A STICKY VANE TRAP FOR MASS TRAPPING OF THE BAGWORM, *Metisa plana* IN OIL PALM

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Pheromone trapping is considered an easy method for controlling flying insects. Several studies have shown that mass trapping has been used either in long-term pest management [*e.g.* codling moth (*Cydia pomonella*), pink bollworm (*Pectinophora gossypiella*), bark beetles, palm weevils, corn rootworm (*Diabrotica* spp.) and fruit flies], or in the eradication of invasive species [*e.g.* gypsy moth (*Lymantria dispar*) and boll weevil (*Anthonomus grandis grandis*)] (El-Sayed *et al.*, 2006).

The oil palm bagworm, *Metisa plana*, and most bagworm species has a free-flying, male adult stage, as opposed to the female adult which is enclosed within the pupal bag and lies sessile to the leaflet undersurface. Thus, an alternative strategy to control the population of this pest is by mass trapping the male adults, thereby curbing their chances of mating with the females to propagate the next generation.

METHODOLOGY

The late larval instars of the bagworm, *M. plana*, can be collected from the field and reared until they turn into pupae, and later selected for the females. At the receptive stage, the female emits a pheromone to lure the adult male moths to mate. These receptive females, enclosed within their pupal bags, can be hung within a sticky vane trap to attract and capture the male moths in large numbers.

Determination of Receptive Females

The late instar *M. plana* larvae (stages 6 or 7, *Figure 1*) collected from the field can be reared on oil palm leaflets in cylindrical cages. When they are ready to pupate, the larvae crawl to the ceiling of the cage, and become inactive. The larva then enters the pupation stage once the hook-shaped attachment is formed (*Figure 2*). The female pupa is always larger than the male. The period of development from the pupal stage to the mature female adult is around 11 days (*Table 1*). Receptivity of the female is determined by the opening of the anterior end of the pupal bag (*Figure 3*) plus the intermittent protrusion of the female's head and thorax from this opening (*Figure 4*) (Basri and Kevan, 1995, Norman and Othman, 2006). During this time, the female emits the pheromone to attract the males for mating. On average, the female will stay receptive for about nine days (*Table 1*). After this period, the hole at the anterior end of the pupal bag eventually closes.

Timing and Installation of Traps

A sticky vane trap was made by interlocking two zinc plates (30 cm × 30 cm). Each trap was baited

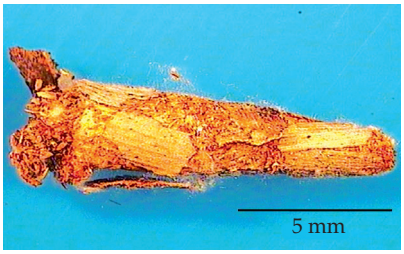

Figure 1. Late larval stage of Metisa plana.

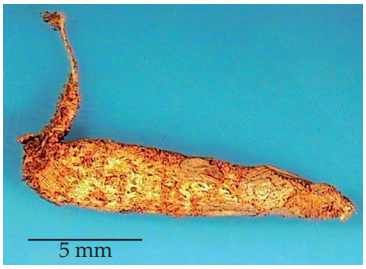

Figure 2. Female pupal stage of Metisa plana.

Figure 3. Opening at the anterior end of the pupal bag of Metisa plana.

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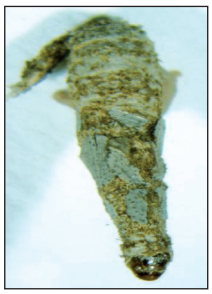


Figure 4. Protrusion of the female's head at the opening.

with four receptive females, one placed at the holed centre in each plane of the trap (*Figure 5*). Every plane of the trap had been evenly sprayed with polybutene glue prior to the placement of the live females. The sticky vane trap was hung on a 2-m long wooden pole, but it can also be hung onto the middle fronds of shorter palms. Thirty traps were placed in three transects (10 traps per transect) along the harvesting paths within a 1-ha bagworm-infested plot (*Figure 6*) (Norman *et al*., 2010). The distance between each trap was about 20 m. A similar sized control plot (without traps), was located approximately 100-200 m away from the trapping plot. A number of census palms were predetermined for both trapping and control plots.

Captures were made in three separate smallholder blocks in Teluk Intan, Perak, with palm ages ranging from 6 to 16 years old. The traps were installed within the infested blocks at approximately 2.5-month intervals. Trapping was conducted over 14 days for each session. Live late instar larvae were again collected in the same block (for rearing to the female stage) at approximately 1-1.5 months after the last trapping. The number of trapping rounds depended on the population density of the bagworm and the number of traps installed.

RESULTS

Male Moth Captures

The mean number of male moths captured varied between 1.7 and 186 individuals/trap/day (*Table 2*). Normally, the number of captures was reduced

Figure 5. High number of moths captured on the sticky vane trap.

Figure 6. Sticky vane traps hung on-wooden poles along transects.

by the second week, because the female receptivity period was only about nine days (*Table 1*).

Reduced Hatching Occurrence

There were significantly (p=0.002) lower occurrences of egg hatching in the trapping plot compared to the control plot at each consecutive block. On average, the percentage of female bags with eggs in the trapping plot was about 20% lower than in the control plot; thus, this further confirmed that the chances of successful mating had been reduced by the trapping of the male moths.

TABLE 1. DEVELOPMENTAL PERIOD FROM PUPA TO RECEPTIVE ADULT AND DURATION OF RECEPTIVITY FOR THE FEMALE *Metisa plana*

No. of female pupae (N)	Period from pupation to receptive female (days ± SE)	Duration of female's receptivity (days ± SE)
33	11.45 ± 0.45	9.42 ± 0.50

TABLE 2. MEAN NUMBER OF MALE MOTHS CAPTURED PER TRAP PER DAY AFTER A 14-DAY TRAPPING AT DIFFERENT LEVELS OF BAGWORM INFESTATION

Block (age of palms)	1st trap placement	Days after first placement of traps (average)			
		75	152	250	335
A (16 years)	29.4	185.7	110.7	10.2	6.3
B (7 years)	48.8	2.8	10.0	tnr	tnr
C (6 years)	58.1	20.2	9.8	tnr	tnr
D (6 years)	5.5	16.7	10.5	1.7	tnr

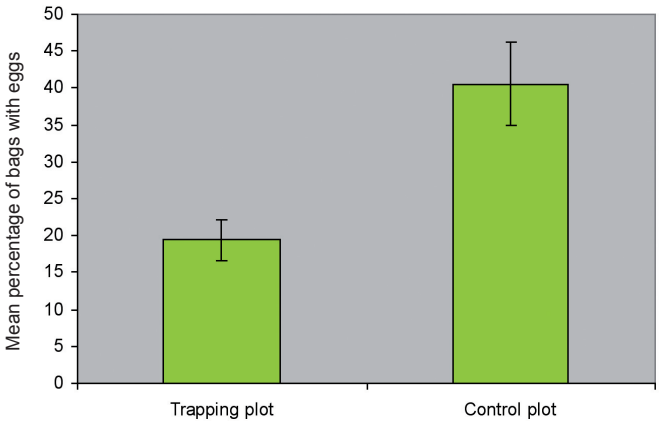
Note: tnr = trapping not required, due to negligible occurrence of bagworm.

Effect of Mass Trapping on the Population of Bagworm

The number of live larvae/pupae was substantially reduced after each trapping round. This also confirmed the earlier observation that the percentage of bags with eggs (mated females) had reduced, hence lowering the population of the subsequent generation of bagworm. In general, the subsequent population of live bagworm larvae in the trapping plot was significantly lower ($p<0.05$) than in the control plot (*Figure 8*). The highest peak of live larvae/pupae in the control plot reached 70 per frond, compared to less than 30 per frond in the trapping plot.

Effect of Trapping in Improving Yield (bunch weight)

Bunch weight data from the study plots were gathered after six months from the commencement of trapping. Average bunch weight in the trapping plot had increased by 22%, and was significantly higher ($p=0.003$) compared with bunch weight before the trapping started (*Figure 9*). In contrast, bunch weight increase in the control plot was only 15% and was not significantly different from the initial bunch weight ($p=0.28$). These results further confirmed that mass trapping was able to improve yields by reducing the bagworm population and frond damage.



Note: Samples were collected in 4 smallholder blocks (with palms ranging from 4-16 years in age).

Figure 7. Percentage of bags with eggs observed (after 14 days of trapping) in trapping and control plots.

ECONOMIC EVALUATION

The vane trap can be made from cheap materials: zinc/plastic and polybutene glue. The cost per unit is about RM 8.00 (*Table 3*). At 40 traps per hectare, the cost of trapping for three rounds (RM 434.00) is about 35% cheaper than that of trunk injection using chemical insecticide (RM 666.00) with the same number of rounds of application.

BENEFITS

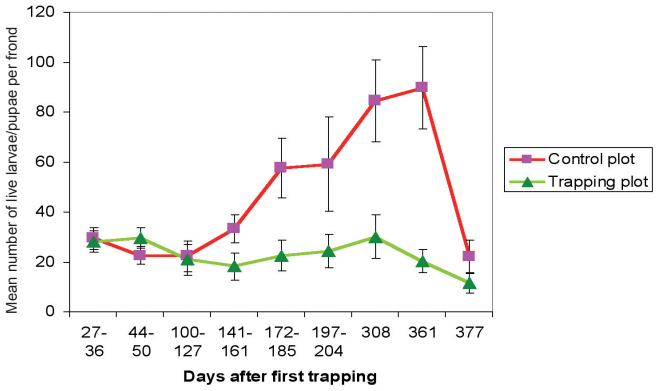
- Traps are easily constructed using cheap materials.
- Trapping reduces the probability of mating of the bagworms and egg occurrence.
- Trapping is able to reduce subsequent bagworm populations.
- It has the potential to reduce insecticide use.
- It increases yield and profit.

CONCLUSION

Mass trapping of the male bagworm moths can complement the integrated pest management (IPM) programme for bagworms by reducing the bagworm population in subsequent generations. Until the full chemical structure of the pheromone is determined, the use of live female bagworms as a lure in the sticky vane traps remains as a viable option for bagworm control.

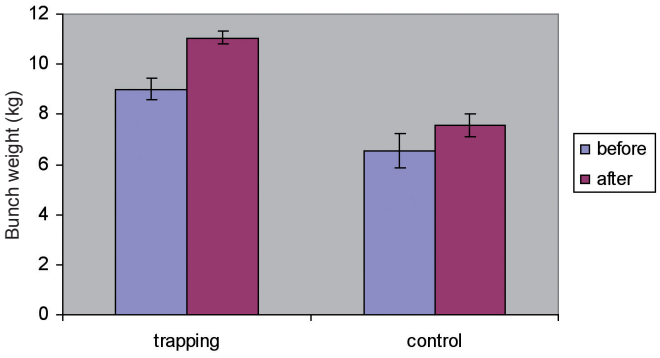
TABLE 3. COST COMPARISON BETWEEN USING STICKY VANE TRAPS AND TRUNK INJECTION WITH CHEMICALS FOR BAGWORM CONTROL

Treatment	Cost of treatment (RM)			
	1 round	2 rounds	3 rounds	Total
Sticky vane trap	305.00	65.00	65.00	435.00
Trunk injection	222.00	222.00	222.00	666.00



Note: Samples collected in 3 smallholder blocks (with palm age ranging from 6-16 years). Trapping rounds were 3, 3 and 6 in the 6, 7 and 16-year-old palm blocks respectively.

Figure 8. Population of live larvae and pupae in the trapping and control plots.



Note: Data collected in a smallholder block C (6-year-old palms) at 6 months after trapping.

Figure 9. Mean bunch weight in the trapping and control plots before and after trapping.

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