘餌對粗腳姬捲葉蛾之誘蟲效果。胡桃果蛀蟲 *Ecdytolopha torticornis* 其性費洛蒙主成分爲 *E*8-12:Ac，其餘成分 1-12:Ac、*Z*8-12:Ac、及 *E*8-12:OH 分別佔主成分的 11.3、4.1、及 2.5% (Chamberlain *et al*., 2003)。

綜合以上轉盤生物檢定及田間試驗結果顯示，粗腳姬捲葉蛾之性費洛蒙組成分應有 *Z*8-12:Ac、*E*8-12:Ac、*Z*8-12:OH、及 *E*8-12:OH 等 4 種成分，其誘蟲有效比例約爲 *Z*8-12:Ac/*E*8-12:Ac/*Z*8-12:OH = 96/4/20~30、*Z*8-12:Ac/*E*8-12:Ac/*E*8-12:OH = 96/4/20~30/1~5，至於 4 種成分配方 *Z*8-12:Ac/*E*8-12:Ac/*Z*8-12:OH/*E*8-12:OH = 96/4/20~30/1~5 其對粗腳姬捲葉蛾誘蟲效果是否會更提升有待進一步試驗證實。另 Chang (1995) 比較多種配方對粗腳姬捲葉蛾及 *C*. *illepida* 之誘蟲效果，結果以含有 *Z*7-12:Ac 成分配方 *Z*8-12:Ac/*E*8-12:Ac/*Z*8-12:OH/*Z*7-12:Ac = 93/4/1/2 誘蟲效果較佳。1-12:Ac 對誘餌誘蟲影響，於其在誘餌中含 30 及 40 在田間試驗顯示誘較多的蟲數(表九)，至於其是否爲其費洛蒙成分，則須再進一步就氣體吸附收集法分析其成分。

合成的性費洛蒙成分 *Z*8-12:Ac 含 0.5%之 *E*8-12:Ac 成分，即顯著降低誘餌對花姬捲葉蛾之誘引力 (Hung *et al*., 2001)。本試驗田間試驗顯示合成的性費洛蒙 *Z*8-12:Ac/*E*8-12:Ac = 96/4 對花姬捲葉蛾不具誘蟲效果，惟當此配方在加入成分 *Z*8-12:OH 及 *E*8-12:OH 對誘蟲數大有提升(表五、六)，另此配方加入比例爲 40 之 1-12:Ac、比例爲 20 之 1-14:Ac、比例爲 10 之 1-16:Ac、及比例爲 5 之 1-18:Ac 時對花姬捲葉蛾誘蟲數有提升現象(表九、十、十一、十二)。顯示此些加入的成分與比例似可消除合成的 *Z*8-12:Ac 中所含 *E*8-12:Ac 對花姬捲葉蛾誘引性之影響；惟若 *E*8-12:Ac 成分比例增加時，此些加入的成分與比例是否有同樣的效果，仍需進一步加以探討。

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Influences of Ester and Alcohol Compounds Identified from the Extract of the Female's Abdominal Tip on the Attractiveness of the Main Sex Pheromone Component, (*Z*)-8-dodecen-1-yl acetate, of the Macadamia Fruit Borer, *Cryptophlebia ombrodelta* (Lower)

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ABSTRACT

The influences of ester and alcohol compounds identified from the extract of the female's abdominal tip on the attractiveness of the main component, (*Z*)-8-dodecen-1-yl acetate (*Z*8-12:Ac), of the sex pheromone of the macadamia fruit borer, *Cryptophlebia ombrodelta* (Lower), were evaluated by turntable bioassays and field tests. Nine compounds were tested: (*E*)-8-dodecen-1-yl acetate (*E*8-12:Ac), 1-dodecyl acetate (1-12:Ac), 1-tetradecyl acetate (1-14:Ac), 1-hexadecyl acetate (1-16:Ac), 1-octadecyl acetate (1-18:Ac), *Z*-8-dodecen-1-ol (*Z*8-12:OH), (*E*)-8-dodecen-1-ol (*E*8-12:OH), 1-dodecanol (1-12:OH), and 1-octadecanol (1-18:OH). The results showed that a sticky board baited with a dosage of 1000 μg *Z*8-12:Ac, in a red septum trapped greater numbers of male moths than other dosages in the turntable bioassay. The catch number was significantly greater with a ratio of *Z*8-12:Ac/*E*8-12:Ac of 100~96/0~4 than with other ratios, but when the ratio of *E*8-12:Ac exceeded 6%, only a few moths were caught. The influences of eight other compounds on the attractiveness to *C. ombrodelta* were tested by formulating different ratios on the basis of *Z*8-12:Ac/*E*8-12:Ac = 96/4. There was no influence on the attractiveness to *C. ombrodelta* when *Z*8-12:Ac/*E*8-12:Ac = 96/4 was mixed with different ratios of 1-12:OH, 1-18:OH, 1-14:Ac, 1-16:Ac, and 1-18:Ac, respectively. Total numbers of moths caught in field tests were 13 and 14 in the wing sticky trap baited with *Z*8-12:Ac/*E*8-12:Ac/1-12:Ac = 96/4/30 and 96/4/40, respectively, which were much higher when compared to other blends (3~7 moths). The results of *Z*8-12:Ac/*E*8-12:Ac = 96/4 mixed with different ratios of *E*8-12:OH were similar to those of *Z*8-12:OH. More moths were trapped by lures containing *Z*8-12:OH (9~22 moths) or *E*8-12:OH (17~22 moth) compared to the check lure formula that contained only *Z*8-12:Ac/*E*8-12:Ac = 96/4 (3~4, 17~22 moths) in field tests. The sex pheromone of *C. ombrodelta* contained 4 components, *Z*8-12:Ac, *E*8-12:Ac, *Z*8-12:OH, and *E*8-12:OH, on the basis of the results in this report.

Key words: *Cryptophlebia ombrodelta* (Lower), (*Z*/*E*)-8-dodecen-1-yl acetate, (*Z*/*E*)-8-dodecen-1-ol

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