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A field evaluation of an EC formulation of chlorpyrifos + cypermethrin for the control of cocoa pod borer, *Conopomorpha cramerella* (Snell.)

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Key words: insecticide, cocoa pod borer control

Abstrak
Keberkesanan racun serangga chlorpyrifos + cypermethrin (500 + 50 g b.a./L) (*Nurelle–D* 505 EC) untuk mengawal pengorek buah koko (PBK) telah dikaji. Keputusan menunjukkan bahawa racun serangga ini pada kadar 0.36 L/ha berkesan untuk mengawal PBK. Enam pusingan semburan telah mengurangkan bilangan purata telur dan peratus serangan PBK secara ketara. Kawalannya setanding dengan kawalan deltamethrin (1.0 L/ha). Racun serangga ini berkesan dalam mengawal populasi telur selama 8 minggu selepas semburan terakhir.

Abstract
The field efficacy of the insecticide chlorpyrifos + cypermethrin (500 + 50 g a.i./L) (*Nurelle–D* 505 EC) against cocoa pod borer (CPB) was studied. The results showed that the insecticide is effective in controlling CPB at 0.36 L/ha (chlorpyrifos + cypermethrin: 180 + 18 g a.i./ha). This provided equal control as the standard deltamethrin at 1.0 L/ha. Six rounds of spraying significantly reduced the mean number of eggs and percentage of pod infestation by the CPB. Chlorpyrifos + cypermethrin was effective in controlling egg population to about 8 weeks after the final spray.

Introduction

The cocoa pod borer (CPB), *Conopomorpha cramerella* (Snellen) (Lepidoptera: Gracillariidae), is the most serious cocoa insect pest in Malaysia and other cocoa producing countries in South East Asia. The pest was first recorded in Sabah in late 1980 and its spread into Peninsular Malaysia was confirmed in September 1986. Damage is caused by the larvae feeding within the pod resulting in clumping of beans making them unextractable after harvesting. The annual monetary loss was estimated to be more than M$1 000/ha as was experienced by some major cocoa estates.

Various control approaches have been attempted since the discovery of the pest. However, chemical control remains the most widely adopted means of managing CPB. Currently, many insecticides have been evaluated for the control of CPB. The insecticides include chlorinated hydrocarbons, organophosphate, carbamates and synthetic pyrethroids (Anon. 1981, 1983; Vanialingam et al. 1981; Sidhu 1984,

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1985; Johney et al. 1986; Sim 1986). However, continued efforts in screening of insecticides against CPB is necessary in the light of new development of insecticides, in anticipation of resistant build-up in CPB as a result of heavy usage of certain insecticides, and searching for alternative insecticides that are more cost efficient.

This paper reports the study on field efficacy of chlorpyrifos + cypermethrin (500 + 50 g a.i./L) *(Nurelle–D* 505 EC) in a multiple spray regime for the control of CPB.

Materials and methods

The study was conducted in a cocoa monoculture area at Felda Umas, about 60 km west of Tawau, Sabah. The experimental field comprised three blocks of more than 20 ha mature cocoa. The area consisted of 6–year–old hybrid cocoa having well-developed canopies and the height maintained at a single jourquette (1.2–1.6 m).

The trial included three rates of an EC formulation of chlorpyrifos + cypermethrin (*Nurelle–D* 505 EC), a commercially recommended rate of deltamethrin (*Decis* 1.4 EC) and a control (sprayed only with water) *(Table 1)*. Treatments were replicated four times using randomized complete block design. The plots, 0.2 ha each, were separated by four rows of untreated cocoa trees.

Table 1. Insecticide treatments and rates used

Treatment	Rate	
	g a.i./ha	L/ha
Chl. + cyp.	180 + 18.0	0.36
Chl. + cyp.	365 + 36.5	0.73
Chl. + cyp.	545 + 54.5	1.09
Del.	14	1.00
Control	–	–

Chl. = chlorpyrifos
Cyp. = cypermethrin
Del. = deltamethrin

Six sequential spray applications at approximately 10–day intervals began on 18 September 1986. The last spray was on 10 November 1986. As the crop peak was slightly delayed, the number of pods susceptible to egg laying was small at the start of the spray program. Spraying was done in the morning using a motorized mist-blower (10–L capacity, model Solo 423). The sprayman walked between two rows of cocoa trees and moved the spray nozzle from side to side while directing the spray towards the pods and the CPB resting site which was on the adaxial surface of the jourquette branches.

The efficacy of the insecticides was measured in terms of reduction of egg numbers and percentage of moderate and heavily infested pods during the pre and postspraying periods. The number of eggs on available pods (about 60) of the preferred egg-laying stage (about 3 months and older) on 20 trees was visually counted at 14–day intervals during the pre and postspraying periods. During the spraying period, the number of eggs was counted 3 days before and after each spraying. Since the number of pods sampled was different on all sampling dates, the mean number of eggs was expressed in terms of egg number per 10 pods. The trees, from which pods were sampled for egg population, were randomly selected along two diagonal transects within each plot. The percentage of moderately and heavily infested pods (more than 30% unextractable beans) was recorded at biweekly harvesting interval during the pre and postspraying periods respectively. Data on infestation level were recorded from April 1986 to February 1987.

The effectiveness of the treatments was determined by statistically subjecting the data to the analysis of variance and the Duncan's multiple range test (DMRT) ($p<0.05$) was used to separate the means. Before analysis, data on egg population (based on mean number of eggs per 10 pods) and infestation percentage were transformed using SQRT $(x + 1)$ and arc sine transformations respectively. However, the untransformed data were used instead to plot the graph on egg population and infestation percentage.

Results and discussion

The results showed that all the treatments had significantly lower egg populations than the control. The mean egg population in the control plot was also reduced as with other treatments but remained significantly higher ($p<0.05$) than the treated plots *(Table 2)* throughout the study period *(Figure 1)*. The reduction of the egg population in control plots after the insecticidal application might have been due to the fumigative action of the insecticides which repelled the ovipositing adult moths. The wet conditions in the control plots due to spraying with water might

Table 2. The effects of insecticide treatments on the cocoa pod borer egg populations

Treatment	Rate (L/ha)	No. of eggs/10 pods BS	No. of eggs/10 pods AS
Chl. + cyp.	0.36	23.93	5.36a
Chl. + cyp.	0.73	29.20	5.83a
Chl. + cyp.	1.09	27.89	5.43a
Del.	1.00	23.46	5.28a
Control	–	27.67	8.00b

Means followed by the same letter within a column are not significantly different by DMRT ($p<0.05$)
BS = before spray, from Apr. to Sept. 1986
AS = after spray, from 17 Nov. 1986 to 16 Feb. 1987
Chl = chlorpyrifos
Cyp. = cypermethrin
Del = deltamethrin

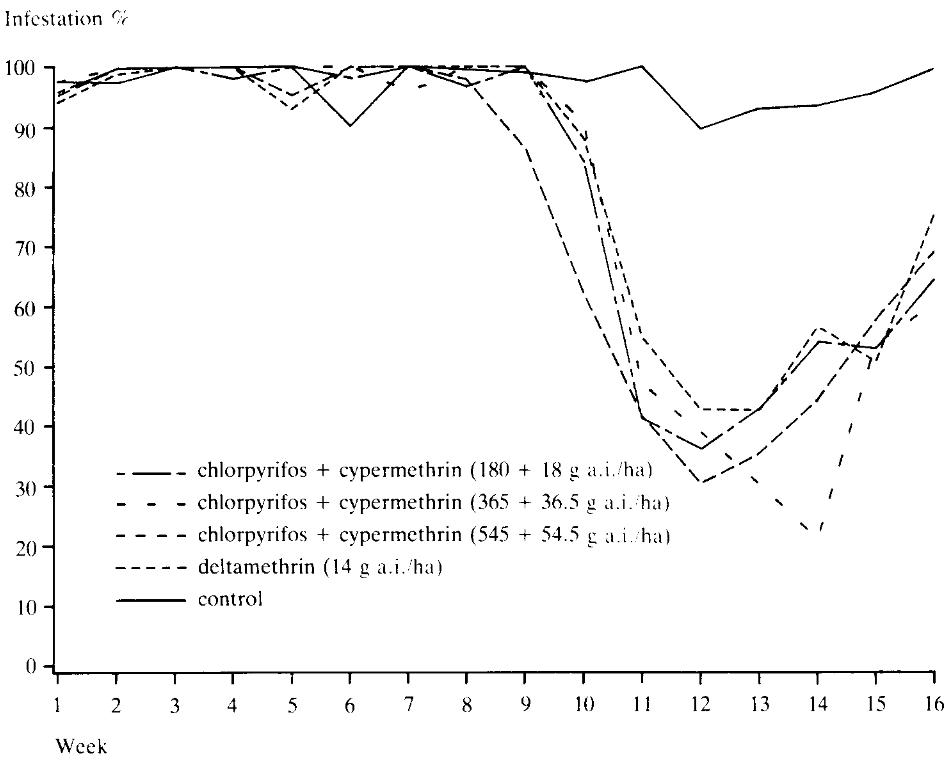

Figure 1. The effects of insecticide spraying on the cocoa pod borer egg population trends

also hinder the female moths from laying eggs. The negative effects of wet conditions on egg-laying activity of the female moths have been reported by Roepke (1912).

There was no significant difference ($p>0.05$) in egg numbers between the deltamethrin-treated plot and the chlorpyrifos + cypermethrin-treated plots *(Table 2)*. Similarly, no significant difference ($p>0.05$) was detected in egg numbers among the three rates of chlorpyrifos + cypermethrin.

It is shown in *Figure 1* that the first application of insecticides had reduced the mean egg population from more than 35 eggs/10 pods to less than 10 eggs/10 pods. The second and third spraying had little effects on egg population levels. Replenishment of fresh eggs by the female moths which had immigrated from the surrounding areas might have been the stabilizing factor. The egg populations fluctuated somewhat (5–15 eggs/10 pods) during the spraying period. The egg numbers were further reduced to less than 5 eggs/10 pods immediately after the fifth spraying. The sixth spraying actually did not lower the egg numbers any further but instead extended the period of lower egg population level. The egg population levels remained low for more than 8 weeks following the last (sixth) spraying but increased sharply at 12th week following the last spraying.

The percentage of pod infestations was significantly reduced (less than 50%) after the insecticidal treatments while infestation level in the control plots remained significantly high (more than 85%) even after the last spraying (*Table 3* and *Figure 2*). The infestation level dropped to less than 50% in the treated plots for more than a month before it began to rise again. Deltamethrin and all treatment rates of chlorpyrifos + cypermethrin were equally effective in reducing infestation.

The results suggest that the efficacy of chlorpyrifos + cypermethrin is comparable to that of deltamethrin even at a lower concentration of 0.36 L/ha (180 + 18 g a.i./ha). The effectiveness of cypermethrin as one of the insecticides for controlling the CPB has been reported (Sidhu 1984). Hence, the presence of chlorpyrifos in the formulation may provide a synergistic effect and may possibly reduce the potential outbreak of mite population as a result of excessive use of the pyrethroids. The population outbreaks of phytophagous mites after applications of synthetic pyrethroids are well documented (Hall 1977; Hoyt et al. 1978; Zwick and Fields 1978; Aliniazee and Cranham 1980; Hislop et al. 1981; Iftner and Hall 1983).

The results also indicate that the five spray rounds is sufficient to suppress the CPB populations. This frequency of spraying is now widely adopted by many growers. At the same time, thoroughness and proper timing of the sprayings are necessary for maximum control of the CPB.

Table 3. The effects of insecticide treatments on the cocoa pod borer infestation

Treatment	Rate (L/ha)	Infestation (%) BS	AS
Chl. + cyp.	0.36	89.41	14.86a
Chl. + cyp.	0.73	85.89	16.41a
Chl. + cyp.	1.09	92.30	13.27a
Del.	1.00	92.25	15.90a
Control	–	88.31	52.07b

Means followed by the same letter within a column are not significantly different by DMRT ($p<0.05$)
BS = before spray, from Apr. to Sept. 1986
AS = after spray, from 24 Nov. 1986 to 16 Feb. 1987
Chl. = chlorpyrifos
Cyp. = cypermethrin
Del. = deltamethrin

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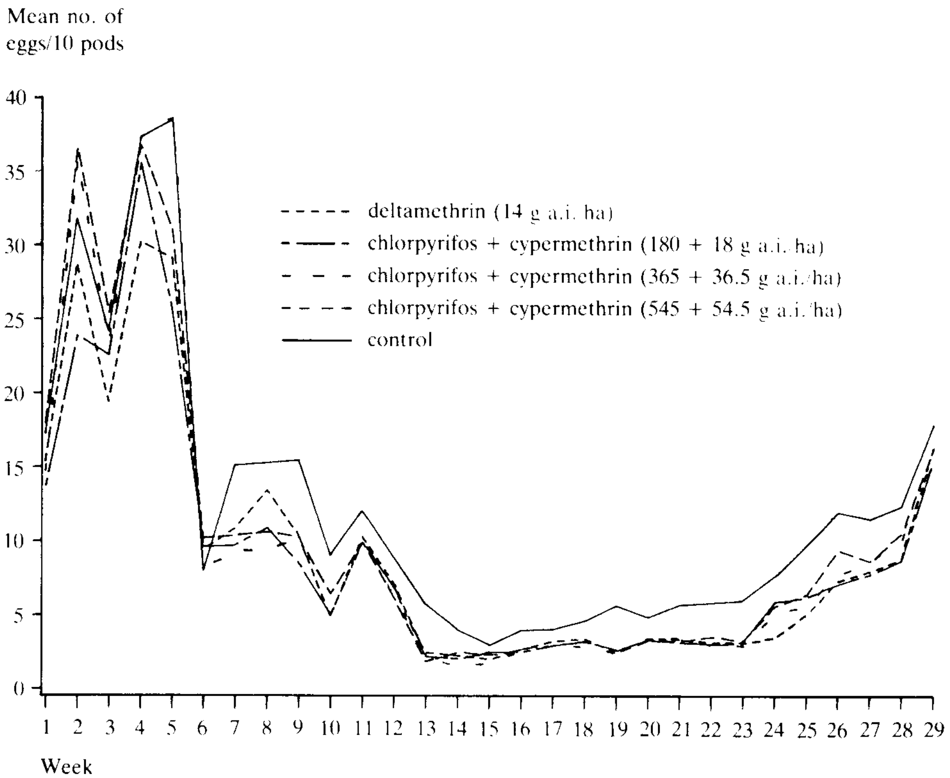

Figure 2. The effects of insecticide spraying on cocoa pod infestation

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