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Effect of Common Insecticides on Liriomyza sativae Blanchard (Diptera: Agromyzidae)【Research report】

藥劑對蔬菜斑潛蠅 (Liriomyza sativae Blanchard) (雙翅目：潛蠅科) 之藥效探討【研究報告】

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Abstract

Seedlings of field bean (Phaseolus vulgaris var. communis Aeschers) with and without the leaf miner (Liriomyza sativae Blanchard) were used to study the effects of three insecticides (oxamyl SL, abamectin EC, cyromazine SL, and cyromazine WP) against the different life stages of L. sativae by dipping method. The results showed that all these insecticides have a significant lethal effect on L. sativae and can be used to control the leaf miner. The highest lethal effect of oxamyl and abamectin was recorded for the egg and larval stages with a survival rate of 0%, and the second most effective period was the adult stage. The adult-24-hour survival rate, the number of eggs and number of feeding stipples were reduced by 18.3-26.0, 97.3-98.9 and 95.2-97.3%, respectively, and the longevity, adult progeny and the number of feeding stipples after 24 hours also decreased by 50.3-62.9, 95.5-98.9 and 89.3-99.9%, respectively. The highest lethal effect of the two cyromazine formulations was recorded for the larval stage with a survival rate of 0%; the second most effective period was the egg stage, although hatching was not affected, while the larval mortality of the 1st, 2nd and 3rd instars was 60.6-64.0, 94.2-98.2 and 100%, respectively. The least affected was the adult stage with no direct effect on the adult-24-hour survival rate and the number of eggs and number of feeding stipples. However, the adult progeny and the number of feeding stipples after 24 hours decreased by 73.9-85.2 and 73.4-75.9%, respectively.

摘要

以帶蟲或不帶蟲菜豆苗 (Phaseolus vulgaris var. communis Aeschers) 浸漬法 (dipping method) 測試歐殺滅 (oxamyl SL)、阿巴汀 (abamectin EC) 及賽滅淨 (cyromazine SL, WP) 等藥劑對蔬菜斑潛蠅 (Liriomyza sativae Blanchard) 未成熟期與成蟲期之影響。結果得知上述三種藥劑均對蔬菜斑潛蠅具顯著之致死效果，確可供該蠅防治用。歐殺滅與阿巴汀對蔬菜斑潛蠅各蟲期之防治效能，均以卵與幼蟲期最高，致死率為 100%，其次為成蟲期。雌蟲接觸上述二種藥劑 24 小時，其間其存活率、產卵數及取食刻點數，不僅各受到 18.3～26.0、97.3～98.9 及 95.2～97.3% 之抑制，尚對雌蟲接觸藥劑 24 小時後之壽命、子代成蟲數及取食刻點數，各達 50.3～62.9、95.5～98.9 及 89.3～99.9% 之抑制。賽滅淨兩種劑型對蔬菜斑潛蠅各蟲期之防治效能，則以幼蟲期最高，致死率達 100%；卵期次之，對孵化率雖無影響，但對其後第一、二及三齡幼蟲之致死率，各為 60.6～64.0、94.2～98.2 及 100%；成蟲期受藥劑影響較低，雌蟲接觸此藥劑不同劑型 24 小時，其間藥劑對雌蟲存活率、產卵數及取食刻點數等，雖均無顯著直接影響，但對雌蟲接觸藥劑 24 小時後之子代成蟲數與取食刻點數，各達 73.9～85.2 與 73.4～75.9% 之抑制。

Key words: Liriomyza sativae, insecticide, stages, field bean

關鍵詞: 蔬菜斑潛蠅、藥劑、蟲期、菜豆。

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藥劑對蔬菜斑潛蠅 (*Liriomyza sativae* Blanchard) (雙翅目：潛蠅科) 之藥效探討

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摘　要

以帶蟲或不帶蟲菜豆苗 (*Phaseolus vulgaris* var. *communis* Aeschers) 浸漬法 (dipping method) 測試歐殺滅 (oxamyl SL)、阿巴汀 (abamectin EC) 及賽滅淨 (cyromazine SL, WP) 等藥劑對蔬菜斑潛蠅 (*Liriomyza sativae* Blanchard) 未成熟期與成蟲期之影響。結果得知上述三種藥劑均對蔬菜斑潛蠅具顯著之致死效果，確可供該蠅防治用。歐殺滅與阿巴汀對蔬菜斑潛蠅各蟲期之防治效能，均以卵與幼蟲期最高，致死率為 100%，其次為成蟲期。雌蟲接觸上述二種藥劑 24 小時，其間其存活率、產卵數及取食刻點數，不僅各受到 18.3～26.0、97.3～98.9 及 95.2～97.3% 之抑制，尚對雌蟲接觸藥劑 24 小時後之壽命、子代成蟲數及取食刻點數，各達 50.3～62.9、95.5～98.9 及 89.3～99.9% 之抑制。賽滅淨兩種劑型對蔬菜斑潛蠅各蟲期之防治效能，則以幼蟲期最高，致死率達 100%；卵期次之，對孵化率雖無影響，但對其後第一、二及三齡幼蟲之致死率，各為 60.6～64.0、94.2～98.2 及 100%；成蟲期受藥劑影響較低，雌蟲接觸此藥劑不同劑型 24 小時，其間藥劑對雌蟲存活率、產卵數及取食刻點數等，雖均無顯著直接影響，但對雌蟲接觸藥劑 24 小時後之子代成蟲數與取食刻點數，各達 73.9～85.2 與 73.4～75.9% 之抑制。

關鍵詞：蔬菜斑潛蠅、藥劑、蟲期、菜豆。

前　言

蔬菜斑潛蠅 (*Liriomyza sativae* Blanchard) 在美國之番茄、芹菜及其他作物上，或在阿根廷之紫苜蓿 (*Medicago sativa* L.) 及中國之蔬菜與花卉生產上均曾造成嚴重經濟損失 (Anonymous, 2002; Pang *et al*., 2005)，亦為荷蘭與英國 A1 級之重要檢疫害

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蟲 (Anonymous, 1984)。由於斑潛蠅對化學藥劑容易產生抗藥性 (Parrella *et al*., 1984; Hara, 1986; Brodbent and Pree, 1989)，且廣效性藥劑對其寄生蜂之毒害 (Spencer, 1973)，以及防治斑潛蠅藥劑之有效期 (effective life) 僅 3 年 (Leibee, 1981) 等因素，致使斑潛蠅防治不易。針對此點，多位學者建議降低施藥頻率與劑量 (Mason *et al*., 1989) 及採取藥劑輪用 (Trumble, 1985a)，以減緩斑潛蠅抗藥性之發展。臺灣於 1995 年 2 月首次在臺中縣霧峰鄉菜豆與南投縣番茄上發現蔬菜斑潛蠅 (Wen *et al*., 1996)。由於行政院農業委員會審定植物保護手冊中，並未列有防治蔬菜斑潛蠅之推薦藥劑，所以本研究以該手冊 (Anonymous, 2007) 中推薦防治番茄斑潛蠅 (*Liriomyza bryoniae* (Kaltenbach)) 之殺蟲劑–歐殺滅溶液 (oxamyl SL)、阿巴汀乳劑 (abamectin EC)、賽滅淨溶液 (cyromazine SL) 及賽滅淨可釋性粉劑 (cyromazine WP)，與推薦濃度，於室內偵測此等藥劑對蔬菜斑潛蠅各蟲期之藥效，期能將結果提供該蠅綜合防治之參考。

材料與方法

寄主植物之栽培

每週定期浸泡菜豆種子 (*Phaseolus vulgaris* var. *communis* Aeschers) (300 粒)，在 25℃ 下經 7 小時種子吸水飽滿後，將其瀝淨，置於塑膠盤內進行催芽，期間並蓋上另一塑膠盤以保持濕度，待 14 小時種子發根後，即移種在溫室置有 3 號蛭石之穴盤 (長 36.5 cm，寬 28 cm，高 4.5 cm；30 穴) 內。每天澆水，經 10～13 天，菜豆苗發育至株高 15～20 cm，子葉 (cotyeldons) 葉寬達 7～9 cm 時，即可供室內蔬菜斑潛蠅產卵與藥劑試驗用。

斑潛蠅之採集

在雲林縣林內鄉菜豆 (*Phaseolus vulgaris* L.) 上採集被蔬菜斑潛蠅幼蟲危害之葉片，攜回室內並將被害葉放入塑膠盤內，待幼蟲化蛹，然後將蛹置入直徑 20 cm、高 22 cm 壓克力筒內，羽化成蟲後，供做飼育之蟲源。

斑潛蠅之繁殖

參照 Chien and Ku (1996) 飼育非洲菊斑潛蠅之方法，在室內 25℃ 定溫下，以溫室內培養之菜豆苗 (株高 15～20 cm、子葉寬 7～9 cm) 供蔬菜斑潛蠅產卵與幼蟲發育。

供試藥劑與豆苗浸藥之處理方法

供試藥劑　歐殺滅溶液、阿巴汀乳劑、賽滅淨溶液及賽滅淨可釋性粉劑爲供試藥劑，其使用形態、濃度、化學類別及出品公司等詳見表一。

帶蟲或不帶蟲豆苗之預備　在 25℃ 定溫下，將 120 隻蔬菜斑潛蠅已交尾雌蟲釋入內置有 30 株 (株高 15～20 cm、子葉寬 7～9 cm) 菜豆苗之繁殖網箱 (長 75 cm，寬 55 cm，高 50 cm)，經產卵 7 小時 (上午 9 點至下午 4 點) 後，將子葉內帶有卵之菜豆苗移出，並放置於溫度 25℃、相對濕度 65～85% RH 及光週期 14L：10D (上午 5 點至下午 7 點間照光) 下之室內繼續飼養，以供後述藥效試驗，包括帶有卵 (產卵後第二日) 或帶有第三齡幼蟲 (產卵後第六日) 豆苗之試驗材料。另準備未經蔬菜斑潛蠅雌蟲產卵之相同大小豆苗，做爲不帶蟲豆苗之試驗材料。所有供試之帶蟲或不帶蟲豆苗，均祇留有 2 片子葉，若有本葉 (plumule leaf) 長出均摘除之。

表一　供試藥劑種類、使用形態、濃度、化學類別及出品公司
Table 1.　Chemicals used in this study

Common names and formulation	Dilution factor	Chemical subgroup	Activity	Manufacturer
Oxamyl 10% SL	250	carbamate	Insecticide, acaricides, nematicides	Sundat (s) PTE Ltd.
Abamectin 2% EC	1000	avermectin	Insecticide, acaricides, nematicides	Syngenta Taiwan Ltd.
Cyromazine 8.9% SL	1000	triazine	Insecticide (insect growth regulator), acaricides	Syngenta Taiwan Ltd.
Cyromazine 75% WP	4000	triazine	Insecticide (insect growth regulator), acaricides	Syngenta Taiwan Ltd.

帶蟲或不帶蟲豆苗浸漬藥劑之處理　在 25℃ 下，各將子葉內帶有 70～100 粒卵之單株菜豆苗、子葉內帶有 20～30 隻第三齡幼蟲之單株菜豆苗、及不帶蟲之單株菜豆苗，齊根剪下，分別倒插浸漬在盛有稀釋藥液之 1,000 cc 塑膠杯內 1 分鐘，其後再將前述已浸藥後之豆苗，分別插入試管架上已盛水之試管內（直徑 1.5 cm、高 7 cm），待 30 分鐘，豆葉表面之藥液自然風乾形成均勻藥膜後，再距豆苗剪口 5 cm 處，以海綿片束紮，並直插入罐蓋上有圓孔（直徑 1.5 cm）之盛水塑膠罐（直徑 4 cm、高 5 cm）底部，供各項試驗用。另設浸水處理之對照組，其方法與過程與浸藥處理相同，僅豆苗浸漬藥劑時，對照組係以水替代之。

一、卵期施藥對各未成熟期之影響

於 25℃ 定溫下在帶蟲（卵）豆苗浸藥處理後之第三天，記錄第一齡幼蟲數與未孵化卵數，以計算卵之存活率。第四天起，每日記錄各齡幼蟲數、蛹數及成蟲數。另設僅浸水處理之帶蟲（卵）豆苗爲對照組。每處理各做 4～6 重複。

二、第三齡幼蟲期施藥對未成熟期存活率之影響

於 25℃ 定溫下，在帶蟲（第三齡幼蟲）豆苗浸藥處理後之第二天，記錄蛹數與死亡幼蟲數，以計算藥劑對第三齡幼蟲存活率之影響。第十天起，每日記錄羽化之成蟲數，以計算藥劑對蛹存活率之影響。另設僅浸水處理之帶蟲（第三齡幼蟲）豆苗爲對照組。每處理各做 4～6 重複。

三、藥劑對成蟲之影響

豆苗浸藥後接蟲 24 小時之處理　爲觀測成蟲與浸藥豆苗接觸 24 小時內之存活率、產子代數及取食刻點數，乃在 25℃ 定溫下，早上 9 點將 2 日齡已交尾成蟲 10 對（羽化後第三日）釋入直徑 20 cm、高 25 cm 之壓克力筒內，除供應 2 株已浸藥處理後之不帶蟲豆苗供其產卵與取食，另以細毛筆將未稀釋純蜂蜜，塗於壓克力筒內壁，供應成蟲食用。24 小時後，僅將成蟲移出，記錄雌、雄蟲之存活數；豆苗仍留在原壓克力筒內，依 Chien and Ku (1996) 之方法，距雌蟲與藥劑接觸後之次日、第四日及第四～六日，分別記錄原浸藥豆葉上雌蟲之取食刻點數、子代卵數（未孵化卵數 ＋ 第一齡幼蟲數）及子代第一至三齡幼蟲數。另設僅浸水處理之不帶蟲豆苗爲對照組。每處理各做 3～5 重複。

成蟲接觸藥劑 24 小時後存活個體之後

表二　蔬菜斑潛蠅卵經不同藥劑處理後各未成熟期之存活百分率[1)]

Table 2. Percentage survival rate of the immature stages of *Liriomyza sativae* after the eggs were treated with various insecticides[1)]

Insecticides	Egg	Larva				Pupa	Egg-pupa
		1st	2nd	3rd	total		
Oxamyl	0b[2)]	-	-	-	-	-	0b
Abamectin	0b	-	-	-	-	-	0b
Cyromazine SL	96.6 ± 1.5a	39.4 ± 4.3b	1.8 ± 1.8b	0b	0b	-	0b
Cyromazine WP	94.1 ± 2.8a	36.0 ± 2.7b	5.8 ± 2.6b	0b	0b	-	0b
CK	95.2 ± 1.1a	94.4 ± 1.9a	98.3 ± 1.0a	96.0 ± 1.4a	88.4 ± 1.3a	72.5 ± 4.8	60.8 ± 3.1a

1) Seedlings of field bean infested by 70-100 *L. sativae* eggs were dipped in an insecticide solution for 1 min. Untreated controls were dipped in distilled water. Each treatment had 4-6 replications, which contained one seedling in an individual acrylic cylinder (20 cm diameter x 25 cm high) and was placed under 25°C, 14L:10D, and 65-85% R.H. 30 min after treatment.

2) Means ($\overline{X}$ ± SEM) within each column followed by the same letter are not significantly different ($p < 0.05$, LSD). Data were transformed to arcsin$\sqrt{x}$ prior to ANOVA.

續觀察　爲觀測成蟲經藥劑處理 24 小時後，對其壽命、生殖力及取食刻點數之影響，乃在上述成蟲經接觸 24 小時豆苗藥膜處理後，自活存者中隨機選取 1 對成蟲，釋入另一直徑 20 cm、高 25 cm 壓克力筒內，每日供應純蜂蜜與未經浸藥處理之 1 株不帶蟲豆苗，直至雌蟲死亡爲止。然後依 Chien and Ku (1996) 之方法，計數該蠅之壽命、生殖力及取食刻點數。對照組之雌蟲，則是選自藥劑試驗中對照組之存活者。每處理各做 6～14 重複。

四、統計分析

各項試驗資料利用 SPSS (Statistical Products and Services Solutions) 軟體先進行變方分析，再以最小顯著差 (LSD) 或 t 值測試法檢測，並採 $p < 0.05$ 之顯著水準比較處理間之差異性。若遇百分率時，資料先進行角度轉換 (arcsine transformation)，再進行分析。

結　果

一、卵期施藥對各未成熟期之影響

蔬菜斑潛蠅卵經三種不同藥劑與劑型處理後，除歐殺滅與阿巴汀均具 100% 殺卵效果外，賽滅淨之劑型不論是溶液或可濕性粉劑，均對卵孵化無藥效，與對照組間無顯著差異 (表二)。但若持續觀察孵化幼蟲在原浸藥處理豆葉上之發育，則發現賽滅淨溶液與可濕性粉劑兩處理，使蔬菜斑潛蠅第一、二及三齡幼蟲之存活率，各銳減爲 36.0～39.4、1.8～5.8 及 0%，兩劑型間雖無顯著差異，但均與對照組呈顯著差異 (表二)。

二、第三齡幼蟲期施藥對未成熟期存活率之影響

供試之三種藥劑與劑型，均對蔬菜斑潛蠅第三齡幼蟲之化蛹有顯著之藥效，第三齡幼蟲之存活率均銳減爲 0% (表三)。

三、藥劑對成蟲之影響

豆苗浸藥後接蟲 24 小時之處理　蔬菜

表三　蔬菜斑潛蠅第三齡幼蟲經不同藥劑處理後未成熟期之存活率[1)]

Table 3. Percentage survival rate of the immature stages of *Liriomyza sativae* after the third instars were treated with various insecticides[1)]

Insecticides	Percent survival		
	Larva	Pupa	Larva-pupa
Oxamyl	0b[2)]	-	0b
Abamectin	0b	-	0b
Cyromazine SL	0b	-	0b
Cyromazine WP	0b	-	0b
CK	100a	86.2 ± 2.0	86.2 ± 2.0a

[1)] Seedlings of field bean infested by 20-30 *L. sativae* larvae were dipped in an insecticide solution for 1 min. Untreated controls were dipped in distilled water. Each treatment had 4-6 replications, which contained one seedling in an individual acrylic cylinder (20 cm diameter x 25 cm high) and was placed under 25ºC, 14L:10D, and 65-85% R.H. 30 min after treatment.

[2)] Means ($\overline{X}$ ± SEM) within each column followed by the same letter are not significantly different ($p < 0.05$, LSD). Percentage of survival data were transformed to arcsin$\sqrt{x}$ prior to ANOVA.

斑潛蠅成蟲經三種供試藥劑與劑型處理後，24 小時內，歐殺滅與阿巴汀兩藥劑，不但對雌蟲或雄蟲，各具 18.3～26.0% 或 18.4～45.8% 顯著之致死力；亦顯著降低 97.3～98.9% 雌蟲之產卵量，抑制 100% 卵之孵化率，及減少 95.2～97.3% 雌蟲之取食刻點數；同時歐殺滅對雄蟲之致死率顯著高於雌蟲 (表四)。賽滅淨兩劑型處理組中，成蟲存活率、產卵數、孵化率及取食刻點數等，雖均與對照組無顯著差異，但其子代第二與三齡幼蟲數卻顯著較對照組，各銳減 75.1 與 97.3～98.9% (表四)。

成蟲接觸藥劑 24 小時後存活個體之後續觀察　成蟲經三種供試藥劑與劑型處理 24 小時後，移至未處理藥劑之豆苗上，記錄其壽命、生育力及取食刻點數。結果顯示不論雌、雄蟲壽命，歐殺滅與阿巴汀處理組各較對照組顯著減少 46.7～62.9 與 50.3～55.7%，而賽滅淨兩劑型處理組卻與對照組無顯著差異；同時各處理組中雌、雄壽命均無顯著差異 (表五)。生殖力方面，歐殺滅與阿巴汀處理組對子代第三齡幼蟲數、蛹數及成蟲數之影響最大，各顯著較對照組減少 96.1～99.2%、95.7～99.1% 及 95.5～98.9%；賽滅淨兩劑型處理組次之，顯著較對照組各減少 75.8～85.2%、73.5～84.6% 及 73.9～85.2% (表五)。子代雌性比方面，各藥劑處理與對照組間無顯著差異 (表五)。取食刻點數方面，歐殺滅與阿巴汀處理組對雌蟲取食刻點數之影響最大，顯著較對照組減少 89.3～99.9%；賽滅淨兩劑型處理組次之，顯著較對照組各減少 73.4～75.9% (表五)。

討　論

一、藥劑類型對蔬菜斑潛蠅防治之影響

藥劑防治害蟲時，因藥劑化學類型 (chemical subgroup)、作用機制之不同，對害蟲防治效果亦不同。本試驗供試之三種藥劑各屬於不同之化學類型，如歐殺滅爲氨基甲酸鹽類 (carbamate) 之殺蟲劑、殺蟎劑及殺線蟲劑，阿巴汀爲土壤微生物代謝產物 (avermectin) 之殺蟲劑、殺蟎劑及殺線蟲劑，賽滅淨爲昆蟲生長調節劑 (insect growth regulator) 之殺蟲劑與殺蟎劑 (表一)。前二種

表四　蔬菜斑潛蠅成蟲經不同藥劑處理後 24 小時內之存活率、子代數及取食刻點數 [1)]

Table 4. Percentage survival rate, progeny and feeding stipples of *Liriomyza sativae* adults treated with various insecticides within 24 hours[1)]

Insecticides	*n*	Percent survival of adult		No. progeny/10 females					Percent survival of egg	No. feeding stipples/ 10 females
		Female	Male	Egg	Larva			Pupa		
					1st	2nd	3rd			
Oxamyl	5	74.0 ± 2.4Ab[2)]	52.0 ± 3.7Bc	5 ± 1b	0b	0c	-	0b	0b	50 ± 12b
Abamectin	5	81.7 ± 4.8Ab	78.3 ± 5.4Ab	2 ± 0b	0b	-	-	-	0b	28 ± 3b
Cyromazine SL	4	100Aa	95.0 ± 2.9Aa	150 ± 28a	141 ± 27a	46 ± 7b	2 ± 1b	0b	99.5 ± 0.2a	967 ± 170a
Cyromazine WP	3	98.0 ± 2.0Aa	98.0 ± 2.0Aa	181 ± 14a	179 ± 13a	46 ± 3b	5 ± 1b	0b	99.1 ± 0.4a	1265 ± 164a
CK	5	100Aa	96.0 ± 4.0Aa	186 ± 13a	185 ± 13a	185 ± 13a	185 ± 13a	185 ± 13a	99.7 ± 0.3a	1048 ± 121a

1) Seedlings of field bean were dipped in an insecticide for 1 min. Untreated controls were dipped in distilled water. Each treatment contained two seedlings in an individual acrylic cylinder (20 cm diameter x 25 cm high). Thirty minutes after treatment, 10 pairs of 2-day old *L. sativae* adults were released into the cylinder and placed under 25°C, 14L:10D, and 65-85% R.H.

2) Means ($\overline{X}$ ± SEM) of percent survival of adult followed by the same uppercase letter denote that there are no significant differences between sexes ($p < 0.05$, *t*-test). Means ($\overline{X}$ ± SEM) within each column followed by the same lowercase letter are not significantly different ($p < 0.05$, LSD). The percentage of survival data was transformed to arcsin $\sqrt{x}$ prior to ANOVA.

表五　蔬菜斑潛蠅成蟲經不同藥劑處理 24 小時後之壽命、生殖力及取食刻點數[1)]

Table 5. The longevity, fecundity and feeding stipples of *Liriomyza sativae* adults treated with various insecticides after 24 hours[1)]

Insecticides	*n*	Longevity (d)		Fecundity/female			Female proportion	No. feeding stipples/female
		Female	Male	No. 3rd instars	No. pupae	No. adults		
Oxamyl	10	5.3 ± 0.4Ab[2)]	6.5 ± 0.5Ab	1 ± 1c	1 ± 1c	1 ± 1d	-	1 ± 1c
Abamectin	14	7.1 ± 1.2Ab	5.4 ± 0.5Ab	5 ± 3c	5 ± 3c	4 ± 3cd	0.56 ± 0.04a	100 ± 48c
Cyromazine SL	10	11.1 ± 0.6Aa	11.3 ± 0.8Aa	31 ± 5b	31 ± 5b	23 ± 4b	0.54 ± 0.04a	248 ± 35b
Cyromazine WP	13	11.5 ± 0.6Aa	9.3 ± 1.0Aa	19 ± 2b	18 ± 2b	13 ± 1bc	0.52 ± 0.04a	225 ± 33b
CK	6	14.3 ± 1.2Aa	12.2 ± 2.1Aa	128 ± 18a	117 ± 20a	88 ± 14a	0.46 ± 0.03a	932 ± 83a

1) For every replicate, one pair of 3-day old *L. sativae* adults that had survived after 24 h of insecticide treatment was placed in the acrylic cylinder (20 cm diameter x 25 cm high) under 25°C, 14L:10D, and 65-85% R.H. Untreated field bean seedlings were provided every day.

2) Means ($\overline{X}$ ± SEM) of longevity followed by the same uppercase letter denote that there are no significant differences between sexes ($p < 0.05$, *t*-test). Means ($\overline{X}$ ± SEM) within each row followed by the same letter are not significantly different ($p < 0.05$, LSD).

藥劑對昆蟲之作用機制爲胃毒或神經毒或接觸毒，因此歐殺滅與阿巴汀均對蔬菜斑潛蠅兼具 100% 殺卵與幼蟲效果。而賽滅淨對昆蟲與蟎之作用機制，則爲抑制其幾丁質之合成與生長調節，因而在該蠅卵期施藥時，賽滅淨之兩種劑型不但均無殺卵效果，且第一、二及三齡幼蟲之死亡率係隨發育而陸續增加；但若在該蠅第三齡幼蟲期施藥時，賽滅淨兩種劑型對幼蟲之死亡率均高達 100%。

二、藥劑對蔬菜斑潛蠅蟲期之藥效

綜合三種供試藥劑對蔬菜斑潛蠅各蟲期之防治程度中，歐殺滅與阿巴汀均以卵與幼蟲期最高，防治率高達 100%，成蟲期次之；而

賽滅淨兩種劑型則以幼蟲期最高，防治率高達100%，卵期次之，成蟲期再次。

三、藥劑對蔬菜斑潛蠅之防治效力

供試之三種藥劑因對蔬菜斑潛蠅幼蟲具高達 100% 之致死率，且各處理間無顯著差異，因而此三種藥劑均可推薦該蠅防治用。但若考慮成蟲之取食刻點與幼蟲食痕對寄主植物苗期之影響，防治蔬菜斑潛蠅之最佳藥劑，則爲歐殺滅與阿巴汀，其次者爲賽滅淨。Poe *et al*. (1978)、Waddill (1978)、Trumble and Toscano (1983) 及 Trumble (1985b) 等曾建議當使用一種藥劑防治斑潛蠅前，應先測試該藥劑對其寄生蜂種類之影響，並據此作爲使用該藥劑之參考。Chien *et al*. (2007a, b) 亦證實防治非洲菊斑潛蠅 (*Liriomyza trifolii* (Burgess)) 之有效藥劑雖有六種，但其中僅賽滅淨與其兩種重要寄生蜂－異角釉小蜂 (*Hemiptarsenus varicornis* (Girault)) 與華釉小蜂 (*Neochrysocharis formosa* (Westwood)) 間之相容性大。底比斯釉小蜂 (*Chrysocharis pentheus* (Walker)) 與岡崎釉小蜂 (*Closterocerus okazakii* (Kamijo)) 爲蔬菜斑潛蠅本地種之有效寄生蜂 (Chien and Chang, 2007, 2008a, b, 2009a, b)，所以若考慮上述藥劑對蔬菜斑潛蠅本地寄生蜂之影響，仍需進一步試驗。

四、藥劑對蔬菜斑潛蠅致死能力外之影響

Robb 與 Parrella (1984) 與 Chien *et al*. (2007a) 曾測試昆蟲生長調節劑 (insect growth regulator, IGR) 施用在非洲菊斑潛蠅幼蟲或成蟲後，確對其成蟲之生殖力具亞致死之影響 (sublethal effect)。本試驗則證實歐殺滅與阿巴汀對蔬菜斑潛蠅成蟲，除有直接致死之影響外，尚對成蟲接觸藥劑 24 小時後之壽命、生殖力及取食刻點數等，具亞致死影響。而賽滅淨之兩種劑型，雖對該蠅成蟲無直接致死之影響，但對成蟲接觸藥劑 24 小時後之生殖力與取食刻點數，卻具亞致死影響。

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Effect of Common Insecticides on *Liriomyza sativae* Blanchard (Diptera: Agromyzidae)

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ABSTRACT

Seedlings of field bean (*Phaseolus vulgaris* var. *communis* Aeschers) with and without the leaf miner (*Liriomyza sativae* Blanchard) were used to study the effects of three insecticides (oxamyl SL, abamectin EC, cyromazine SL, and cyromazine WP) against the different life stages of *L. sativae* by dipping method. The results showed that all these insecticides have a significant lethal effect on *L. sativae* and can be used to control the leaf miner. The highest lethal effect of oxamyl and abamectin was recorded for the egg and larval stages with a survival rate of 0%, and the second most effective period was the adult stage. The adult-24-hour survival rate, the number of eggs and number of feeding stipples were reduced by 18.3-26.0, 97.3-98.9 and 95.2-97.3%, respectively, and the longevity, adult progeny and the number of feeding stipples after 24 hours also decreased by 50.3-62.9, 95.5-98.9 and 89.3-99.9%, respectively. The highest lethal effect of the two cyromazine formulations was recorded for the larval stage with a survival rate of 0%; the second most effective period was the egg stage, although hatching was not affected, while the larval mortality of the 1st, 2nd and 3rd instars was 60.6-64.0, 94.2-98.2 and 100%, respectively. The least affected was the adult stage with no direct effect on the adult-24-hour survival rate and the number of eggs and number of feeding stipples. However, the adult progeny and the number of feeding stipples after 24 hours decreased by 73.9-85.2 and 73.4-75.9%, respectively.

Key words: *Liriomyza sativae*, insecticide, stages, field bean

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