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The Secondary Killing Effect of Hydramethylnon Bait trays on Cockroaches and the Control Experiment in Houses 【Scientific note】

Hydramethylnon毒餌對蜚蠊之二次毒效及於住家之應用【科學短訊】

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Abstract

Bait with 1.65% hydramethylnon was tested for the control of cockroaches. The roaches were attracted to the bait and fed on it. The poisoned roaches died within several days and furthermore, the cockroaches in the colony which did not feed directly on the bait were also died. Results obtained in this study indicate that cockroaches feeding on toxic bait can transfer lethal toxic substances to other roaches in the colony. Six 1.65% hydramethylnon bait trays (56cm²) were tested in houses (66m²) at Nankang, Taipei, for three months from September to December 1993. The reduction rates of cockroaches in these houses were 68-70%. Subsequent tests were carried out again from April to June and from July to October 1994. The effects of six bait trays were the same with the control groups, yet 37-65% reduction rates were found using the twelve trays in a house in the period April to June, and 27-52% reduction rates from July to October. These results reveal that six hydramethylnon baits were sufficient in reducing the roach population in house of 66m² during autumn and winter. However, more than 12 baits were required to control roaches during spring and summer. The cumulative capture percentages of *Periplaneta americana*, *P. australasiae*, *P. brunnea*, *Blattella germanica* and *Pycnoscelus surinamensis* were 58.1%, 32.4%, 8.7%, 0.5% and 0.2%, respectively. The kitchen was the area where most roaches were caught.

摘要

將1.65% hydramethylnon毒餌置於蜚蠊出沒處，可誘引蜚蠊取食，取食者於數日內死亡，同群其他未食餌者亦可逐漸死亡，證實取食毒餌中毒之蜚蠊可傳播毒劑予其他個體進而使之致死，毒劑傳播之方式乃經由蜚蠊的食糞行為形成，證明hydramethylnon毒餌之二次毒性效應。另以1.65% hydramethylnon大毒餌(上表面56cm²)在台北南港中研究附近20坪大的住家進行實際應用測試，1993年9-12月使用6個毒餌，蜚蠊之減少率為68-70%，1994年4-6月使用12個毒餌，減少率降為37-64%，1994年7-10月使用6個毒餌減少率為0-39%；使用12個毒餌減少率為27-52%。可知，在20坪的進戶如單獨使用此毒餌防治蜚蠊，秋冬季每戶放6個毒餌即可，春夏季則每一戶至少要放12個毒餌，方可達到效果。於試驗住戶誘捕蜚蠊之結果美洲蜚蠊 *Periplaneta americana* (L.)佔58.1%為最高、澳洲蜚蠊 *P. australasiae* (Fab.)32.4%次之。捕獲的地點則以富含食物的廚房為主。

Key words: cockroach, toxic bait, secondary killing effect, hydramethylnon.

關鍵詞: 蜚蠊、毒餌、二次毒效、愛美隆。

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Hydramethylnon毒餌對蜚蠊之二次毒效及於住家之應用

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摘 要

將1.65% hydramethylnon毒餌置於蜚蠊出沒處，可誘引蜚蠊取食，取食者於數日內死亡，同群其他未食毒餌者亦可逐漸死亡，證實取食毒餌中毒之蜚蠊可傳播毒劑予其他個體進而使之致死，毒劑傳播之方式乃經由蜚蠊的食糞行為形成，證明hydramethylnon毒餌之二次毒性效應。另以1.65% hydramethylnon大毒餌(上表面56cm²)在台北南港中研院附近20坪大的住家進行實際應用測試，1993年9—12月使用6個毒餌，蜚蠊之減少率為68—70%，1994年4—6月使用12個毒餌，減少率降為37—64%，1994年7—10月使用6個毒餌減少率為0—39%；使用12個毒餌減少率為27—52%。可知，在20坪的住戶如單獨使用此毒餌防治蜚蠊，秋冬季每戶放6個毒餌即可，春夏季則每一戶至少要放12個毒餌，方可達到效果。於試驗住戶誘捕蜚蠊之結果美洲蜚蠊*Periplaneta americana*(L.)佔58.1%為最高、澳洲蜚蠊*P. australasiae*(Fab.)32.4%次之。捕獲的地點則以富含食物的廚房為主。

關鍵詞：蜚蠊、毒餌、二次毒效、愛美隆

蜚蠊滋擾人畜、污染食物、傳播有害微生物，是重要衛生害蟲之一。噴洒殺蟲藥劑對蜚蠊為快速而有效的防治方法，唯噴灑法具有直接藥劑污染之危險。若將藥劑與餌料混合成毒餌，誘引蜚蠊取食，雖不如噴洒性藥劑速效，但對消費者較具安全性。

代謝阻止劑如hydromethylnon[tetrahydro-5, 5-dimethyl 2(1H)-pyrimidinone(3-[4-(trifluoromethyl)phenyl]1-(2-[4-(trifluoromethyl)phenyl]ethyl)-2-propenylidene)

hydrazone](中文名暫譯：愛美隆)之作用屬於對動物細胞內粒線體呼吸之抑制劑(inhibitor of mitochondrial respiration)(Hollingshaus, 1987)，可阻止蟲體能量之代謝，取食後之昆蟲產生活動力降低終至死亡現象。本劑亦為胃毒劑，可廣泛用於蟲害防治。其應用於蜚蠊之防治，目前已有許多相關研究(Milio *et al.*, 1986; Thoms and Robinson, 1987; Koehler and Patterson, 1991; Scott, 1991; Silverman *et al.*, 1991)。

往昔曾以hydramethylnon和abamectin為毒餌評估其對蜚蠊防治效果(Wang *et al.*, 1995), 本文擬進行hydramethylnon二次毒殺效應及以1.65% hydramethylnon毒餌進行居家測試, 以期了解毒餌應用效果, 供往後推廣之參考。

Hydramethylnon二次毒殺效應檢查之供試昆蟲為德國蜚蠊*Blattella germanica* (L.), 2-4週齡成蟲, 台北品系。以及美洲蜚蠊*Periplaneta americana* (L.), 2-4週齡成蟲, 台北品系。將德國蜚蠊及美洲蜚蠊各10隻(右前翅剪一缺口以與未食毒餌者區別)接入內含1.65% hydramethylnon毒餌之2公升玻璃缸中, 任其取食2天, 再移入供試之60×42×23cm³塑膠測試箱內, 然後接入德國蜚蠊及美洲蜚蠊各10對, 供給充份食水、狗飼料及藏匿處所, 俾蜚蠊自由取食及活動, 箱附蓋, 箱壁敷Fluon AD1以防蜚蠊逃逸, 每日觀察記錄活動情形及死亡率。空白對照組, 以狗飼料替代毒餌, 步驟同上。實驗組4重複, 對照組3重複。

1.65% hydramethylnon毒餌之應用測試於1993年9-12月、1994年4-6月及7-9月, 分別於中研院附近的凌雲五村住家, 共進行3次, 每次歷時3個月。此毒餌外有56cm²黑色塑膠套, 蜚蠊可由入口進入其間取食。供試住家每戶約20坪。試驗前於住家客廳、飯

廳、廚房、浴廁、房間及儲藏室各放一至二個市售黏蟑盒, 調查蜚蠊常出沒的地點。每次試驗時, 先在試驗住家上述地點放置5個黏蟑盒, 一週後收回調查黏附其中蜚蠊種類及數目(檢查過的蜚蠊不釋回, 據筆者未發表之資料, 如此對蜚蠊族群影響較小)。其後在各該地點放置1.65% hydramethylnon毒餌6個, 毒餌置放4、8、12週後, 再放5個黏蟑盒於住家一週, 調查住家蜚蠊數目。第一次試驗比較每戶放6個毒餌及不放毒餌的效果, 試驗組16戶, 對照組4戶。第二次試驗比較每戶放12個毒餌或6個毒餌的效果, 對照組5戶, 放6個毒餌4戶, 12個毒餌5戶。第三次試驗同第二次, 只是對照組3戶, 放6個毒餌9戶, 12個毒餌7戶。此部份之數據處理, 以每一次試驗, 處理前一週內, 每戶五個黏蟑盒捕獲之蜚蠊平均數當作1, 處理後4、8、12週之相對捕獲數依此換算, 蜚蠊減少率以處理後4、8、12週個別之 $(1-T/C) \times 100\%$ 表示, T為處理之相對捕獲數, C為對照之相對捕獲數。

將已取食1.65% hydramethylnon毒餌的蜚蠊與其他未食毒餌之個體放一起, 結果如表一所示, 未食毒餌之德國蜚蠊和美洲蜚蠊成蟲均會死亡, 其死亡率德國蜚蠊在3天後為12.5%, 13天後全數死亡, 美洲蜚蠊死亡速緩慢, 死亡率較小, 第9天後死亡率27%, 20天

表一 德國蜚蠊及美洲蜚蠊取食1.65% hydramethylnon毒餌後之傳毒效果檢查

Table 1. The transferring effect of lethal toxic material by adult *Blattella germanica* and *Periplaneta americana* after eating the 1.65% hydramethylnon bait

Roach spp.	Cumulative mortality (mean±S.E., %)						
	Days after treatment						
	3	5	7	9	11	13	20
<i>Blattella germanica</i>	0	12.5±0.5	38.8±6.3	70.0±29.4	90.0±10.8	100	100
control(<i>B. germanica</i>)	0	0	0	0	0	0	0
<i>Periplaneta americana</i>	0	0	0	27.5± 6.5	37.5±10.4	48.8±19.3	60.0±14.1
control(<i>P. americana</i>)	0	0	0	0	0	0	0

後死亡率累積為60%。足見取食毒餌的蜚蠊確可傳播此有毒物質，造成同群未食個體死亡。

蜚蠊傳播毒餌的毒劑於同群其他個體的途徑，Silverman等人(1991)以放射性C14標記的2% hydramethylnon毒餌供德國蜚蠊取食72小時，發現其糞便中有50% hydramethylnon未經代謝，且初齡若蟲較不喜外出覓食，而以較大若蟲或成蟲的排泄物為食。Chao *et al.*(1992)以毒餌供美洲蜚蠊取食一天後，將取食毒餌之活蟲1或2隻放到未食毒餌之健康成蟲中，10天後皆可得完全死亡率。若改以取食毒餌致死的蟲體，則未能引起死亡。Wang *et al.*(1995)以取食過hydramethylnon毒餌之蜚蠊蟲屍及蟲糞供健康蜚蠊取食，發現食糞者高達80%的死亡率，食屍者則無死亡。可見hydramethylnon毒餌二次殺蟑的機制之一是經由蜚蠊的糞便引起。

取食毒餌後殘存之蜚蠊之中毒症狀為失去平衡感，行動遲緩，對光週期的適應性差，白晝亦可見其離開匿居處所蹣跚而行，因此在自然狀況下極易因其它因素死亡，如墜水溺斃或被踩死。

毒餌的優點為可置於蜚蠊的隱蔽處所，讓較不外出之初齡若蟲容易取食，或經由誤食毒餌之外出蜚蠊排出含毒糞便讓同巢其他個體取食而致死，因此若長期使用此藥可增加降低蜚蠊族群之可能性。此外，選擇毒殺速度慢的毒餌，較不易讓蜚蠊提高警覺，增加其誤食致死的機會。

凌雲五村平房區的供試住家每戶放置1.65% hydramethylnon大毒餌以防治家居蜚蠊，效果如圖一、表二所示。圖一為蜚蠊被黏蟑盒誘捕之百分率，表二為蜚蠊減少的比率。

圖一可見，1993年9—12月的秋冬季，每戶使用6個毒餌即產生顯著防治效果。1994年

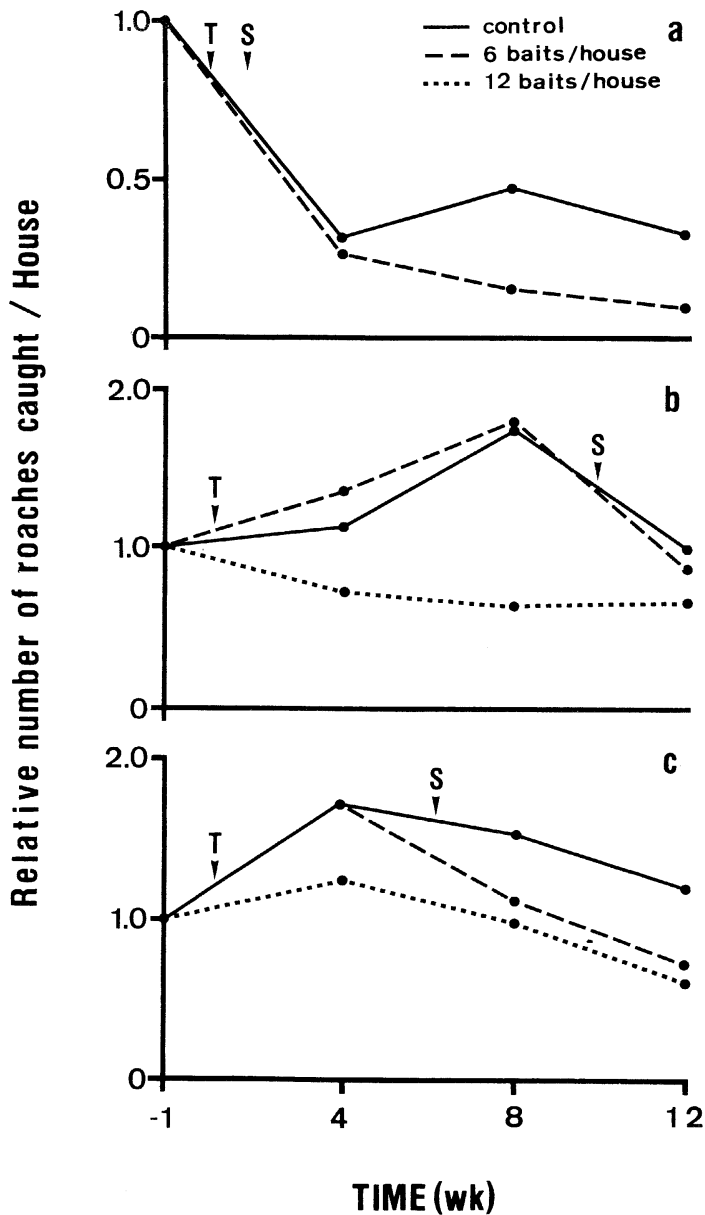
4—6月春季的測試，使用6個毒餌防治效果與對照組則無差異，使用12個毒餌效果較顯著。1994年7—10月夏秋季測試，使用6或12個毒餌都可具有防治效果。

表二可見，1993年9—12月的秋冬季，每戶使用6個毒餌，4週後蜚蠊減少16%，8週後為68%，12週後為70%。1994年4—6月春季的測試，使用6個毒餌在4週及8週之後不見防治效果，12週後減少12%，使用12個毒餌則4週後減少37%，8週後64%，12週後減少30%。1994年7—10月夏秋季的測試，使用6個毒餌處理後第4週不見防治效果，8週後減少27%，12週後39%，使用12個毒餌4週後蜚蠊減少27%，8週後36%，12週後52%。

上述試驗期間某些時段，如圖一a之第4週、圖一b之第12週和圖一c之第8週，調查之前遇北市環保局之定期消毒，此定期消毒每隔兩個月於此眷村巷道溝渠噴洒合成除蟲菊精防治登革熱病媒蚊。若不考慮環保局消毒所產生之效果，則1993年9—12月使用6個毒餌之減少率為68—70%，1994年4—6月使用12個毒餌減少率較對照組更佳，為37—64%，1994年7—10月的結果相近，使用12個毒餌減少27—52%。依此二圖表分析，此毒餌的有效期至少三個月。

從黏蟑屋中捕獲的蟲種及總蟲數分析，美洲蜚蠊佔58.1%，澳洲蜚蠊佔32.4%，棕色蜚蠊佔8.7%，德國蜚蠊佔0.5%，潛伏蜚蠊佔0.2%。捕獲的地點以富含食物的廚房為主，飯廳、客廳、浴室、房間及儲藏室依序次之。此結果和以往我等於市場、飯店及醫院裡捕獲的結果不同，以往調查以德國蜚蠊居多(Chow *et al.*, 1986)。

Milio *et al.*(1986)謂公寓廚房(未提面積大小)擺五個1.65% hydramethylnon毒餌(黑色塑膠外套上表面25cm²)，半年內對德國蜚蠊的防治率為49.3—73.2%，若擺12個，則防



圖一 1993-1994年間，在臺灣台北市凌雲五村住家，測試1.65% hydramethylNon大毒餌後，蜚蠊被黏蟑屋誘捕之百分率。a.1993年9-12月，比較每戶放6個毒餌與不放毒餌的結果。b.1994年4-6月，比較每戶放6或12個毒餌與不放毒餌的結果。c.1994年7-10月，比較每戶放6或12個毒餌與不放毒餌的結果。T是處理期，S是環保局定期消毒期，-1是處理前一週。

Fig. 1. The controlling effect of 1.65% hydramethylNon bait trays (56cm²) tested in houses (66m²) at Nankang, Taipei, Taiwan. a. From September to December 1993. b. From April to June 1994. c. From July to October 1994. T: Treated group. S: The area was sprayed with synthetic pyrethrins by the Bureau of Environmental Protection, Taipei Municipal Government. -1: One week of pretreatment.

表二 1993—1994年間，在台灣台北市凌雲五村住家，測試1.65% hydramethylnon大毒餌，蜚蠊減少之比率

Table 2. The reduction rates induced by 1.65% hydramethylnon bait in houses

Test period	Treatment	Reduction rate (%) [*]		
		Weeks after treatment		
		4 wk	8 wk	12 wk
Sep—Dec 1993	6 baits	16	68	70
Apr—Jun 1994	6 baits	—	—	12
	12 baits	37	64	30
Jul—Oct 1994	6 baits	—	27	39
	12 baits	27	36	52

*Reduction rates: $[(1 - T/C) \times 100\%]$ induced by 1.65% hydramethylnon bait trays (56 cm²) tested in some houses (66m²) at Nankang, Taipei, Taiwan.

T: Relative no. of roaches caught in treated group.

C: Relative no. of roaches caught in control group.

治率為76.8—99.5%。另外，相同之試驗於13.6坪(9m×5m)的雞舍放置相同的毒餌(形狀較大，56cm²)12個，以標幟再捕法檢查此毒餌對美洲蜚蠊的防治效果，五週內處理組的蜚蠊數目是試驗前的7—104%，對照組則是67—236%。Thoms and Robinson(1987)比較幾種毒餌對建築物(含二至六個公寓)中東方蜚蠊的防治，每一建築內外各放10個大型hydramethylnon毒餌，三個月內族群降低約50%。Fuchs(1986)在加拿大以每9平方公尺放3—6個hydramethylnon毒餌的密度防治德國蜚蠊，可達100%效果，且持續12週之久。MacDonald *et al.*(1987)以相同毒餌防治同種蜚蠊，4週內蜚蠊數目降低87%。

由往昔研究與吾等的試驗結果比較知，20坪的住戶如單用此毒餌防治蜚蠊，則秋冬蜚蠊族群降低的季節(Chow *et al.*, 1986)，每戶放6個毒餌即達防治效果，春夏蜚蠊族群上升的季節(Chow *et al.*, 1986)，則每一戶至少要放12個毒餌，方可奏效。

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The Secondary Killing Effect of Hydramethylnon Bait Trays on Cockroaches and the Control Experiment in Houses

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ABSTRACT

Bait with 1.65% hydramethylnon was tested for the control of cockroaches. The roaches were attracted to the bait and fed on it. The poisoned roaches died within several days and furthermore, the cockroaches in the colony which did not feed directly on the bait were also died. Results obtained in this study indicate that cockroaches feeding on toxic bait can transfer lethal toxic substances to other roaches in the colony. Six 1.65% hydramethylnon bait trays (56 cm²) were tested in houses (66m²) at Nankang, Taipei, for three months from September to December 1993. The reduction rates of cockroaches in these houses were 68-70%. Subsequent tests were carried out again from April to June and from July to October 1994. The effects of six bait trays were the same with the control groups, yet 37-65% reduction rates were found using the twelve trays in a house in the period April to June, and 27-52% reduction rates from July to October. These results reveal that six hydramethylnon baits were sufficient in reducing the roach population in a house of 66m² during autumn and winter. However, more than 12 baits were required to control roaches during spring and summer. The cumulative capture percentages of *Periplaneta americana*, *P. australasiae*, *P. brunnea*, *Blattella germanica* and *Pycnoscelus surinamensis* were 58.1%, 32.4%, 8.7%, 0.5% and 0.2%, respectively. The kitchen was the area where most roaches were caught.

Key words: cockroach, toxic bait, secondary killing effect, hydramethylnon.