FIELD EVALUATION OF INSECTICIDES AND A CULTURAL PRACTICE AGAINST THE BUNCH MOTH, *Tirathaba rufivena* (LEPIDOPTERA: PYRALIDAE) IN A MATURE OIL PALM PLANTATION

Keywords: Bunch moth, *Tirathaba rufivena*, oil palm, *Elaeis guineensis*, *Bacillus thuringiensis*, cyfluthrin, diflubenzuron, endosulfan.

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A field evaluation of a number of insecticides against Tirathaba rufivena *was undertaken in a mature oil palm plantation at Teluk Intan between April and October 1988 over an area of 6.5 hectares.*

The insecticides evaluated were endosulfan, diflubenzuron, cyfluthrin and Bacillus thuringiensis *Berliner (Thuricide). The insecticides were applied three times at fortnightly intervals. Experimental controls were set up a) with no chemical treatment and b) using a cultural practice to maintain good sanitation.*

The effects of treatments on the infestation of bunches and the larval density of the bunch moth were evaluated. Bacillus thuringiensis, *cyfluthrin and diflubenzuron were more effective than endosulfan in the control of bunch moth. The cheapest treatment was* B. thuringiensis, *followed by cyfluthrin. The cost of using diflubenzuron was 2.5 times more than that of* B. thuringiensis. *Although cultural control could not be proven effective, it brought about some reduction in pest population and bunch damage and would also be expected to improve the efficiency of spraying insecticides.*

INTRODUCTION

The bunch moth *Tirathaba rufivena* (Walker) is an occasional pest of oil palm in instances where the bunches are missed during harvesting and in areas where pollination is poor (Chan, 1973). The caterpillars of *T. rufivena* feed on both male and female inflorescences (Wood and Ng, 1974).

TABLE 1. THE RATES OF APPLICATION OF VARIOUS INSECTICIDES FOR BUNCH MOTH CONTROL

Common name	Trade name	% active ingredient (a.i.)	Application rate
endosulfan	Thiodan	32.9	313.6 g a.i./ha
diflubenzuron	Dimilin	25.0	150 g a.i./ha
cyfluthrin	Baythroid	5.0	13.5 g a.i./ha
Bacillus thuringiensis	Thuricide	16000 I U/mg	500 g c.p./ha[a]

a) c.p. = commercial product

For each 20 litres of insecticide mixture, 30 ml of Tenac sticker with 15ml of DS747 Spreader were added.

Of a total of 24 types of insecticides evaluated against *T. rufivena*, endosulfan was the most effective for control of the bunch moth, because of its selective activity (Wood and Ng, 1974). Chan (1973) found that endosulfan, when sprayed at 7-day intervals for three spray rounds, eliminated the field population of *T. rufivena*, and he reported that acephate and chlorpyrifos were also effective.

Outbreaks of *T. rufivena* occurred in various FELDA oil palm schemes of 3.5 to 5-year old palms in 1972/73 (Ng, 1977), and in young plantings of several estates in Johor, Negeri Sembilan, Perak and Selangor (Wood and Ng, 1974). At an estate in Teluk Intan, the bunch moth has been a recurring problem over the last ten years and in April 1988, 200 of 960 hectares were badly affected by *T. rufivena*. Several insecticides, namely methamidophos, trichlorfon and endosulfan, have been used but the bunch moth problem still recurs, so a field evaluation of other insecticides against the bunch moth was necessary. This paper reports the findings from such an evaluation and also the effect of a cultural practice against the bunch moth at Teluk Intan.

MATERIALS AND METHODS

The study was undertaken in a mature oil palm plantation (planted 1974) at Teluk Intan from April to October 1988. The insecticides evaluated were endosulfan (regarded as the standard), diflubenzuron, cyfluthrin and *Bacillus thuringiensis*. The rates of application followed those recommended, and are shown in *Table 1*. A control was included in the experiment. Another treatment without insecticide was also included: this was to evaluate a cultural practice which involved the pruning of fronds supporting the mature bunches, and the removal of old male flowers at post-anthesis to maintain good sanitation. About 32 fronds were maintained per palm.

The experimental layout was a randomized block design. The plot size used was 4 × 6 palms, with six replicates, over a total area of 6.5 hectares. It was decided that there would be no guard palms in any of the plots so that an adequate number of bunches could be collected for assessment. It was felt that the effect of insecticidal drift would be negligible because the treatments involved spraying on to the bunches at all stages of development.

A pre-treatment assessment was made in late April 1988, while the application of insecticides was carried out three times: at 14, 28 and 42 days after the pre-treatment assessment. The application of insecticides was accomplished by two workers handling one knapsack power sprayer equipped with a 25-30 foot telescopic aluminium lance to raise the height of the nozzle to the level of the palm crown to facilitate adequate spray coverage. Spray droplets were directed to the bunches at all stages of development. About 2 litres of insecticide mixture were applied per palm. The application of insecticides was carried out from the early morning till late afternoon, except on rainy days.

Four post-treatment assessments were undertaken; the first at 17 days after the first spray application, with subsequent assessments at 19, 49 and 79 days after the final (third) spray application. The duration of each post-treatment assessment was extended to 2 - 3 harvesting rounds because not all plots yielded bunches at each harvesting round.

For each assessment within each plot, the number of bunches with and without larval damage was recorded. From each plot, two bunches or more were selected at random and chopped up; the larvae present were then counted. The data were transformed by $\sqrt{x}$ for the mean number of larvae per bunch and by angular transformation for the percentages of ripe bunches with damage.

Analysis of variance was subsequently performed on the data and the means were compared by the use of Duncan's New Multiple Range Test.

Corrected relative infestation (CRI) was used to analyse the relative effectiveness of various treatments according to the formula below:

$$CRI = 100\frac{ad}{bc}$$

where,

a and c = counts before and after standard sprays.

b and d = counts before and after experimental sprays.

RESULTS

Percentage of bunches with damage

The percentages of bunches with *Tirathaba* damage are shown in *Figures 1(i) to 1(iv)*. For the pre-treatment period, high percentages of bunches with damage were recorded for all treatments, varying from 74.2% in the *B. thuringiensis* plots to 92.4% in the cultural-practice plots. There were no significant differences in damage during the pre-treatment period.

At 19 days after the final spray application (DAFS), the numbers of bunches with *Tirathaba* damage were still high in all treatments except for *B. thuringiensis*, where a significant reduction ($P<0.01$) was obtained.

At 49 DAFS, there was a general reduction in the percentage of bunches with damage for all treatments. However, relative to the control, significant reductions had been obtained only for plots treated with diflubenzuron and *B. thuringiensis* ($P<0.05$). Although the percentage reduction in bunches with damage for cultural practice plots was lower than the control, the difference was not significant. Similar results were obtained at 79 DAFS, when further reductions in damage were recorded for all treatments.

Effects on *Tirathaba* larval density

Prior to the spraying of insecticides, high *Tirathaba* larval densities were recorded for all treatments and control plots, except for *B. thuringiensis* plots. The mean number of larvae/bunch varied from 18.8 in the cultural practice plots to 29.6 in the cyfluthrin plots, while the corresponding number for *B. thuringiensis* plots was 8.3 larvae/bunch (*Figure 2(i)*).

Seventeen days after the first spray application, there was a marked reduction in *Tirathaba* larval densities in all treatments except the cultural practice (*Figure 2(ii)*). There was also a decline in *Tirathaba* population density in the control plots but the reduction was not as marked as in the insecticide-treated plots. The differences between the control and the insecticide-treated plots were significant ($P<0.05$).

With regard to diflubenzuron, cyfluthrin and *B. thuringiensis* plots, the *Tirathaba* population densities remained significantly low ($P<0.05$) up to 49 DAFS, at levels of less than 1 larva/bunch compared with 34.2 larvae/bunch for the control (*Figures 2(iii) – 2(iv)*). At 79 DAFS, the *Tirathaba* population densities in these treated plots remained significantly lower ($P<0.01$) than in the control plots, but the population levels were slightly higher than at 49 DAFS (*Figure 2(v)*). Amongst these treated plots, the highest density was for cyfluthrin at 5.3 larvae/bunch.

For endosulfan, although the *Tirathaba* population density was significantly different at 49 DAFS ($P<0.05$) from the control, it was nine times higher than the corresponding value for *B. thuringiensis* plots. By 79 DAFS, the *Tirathaba* population density in the endosulfan

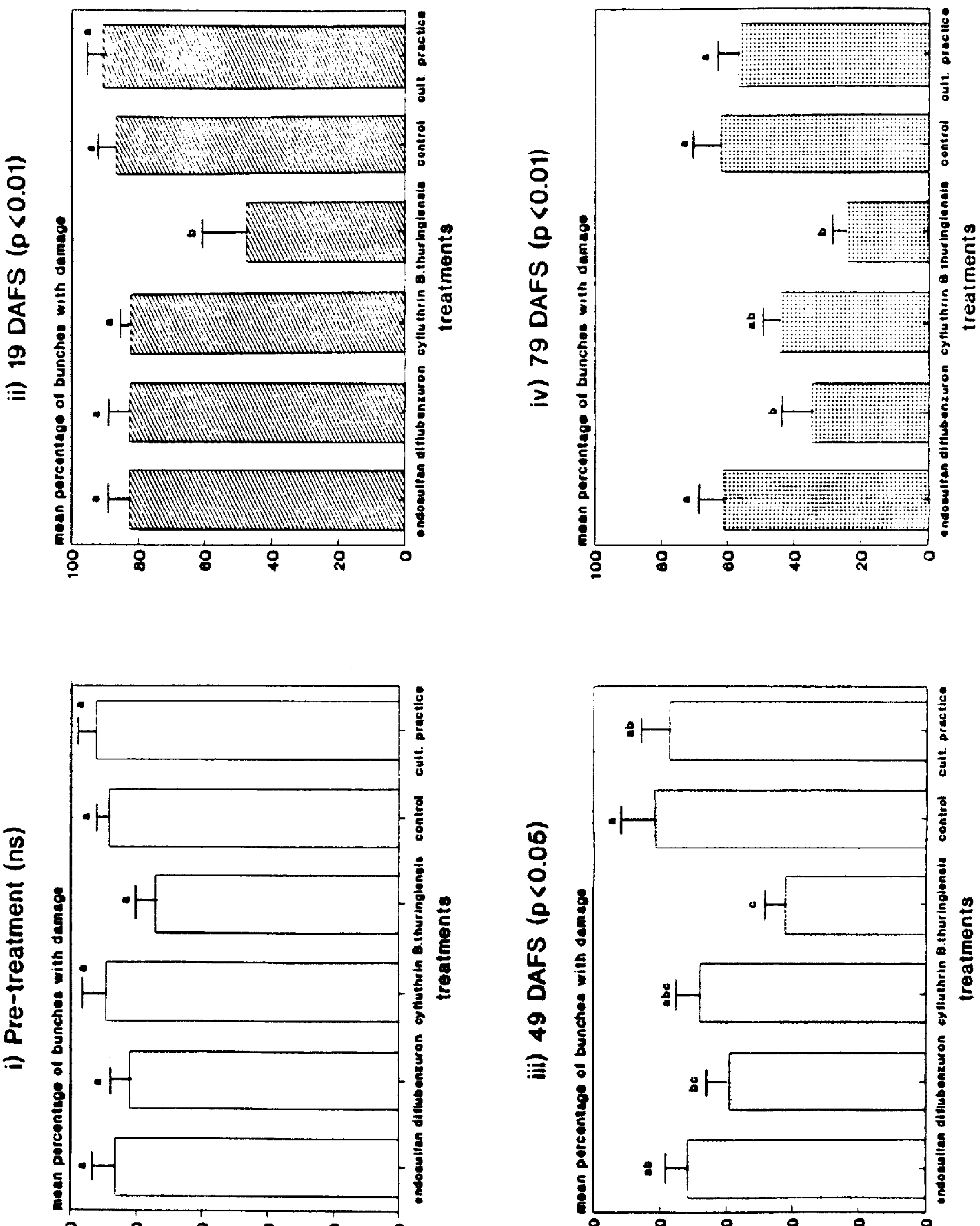

Figure 1. The effects of various control measures on Tirathaba rufivena *infestation of oil palm bunches, after the completion of final spray application.*

Note: *Means followed by the same letter are not significantly different.*

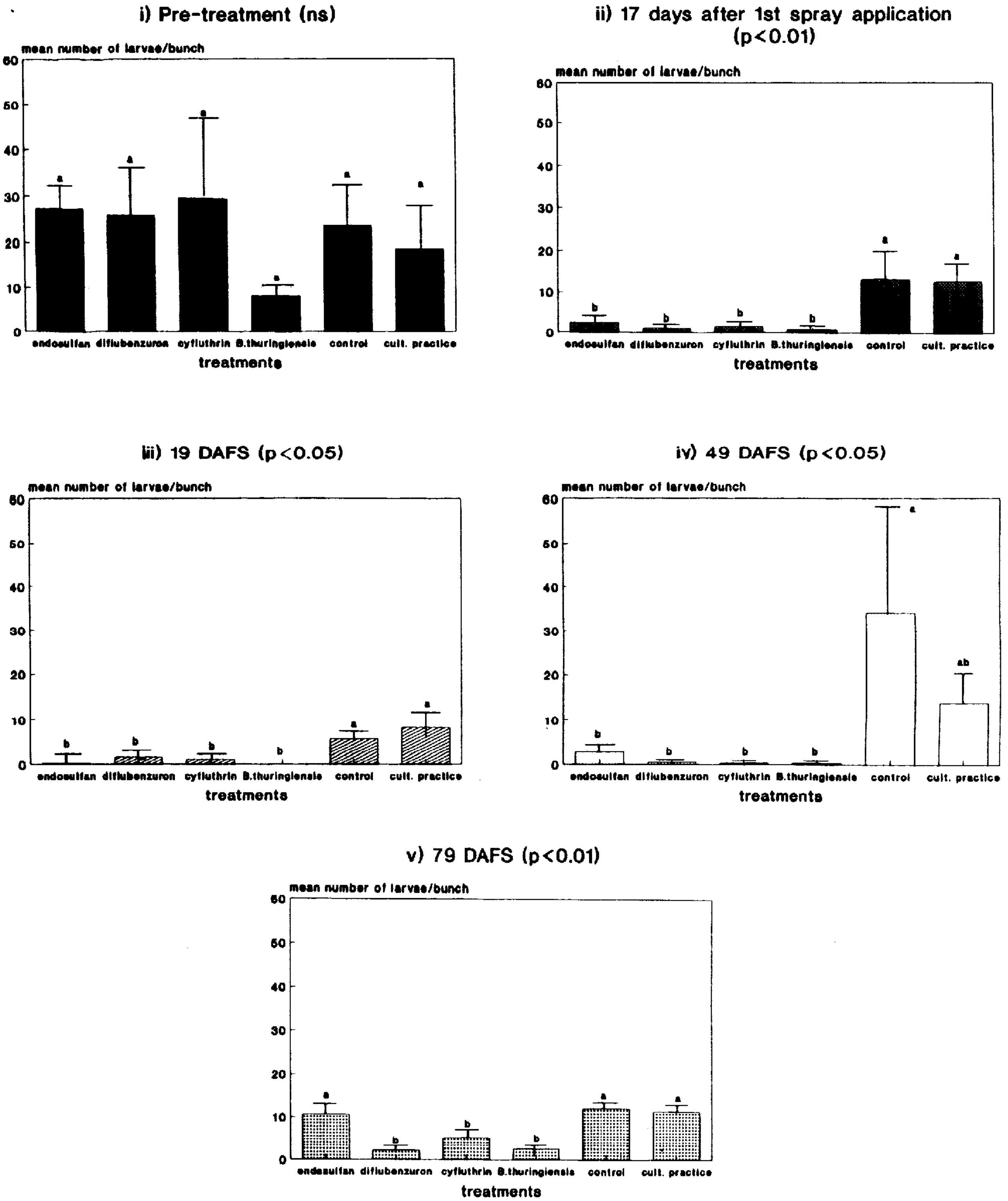

Figure 2. The effects of various control measures on the larval density of the bunch moth T. rufivena *after the completion of the final spray application.*

Note: Means followed by the same letter are not significantly different.

plots had increased to 10.7 larvae per bunch, which was close to the level found in the control plots, of 12.1 larvae/bunch.

For the cultural practice treatment, there was a very slight decline in *Tirathaba* population density, indicating that the approach could cause some reduction in pest population.

Relative effects of treatments

The results on the relative effectiveness of various treatments expressed as corrected relative infestation (CRI) are shown in (*Figures 3(i)-3(iv)*). At 19 DAFS, *B. thuringiensis* gave the best performance, followed by cyfluthrin. At 49 DAFS, cyfluthrin gave the best control, followed by diflubenzuron and *B. thuringiensis*. At 79 DAFS, diflubenzuron gave the best performance, followed by cyfluthrin and *B. thuringiensis*. Overall, *B. thuringiensis* gave the best performance, followed by cyfluthrin and diflubenzuron: the respective CRI averages were 37.8, 46.8 and 56.6 percent.

DISCUSSION

The assessment of the impact of insecticides at 19 and 49 DAFS, based on the percentage of harvested bunches with damage, represented intermediate effects because the damage recorded during these periods was actually old, *i.e.* it was already present on the immature bunches before the completion of spraying operations. This accounted for the high percentage of harvested bunches with *Tirathaba* damage at 19 and 49 DAFS.

The effect of the insecticides in reducing damage was manifested at a later period, by a significant decline in the percentage of ripe bunches with damage at 79 DAFS, or 3½ months after the first spray application for diflubenzuron and *B. thuringiensis*. This suggests that it would be easier to apply insecticide and prevent damage when the bunches are still immature, before they are 3½ months old. Spray penetration into the inside of the immature bunches is likely to be easier than with a packed mature bunch.

The build-up of the *Tirathaba* population in endosulfan-treated plots was faster than with the other insecticidal treatments because the increase in the population appeared to occur from 49 DAFS, compared with 79 DAFS for the other insecticidal treatments. This phenomenon could perhaps account for the higher percentages of ripe bunches with damage in the endosulfan treatment, as compared with the other insecticidal treatments.

In the *B. thuringiensis* plot, the pre-treatment population density of the bunch moth was considerably lower than in the diflubenzuron and cyfluthrin plots. This could cast doubt on the effectiveness of *B. thuringiensis* after spraying. However, such a doubt was dispelled by comparing the reduction in population density from the pre-treatment to 17 days after the first spray application with *B. thuringiensis*, diflubenzuron and cyfluthrin. The respective reductions showed comparable values: 90.4, 95.0 and 94.3 percent. Thus, although the initial level of the bunch moth population in the *B. thuringiensis* plots was low, the subsequent results ought to be reliable for interpretation.

The low larval counts in insecticide-treated plots up to 49 DAFS suggest that there was negligible inter-plot migration and a low population resurgence during this period. The effect of migration was probably manifested at around 79 DAFS, when increases in larval densities of *Tirathaba* were recorded in all treated plots.

Although the cultural practice treatment was not effective as a control measure, it caused some reduction in the pest population and also in bunches with damage. Further, if this practice was combined with a chemical treatment, it would improve the efficiency of spraying insecticides.

The effects of *B. thuringiensis*, diflubenzuron and cyfluthrin were clearly superior to those of endosulfan, and they are useful alternatives for bunch moth control. The choice of insecticide would depend on its availability and on the cost of materials and application. From the estimated cost of application of insecticide, it was apparent that amongst the effective insecticides, *B. thuringiensis* (21.3 cents/palm) and cyfluthrin (22.6 cents/palm) would be much cheaper than diflubenzuron (50.5 cents/palm) for the control of bunch moth.

The effectiveness of *B. thuringiensis* in the field was later confirmed by Tan and Mukesh (personal communication) who found that more

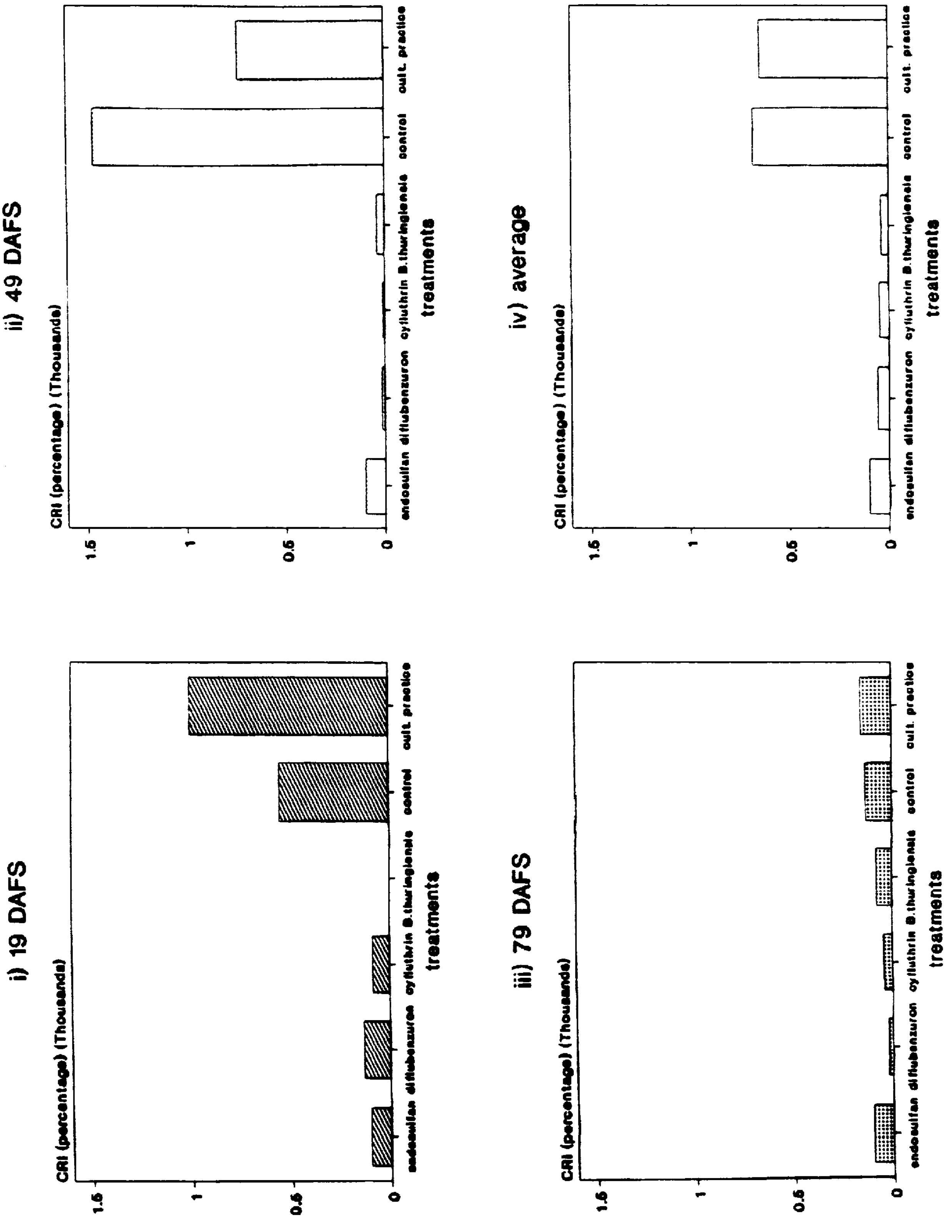

Figure 3. The effectiveness of various treatments against the bunch moth T. rufivena *expressed as corrected relative infestation (CRI).*

Note: *Means followed by the same letter are not significantly different.*

than 90% *Tirathaba* control could be obtained with *B. thuringiensis*.

CONCLUSION

The field evaluation trial at Teluk Intan demonstrated that *B. thuringiensis*. cyfluthrin and diflubenzuron were more effective than endosulfan in the control of the bunch moth, *T. rufivena*. Thus, safer alternatives to endosulfan are available for this purpose.

Although the cultural practice was not effective, the removal of fronds supporting near-ripe bunches reduced the pest density and the level of attack by *T. rufivena* to some extent. It would also increase the efficiency of spraying insecticides on to the bunches.

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REFERENCES

CHAN, C O (1973). Some notes on the oil palm bunch moth (*Tirathaba mundella* Walk.) and its control. *In: Advances in oil palm cultivation*. R L Wastie and D A Earp (eds)., Incorporated Society of Planters, Kuala Lumpur, pp. 396-401.

NG, K Y (1977). *Venturia palmaris* Wilkinson (Hymenoptera: Ichneumonidae) - A parasite of oil palm bunch moth *Tirathaba rufivena* Walker (Lepidoptera: Pyralidae). *In International developments in oil palm*. D A Earp and W Newall (eds)., Incorporated Society of Planters, Kuala Lumpur, pp. 519-520.

TAN, Y P and MUKESH, S (1991). Personal Communication, and Annual Report 1989, United Plantations Research Department.

WOOD, B J and NG, K Y, (1974). Studies on the biology and control of the oil palm bunch moth. *Tirathaba mundella* (Walker) (Lepidoptera: Pyralidae). *Malay. Agric J. 49*, 310-331.