Smart Ways to Protect Your Investment from Rhinoceros Beetle & Rodent Pests

by Noor Hisham Hamid
The practice of Integrated Pest Management (IPM) has been implemented in oil palm in Malaysia against several pests and diseases (P&D) of oil palm.

Holistic approaches have been built into the P&D control programme to reduce pest populations below the threshold level with minimal environmental impact.
Severe damage as much as 15% of leaf area can be lost (Samsuddin et al 1993), resulting in a yield decline of up to 25% (Liau and Ahmad, 1991).

Reproduction Potential:

- 1 female produces 15 eggs, 40% mortality = 7.5 eggs.
- 7.5 eggs produce 75 eggs, 40% mortality = 45 adults. 1 male : 1 female.
- 45 adults produce 1,725 eggs, 40% mortality = 1,035 adults. 1 male : 1 female.

Monetary loss:

- FFB price RM 600.00/tan
- Average yield for 1st year harvesting = 10 tan/ha.
- Crop lost due to severe infestation : 25%
- Potential lost/ ha/year = RM1500
- Potential monetary lost per year if 10,000 ha replanting program = RM15 mill
BREEDING SITES

'UNDERPLANTING'
DI FELDA

MENCINCANG TIDAK
MENGIKUT SPESIFIKASI
BIOPESTICIDE PRODUCT (ORY-X)

• Intensively research in laboratory by Malaysian Palm Oil Board (MPOB)

• Excessively tested in small and large scale areas of oil palm in Malaysia by Felda Agricultural Services Sdn Bhd (FASSB).
Metarhizium – Artificial Breeding Site

Rhinoceros beetle adult attracted to pheromone trap and decomposed chipping in disseminator trap

Contaminated beetles disseminate the inoculums into the field (breeding sites in replanting areas)

Breeding site inoculated with Metarhizium

Pheromone Trap

New approach for delivery system of Metarhizium into the oil palm replanting.
Application : Artificial Breeding Site (ABS)
Metarhizium trial at Sahabat 17 (at 20 MAA)

Cumulative infection, % of RB by Metarhizium at 20 MAA (Treated area)

Cumulative infection, % of RB by Metarhizium at 20 MAA (Untreated area)

- N, Treated Population = 1818 (29%) – healthy (1288)
- N, Control Population = 2201 (3.8%) – healthy (2120)
- Corrected Mortality, % (Abbot’s Formula) = 37%
# Mean of palm damaged (%)

<table>
<thead>
<tr>
<th>Month after application (MAA)</th>
<th>Treated</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.65 ± 0.26</td>
<td>2.06 ± 0.66</td>
</tr>
</tbody>
</table>

![Graph showing comparison between Treated and Control groups over time](image)
Metarhizium Solid Substrate/ORY-X EZI
Infection incidence: monthly assessment
Fig. 4. Per cent of infection of *M. anisopliae* on *O. rhinoceros* stage through blanket application. Means followed by the same letter are not statistically different by Kruskal–Wallis followed by pairwise Mann-Whitney U tests at the 5% probability level.

Fig. 5. Per cent of infection of *M. anisopliae* on *O. rhinoceros* stage through disseminator trap application. Means followed by the same letter are not statistically different by Kruskal–Wallis followed by pairwise Mann-Whitney U tests at the 5% probability level.
JANGKITAN KULAT METARHIZIUM KE ATAS KUMBANG BADAK

1. Jangkitan bermula apabila spora bersentuh kulit dan bercambah apabila persekitaran lembab.

2. Spora mengeluarkan hifa muda dan sintesis enzim untuk memcernakan kulit serangga.

3. Hifa muda memasuki badan serangga dan mengeluarkan bahan toksik untuk menyekat sistem pertahanan badan serangga.

[Diagram showing stages of infection]

Peringkat awal jangkitan dengan tanda bintik hitam dikulit (panah)

Selanjutnya, hifa ini terus merebak, membiak serta menyerang organ-organ utama menyebabkan ia tidak berfungsi.

4. Hifa merebak di dalam badan serangga menyebabkan serangga akan mati dan menjadi keras.

5. Selanjutnya, hifa akan keluar semula di atas kulit dan seterusnya mengeluarkan spora-spora baru.

Kumbang ditumbuhi spora
## COST COMPARISON

<table>
<thead>
<tr>
<th></th>
<th>Metarhizium</th>
<th>Metarhizium</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commercial Name</strong></td>
<td>ORY-X</td>
<td>ORY-X EZI</td>
</tr>
<tr>
<td><strong>Active ingredient</strong></td>
<td>$1.5 \times 10^{12}$</td>
<td>$1.5 \times 10^{12}$</td>
</tr>
<tr>
<td><strong>Application Method</strong></td>
<td>ABS</td>
<td>ABS</td>
</tr>
<tr>
<td><strong>Price / liter @ kg</strong></td>
<td>160.00</td>
<td>16.00</td>
</tr>
<tr>
<td><strong>Rate (kg)</strong></td>
<td>1.00</td>
<td>10.00</td>
</tr>
<tr>
<td><strong>Product cost (RM)</strong></td>
<td>160.00</td>
<td>160.00</td>
</tr>
<tr>
<td><strong>Labor (RM)</strong></td>
<td>11.00</td>
<td>11.00</td>
</tr>
<tr>
<td><strong>Frequency of treatment</strong></td>
<td>2 round / 36 month</td>
<td>1 round / 36 month</td>
</tr>
<tr>
<td><strong>Cost/ ABS(RM)</strong></td>
<td>182.00</td>
<td>182.00</td>
</tr>
<tr>
<td><strong>ABS (RM)</strong></td>
<td>50.00</td>
<td>50.00</td>
</tr>
<tr>
<td><strong>Pheromone trap/ha (RM)</strong></td>
<td>189.00</td>
<td>189.00</td>
</tr>
<tr>
<td><strong>Petrol, surfactant etc(RM)</strong></td>
<td>25.00</td>
<td>25.00</td>
</tr>
<tr>
<td><strong>Total cost (RM)</strong></td>
<td>446.00</td>
<td>421.00</td>
</tr>
<tr>
<td><strong>Per ha + Pheromone</strong></td>
<td>RM 89.2</td>
<td>RM 84.2</td>
</tr>
<tr>
<td><strong>Per ha (-) Pheromone</strong></td>
<td>RM 51.4</td>
<td>RM 46.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Cypermethrin</th>
<th>Carbofuran</th>
<th>Carbosulfan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price (RM)</td>
<td>RM 209.28</td>
<td>RM 246.00</td>
<td>RM 387.00</td>
</tr>
<tr>
<td>Application</td>
<td>Spraying on frond base</td>
<td>Apply on frond spear</td>
<td>Apply on frond spear</td>
</tr>
</tbody>
</table>
**ORYCTES BEETLE : IPM**

1. **Pheromone trap**
   - Immediately after felling program at 1 trap / 2 ha
   - Place at the boundary for 8 - 12 months
   - Monitor the trap at weekly interval

2. **Legume cover**
   - Establishment of legume cover immediately after planting
   - Legume cover should be well covered 6 - 7 months after felling

3. **Metarhizium anisopliae (Ory X / MSS)**
   - Apply at 5-6 months after felling program onto the artificial breeding sites
   - Setting up at the boundary, 1 point for 5 ha
   - Apply Ory X / MSS onto the trapping point at 4 months interval

4. **Census & chemical application**
   - Chemical treatment to be carried out if damage above critical level (5%)
   - Cypermethrin (0.056%) at 2 weeks interval until the fresh damage below 5%
Potential losses 25% yield
15% damage

42% recovered

38% recovered

2% recovered

2.7% damage

82% recovery of economic losses or RM1,200 per ha or 12.0 mil per 10,000 ha
IPM APPROACH - TIMELINE

- **Chipping & Felling starts (on specification of size)**
- **Breeding season starts**
  - **Semi-chemical (Pheromone trap)**
- **Immediate establishes of cover crop**
- **High infestation of RB**

**Biological approach**
- *Metarhizium anisopliae, ORY-X ®*
  - Blanket application, or
  - Artificial breeding site

**Chemical control**
- **Cypermethrin. 0.056% Cyfluthrin 0.018%**
  - Prophylactic spraying

**Manual hand-picking**

**Timeline:**
- 5th month: Breeding season starts
- 24th month: High infestation of RB
OBJECTIVE:
• To develop a control package of rats in oil palm
• Regular survey and monitoring of rat population in the field
• One round 100% density application or one bait per palm and follow up with selective application rounds if the fresh damage is above 5% in selective blocks
• Barn owl establishment

TARGET:
• Reduce incidence of attack below 5%

STRATEGIES
• 1st generation anticoagulant poison i.e chlorophacinone is being used since 1980’s replacing warfarin. Baiting is by far the most effective and practical method.
• Other practices include fixing up wire netting collar as protectant.
• New bait formulation using bromodialone as the active ingredient
• The role of the barn owl, *Tyto alba*, in controlling rats in mature oil palm
• Preliminary results suggest that both baiting and predation by barn owl markedly controlled rat damage.
MATURE PALM:
SERIOUS DAMAGE CAUSED 5% - 12% LOSSES OF OIL YIELD.

IMMATURE PALM
CAUSED 20% OF YIELD LOSSES COMPARED TO NON DAMAGE PALM

ECONOMIC LOSSES
Integrated Pest Management of Rat

IDENTIFICATION OF RAT SPECIES

- *Rattus tiomanicus* (Wood rat)
- *Rattus rattus diardii* (House rat)
- *Rattus argentiventer* (Rice field rat)
STRONGLY SUPPORT THROUGH RESEARCH & DEVELOPMENT

- **FASSB**: > 30 YEARS EXPERIENCES IN R&D
- **ACCEPTANCE & PALATIBILITY TEST IN LABORATORY**
- **POPULATION STUDY IN FIELD**
BUTIK S (1st Generation Rodenticide)
AI : 0.005% CHLOROPHACINONE

BUTIK G2 (2nd Generation Rodenticide)
AI : 0.005% BROMODIOLONE
<table>
<thead>
<tr>
<th>Bait</th>
<th>Total of Test Bait Consumed (g)</th>
<th>Total of Control Bait Consumed (g)</th>
<th>Total (g)</th>
<th>% Acceptance</th>
<th>Palatability ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUTIK G2</td>
<td>447.7</td>
<td>579.6</td>
<td>1027.3</td>
<td>43.6</td>
<td>0.77</td>
</tr>
<tr>
<td>X1 Bait</td>
<td>263.3</td>
<td>668.9</td>
<td>932.2</td>
<td>28.2</td>
<td>0.39</td>
</tr>
</tbody>
</table>

EPA requirement for acceptance level: Not significantly different from 33% against standard diet (equivalent to a palatability ratio of 0.5).
# COMMERCIAL FIELD’S EFFICACY TEST OF BUTIK G2

<table>
<thead>
<tr>
<th>Bait</th>
<th>No of round applied</th>
<th>% FFB Damage</th>
<th>% Efficacy</th>
<th>Below critical level (5.0%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pre-census</td>
<td>4 WAA</td>
<td>4 WAA</td>
</tr>
<tr>
<td>BUTIK G2</td>
<td>3</td>
<td>17.0</td>
<td>2.0</td>
<td>94.1</td>
</tr>
<tr>
<td>X1 Bait</td>
<td>3</td>
<td>13.0</td>
<td>6.0</td>
<td>76.9</td>
</tr>
<tr>
<td>CONTROL</td>
<td>-</td>
<td>5.0</td>
<td>10.0</td>
<td>- 100</td>
</tr>
</tbody>
</table>

WAA : Week After Application
Biological Approach – Barn owl

- In Peninsular, barn owl (*Tyto alba*) population is rapidly increased after the establishment of artificial nest box.
- 99.4% diet consisted of *Rattus* sp.
- A pair of breeding birds and their chicks (usually 4 - 5 chicks) might eat as many as 3,000 rats each year.
- Barn owls prefer to live in environment where the rats are abundant.
Amount eaten by Rat Species

<table>
<thead>
<tr>
<th>Rat Species</th>
<th>Mean consumption Kernel (gm/rat/day)</th>
<th>Weight of kernel/fruit (g)</th>
<th>No. Unripe fruits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rattus tiomanicus</td>
<td>8</td>
<td>0.4</td>
<td>20</td>
</tr>
<tr>
<td>Bandicota indica</td>
<td>80</td>
<td>0.4</td>
<td>200</td>
</tr>
</tbody>
</table>

*Rattus tiomanicus (100 - 130g)

Bandicota indica (350 – 1000g)
HABITAT AND DAMAGES

BANDICOTA INDICA
RODENTICIDE BAITS – EFFICACY STUDY

BUTIK S  BUTIK G2  EBOR 2030  STORM  YASADION
Mortality study of large bandicota on different rodenticides

Mortality of *Bandicota indica* after treated with baits at 1, 3 & 6 pcs

<table>
<thead>
<tr>
<th>Type of rodenticide</th>
<th>% Mortality IKETUL</th>
<th>% Mortality 3KETUL</th>
<th>% Mortality 6KETUL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHLOROPHACINONE</td>
<td>12.5</td>
<td>71.5</td>
<td>66.6</td>
</tr>
<tr>
<td>BROMADIOLONE</td>
<td>75</td>
<td>88.8</td>
<td>100</td>
</tr>
<tr>
<td>FLOUCUMAFEN</td>
<td>20</td>
<td>66.6</td>
<td>100</td>
</tr>
<tr>
<td>BRODIFACOUM</td>
<td>50</td>
<td>70</td>
<td>78</td>
</tr>
<tr>
<td>DIPHACINONE</td>
<td>50</td>
<td>77.7</td>
<td>87.5</td>
</tr>
<tr>
<td>CONTROL</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Type of rodenticide
Mean of taken bait by *Bandicota indica* (g) after 4 days

<table>
<thead>
<tr>
<th>Bait Type</th>
<th>Mean Taken (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUTIK S</td>
<td>10.5</td>
</tr>
<tr>
<td>BUTIK G2</td>
<td>29.7</td>
</tr>
</tbody>
</table>

*BAIT’S PREFERENCE*
EFFICACY OF RODENTICIDE: BUTIK G2
Plantain squirrel – *Callosciurus notatus*
SQUIRREL DIET – INDIRECT IMPACT TO DECREASE THE WEEVIL POPULATION

Pollinator larvae

Male spikelet
THANK YOU

SUCCESS
it's not always what you see