Week 11

PALM TREE: Rhino beetle and Scale insects

Department of Plant Protection
Faculty of Agriculture
Universitas Gadjah Mada, Yogyakarta 55281
AGENDA

• THE RHINO BEETLE: species, bioecology, distribution, bionomy, outbreaks, coping strategy.
• THE COCONUT SCALE INSECTS: species, bioecology, distribution, bionomy, outbreaks, coping strategy.
THE RHINO BEETLE: species, bioecology, distribution, bionomy, outbreaks, coping strategy.
Kumbang badak *Oryctes rhinoceros* menjadi tantangan budidaya kelapa, kelapa sawit dalam 10 tahun terakhir, dampak replanting
Tanaman muda mati 25%

Kumbang Badak *Oryctes rhinoceros*

- Betina
- Jantan

Instar 1: 12 hari
Instar 2: 19 hari
Instar 3: 21 hari
Pupa: 32 hari
Imago: 20 hari
Telur: 95 hari

Tandang buah segar turun 69%

IMAGO HAMA PERUSA_K WABAH & TANTANGAN

LARVA DEKOMPOSER & GIZI TINGGI
BERKAH & PELUANG
How to solve the problems of rhino beetle?

The methods approach should be safe, effective, sustainable, economic and environmentally sound.

1. Utilize by products for animal feeds – minimize the breeding sites of rhino beetle

2. Unilize 3rd instar larva for foods. UTILIZE THE 3rd INSTAR FOR FOOD IS PROMISSING. Since the larvae have economic value they will be collected intensively and continuously, the hand picking will be the best control method
ANALISIS POTENSI LIMBAH SAWIT DAN KUMBANG BADAK
LIMBAH ORGANIK KELAPA SAWIT

- Prunning
- Replanting
- Pabrik CPO
- Rumpukan
- Batang cincang
- Batang
- Tandan kosong
- Serat

Breeding site hama kumbang badak *Oryctes rhinoceros*
Pelepah daun diolah, rumpukan tidak ada lagi, mencegah Oryctes, bahan organik diganti pupuk kandang

Pupuk organik dari limbah

Mikroba simbion dalam sistem pencernaan Oryctes rhinoceros produser enzim selulase aktivator fermentasi pakan sapi

Pengolahan pakan sapi

Wafer

Fermentasi
POTENSI LIMBAH SAWIT UNTUK PAKAN TERNAK
LARVA KUMBANG BADAK MEMAKAN BAHAN ORGANIK LIMBAH SAWIT DAN LAINNYA

SIMBION DALAM SISTEM PENCERNAAN

POTENSI MIKROBA PENGHASIL ENSIM SELULASE

FERMENTASI DALAM PENGOMPOSAN BAHAN ORGANIK

POTENSI LARVA KUMBANG BADAK – DEKOPOSER ?
DEKOMPOSISI LIMBAH ORGANIK SAWIT OLEH LARVA HAMA KUMBANG BADAK
Tandan Kosong

Batang mati

Batang lapuk hancur

Larva hama kumbang badak *Oryctes rhinoceros* adalah dekomposer bukan hama
KANDUNGAN NUTRIENTS

Belum dikaji

BERPOTENSI BAHAN EDIBLE FILM

POTENSI IMAGO KUMBANG BADA – PANGAN FUNGSIONAL
KARKAS LARVA KUMBANG BADAK
NUTRISIUS

**Koleksi larva intensif dan berkelanjutan merupakan upaya pengendalian hama yang strategis.**

**LARVA INSTAR III: 11,7 g/ekor**

**BADAN TANPA ISI**

- PERUT 42,3%
- ISI PERUT 57,7%

**PROTEIN**

- 6,56% dari tepung

**MINYAK**

- 21,95% dari tepung

**NILAI GIZI LARVA Oryctes rhinoceros**
Asam amino protein larva Oryctes rhinoceros L.

**TEPUNG LARVA ORYCTES:**

**TEPUNG:**
31,5% larva hidup

**Prospek Pemanfaatan Tepung**

Bahan produksi minyak & Protein

Bahan makanan aneka kuliner

**BY PRODUCTS:**
71,49% dari tepung

**Prospek Pemanfaatan by products:**
By products berisi chitosan (?) antara lain untuk edible film

**MIKROBA SIMBION & ENZIM**

**Analisis gas kromatografi GC7890B asam lemak dari minyak larva O. rhinoceros**

<table>
<thead>
<tr>
<th>DESKRIPTSI</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myristoleic Acid (C14:1)</td>
<td>0,75</td>
</tr>
<tr>
<td>Palmitoleic Acid (C16:1)</td>
<td>43,62</td>
</tr>
<tr>
<td>Heptadecanoic Acid (C17:0)</td>
<td>6,38</td>
</tr>
<tr>
<td>oix-10-Heptadecenoic Acid (C17:1)</td>
<td>0,15</td>
</tr>
<tr>
<td>Nervic Acid (C18:3)</td>
<td>0,22</td>
</tr>
<tr>
<td>Linoleic Acid (C18:2n6c)</td>
<td>6,10</td>
</tr>
<tr>
<td>oix-10-Linoleic Acid (C18:3n6c)</td>
<td>37,41</td>
</tr>
<tr>
<td>n-3Linolenic Acid (C18:3n3)</td>
<td>6,96</td>
</tr>
<tr>
<td>Linolenic Acid (C18:3n3)</td>
<td>0,07</td>
</tr>
<tr>
<td>Arachidonic Acid (C20:4n6)</td>
<td>0,16</td>
</tr>
<tr>
<td>oix-9,11,14-Eicosatrienoic Acid (C20:3n6); oix-11,14,17-Eicosatrienoic acid (C20:3n3)</td>
<td>3,78</td>
</tr>
<tr>
<td>Erucic Acid (C22:1n9)</td>
<td>0,41</td>
</tr>
</tbody>
</table>

**Prospek Pemanfaatan minyak**

*Palmitoleic Acid ~ Omega 7 Linoleic Acid* untuk Makanan fungsional

**BIOAKTIF PANGAN FUNGSIONAL**

**Antioksidan**
Peptida Bioaktif

**Antihipertensi**
Peptida Bioaktif

**Flavor Enhancer**
Asam Glutamat & Asam Aspartat

**Produk Pakan Ternak**

**Produk**

**by products**

**LOCALLY ROOTED, GLOBALLY RESPECTED**

*ugm.ac.id*
Canned Rhino Beetle Larvae
Brand: Thailand Unique
Product Code: C88:2013
Availability: Out Of Stock
Price: $7.00

Contribution to the knowledge base of entomological collection.

Oryctes nasicornis - Larva (1)
- COLEOPTERS
- SCARABAEIDAE (SCARABS)
- DYNASTINAE

Price: 24.60€
Product Code: 224789
Product Available

CONTOH LARVA Oryctes rhinoceros MAKANAN LUAR BIASA
Table 1. Properties of 3\textsuperscript{rd} instar larva of rhinoceros beetle

<table>
<thead>
<tr>
<th>Properties</th>
<th>n</th>
<th>range</th>
<th>Average ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total collected larvae (individuals)</td>
<td>1,463</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh larva weight (g/larva)</td>
<td>203</td>
<td>8.25 – 22.64</td>
<td>11.17 ± 1.72</td>
</tr>
<tr>
<td>Fresh carcass (%)</td>
<td>3</td>
<td>41.28 – 43.26</td>
<td>42.36 ± 0.82</td>
</tr>
<tr>
<td>Gut content and blood (%)</td>
<td>3</td>
<td>56.74 – 58.72</td>
<td>57.64 ± 0.82</td>
</tr>
<tr>
<td>Larval flour (%) of fresh larvae</td>
<td>3</td>
<td>29.77 – 30.70</td>
<td>30.39 ± 0.44</td>
</tr>
<tr>
<td>~ color of flour</td>
<td>brownish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>~ water content of larval flour (%)</td>
<td>3</td>
<td>4.75 – 4.99</td>
<td>4.85 ± 0.10</td>
</tr>
<tr>
<td>Crude fat (%) of larval flour</td>
<td>3</td>
<td>21.83 – 22.01</td>
<td>21.95 ± 0.08</td>
</tr>
<tr>
<td>~ fat aroma</td>
<td>nutty and smoky</td>
<td></td>
<td></td>
</tr>
<tr>
<td>~ fat color</td>
<td>brownish white</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolate of crude protein (%) of fresh carcass</td>
<td>11</td>
<td>1.51 – 2.66</td>
<td>2.07 ± 0.45</td>
</tr>
<tr>
<td>~ water content of isolate protein (%)</td>
<td>3</td>
<td>7.16 – 8.64</td>
<td>7.99 ± 0.76</td>
</tr>
<tr>
<td>~ color of protein</td>
<td>brownish white</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data Riset, 2020
Tabel 2. Fatty acid content of crude fat from larvae of rhinoceros beetle, results of gas chromatography GC 7890B

<table>
<thead>
<tr>
<th>Fatty acid profiles</th>
<th>Composition (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myristic acid</td>
<td>2.37 ± 2.09</td>
</tr>
<tr>
<td>Myristoleic acid</td>
<td>0.33 ± 0.01</td>
</tr>
<tr>
<td>Pentadecanoic acid</td>
<td>0.17 ± 0.04</td>
</tr>
<tr>
<td>Cis-10-Pentadecenoic acid</td>
<td>0.30 ± 0.01</td>
</tr>
<tr>
<td>Palmitic acid</td>
<td>45.91 ± 1.94</td>
</tr>
<tr>
<td>Palmitoleic acid</td>
<td>ND</td>
</tr>
<tr>
<td>Heptadecanoic acid</td>
<td>0.15 ± 0.01</td>
</tr>
<tr>
<td>Cis-10-Heptadecenoic acid</td>
<td>0.21 ± 0.00</td>
</tr>
<tr>
<td>Stearic acid</td>
<td>5.58 ± 0.24</td>
</tr>
<tr>
<td>Oleic acid</td>
<td>34.60 ± 1.48</td>
</tr>
<tr>
<td>Linoleic acid</td>
<td>7.82 ± 1.66</td>
</tr>
<tr>
<td>Gamma Linolenic acid</td>
<td>0.44 ± 0.06</td>
</tr>
<tr>
<td>Linolenic acid</td>
<td>0.14 ± 0.03</td>
</tr>
<tr>
<td>Henecosanoic acid</td>
<td>0.18 ± 0.01</td>
</tr>
<tr>
<td>Behenic acid</td>
<td>0.13 ± 0.01</td>
</tr>
<tr>
<td>Cis-13,16-Docosadienoic acid</td>
<td>1.71 ± 0.02</td>
</tr>
</tbody>
</table>

The results are represented as the means ± standard deviation (n = 2). ND = Not Detected.

Data Riset, 2020
Table 3. Amino acids content of protein isolate from larvae of rhinoceros beetle, results of chromatography analysis

<table>
<thead>
<tr>
<th>Amino acid</th>
<th><em>Oryctes rhinoceros</em> larva protein isolate (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Essential amino acid (EAA)</strong></td>
<td></td>
</tr>
<tr>
<td>Histidine (His)</td>
<td>87.88</td>
</tr>
<tr>
<td>Isoleucine (Ile)</td>
<td>99.17</td>
</tr>
<tr>
<td>Leucine (Leu)</td>
<td>135.18</td>
</tr>
<tr>
<td>Lysine (Lys)</td>
<td>225.29</td>
</tr>
<tr>
<td>Phenylalanine (Phe)</td>
<td>90.92</td>
</tr>
<tr>
<td>Threonine (Thr)</td>
<td>95.67</td>
</tr>
<tr>
<td>Valine (Val)</td>
<td>136.06</td>
</tr>
<tr>
<td><strong>Non-essential amino acid (NEAA)</strong></td>
<td></td>
</tr>
<tr>
<td>Aspartic acid (Asp)</td>
<td>196.15</td>
</tr>
<tr>
<td>Glutamic acid (Glu)</td>
<td>466.65</td>
</tr>
<tr>
<td>Serine (Ser)</td>
<td>135.50</td>
</tr>
<tr>
<td>Glycine (Gly)</td>
<td>154.90</td>
</tr>
<tr>
<td>Tyrosine (Tyr)</td>
<td>391.88</td>
</tr>
<tr>
<td>Arginine (Arg)</td>
<td>173.89</td>
</tr>
<tr>
<td>Alanine (Ala)</td>
<td>141.58</td>
</tr>
</tbody>
</table>

Data Riset, 2020
The Food Systems and Food Safety Division (ESF) of FAO has just published online its edible insects publication (Title: Looking at edible insects from a food safety perspective).
A variety of edible insects sold in a market in Thailand.

FAO sdh lama mencanangkan *insects for food*. Maka arah riset ini untuk antisipasi hama dengan pemanfaatan.

Dari buku FAO tersebut kumbang badak (*Orytes rhinoceros*) belum ada, peluang besar dikebangkan menuju komersial.
The global market for edible insects is expected to reach approximately USD 8 billion by 2030 (Globe Newswire, 2019). As of 2017, crickets (house Roasting of mealworms in a processing facility in Republic of Korea.

Retail packaging of silkworm pupae in Viet Nam.

Fresh grasshoppers collected from the wild and on display at a local market in Niger.
**Woman selling dried caterpillars at a market in the Congo.**

**Chapulines (toasted or dried grasshoppers) available for purchase at a sporting event in the United States of America.**

**Chinicuiles, a traditional Mexican dish prepared with red maguey worms.**
Cricket flour can be used for preparing baked products.

Edible palm weevil larvae served at a local market in Ecuador.
Fig 2. Influence of gender and age against potency of collecting 3\textsuperscript{rd} instar larvae of rhinoceros beetle per 2 hours at the oil palm plantation in Sei Silau, Asahan Regency, North Sumatera Province, Indonesia.
3rd larval instar of rhino beetle is potentially and promising for functional foods. It needs for further research.

Koleksi larva intensif dan berkelanjutan merupakan upaya pengendalian hama yang strategis.

*Perburuan Oryctes intensi, masif, terus menerus*

Kinerja pemburu = predator

PEMANFAATAN KUMBANG BADAK SEBAGAI SUMBERDAYA EKONOMI MERUPAKAN BASIS PENGENDALIAN BERKELANJUTAN
THE COCONUT SCALE INSECTS: species, bioecology, distribution, bionomy, outbreaks, coping strategy
The Species of Coconut Scale Insects

There are two species of the coconut scale insects in Indonesia, namely the Javanese coconut scale insect (*Aspidiotus destructor* Signoret (Hemiptera: Diaspididae), and the Taruna coconut scale insect (*Aspidiotus destructor rigidus* Reyne (Hemiptera: Diaspididae)). The second one is more destructive and explosive in eastern parts of Indonesia, while the first one in Yogyakarta is in balance with natural enemies mainly coccinellid predator. *Chilocorus politus* Mulsant.
The Javanese coconut scale insect (Kutu Perisai Jawa) (*Aspidiotus destructor* Signoret (Hemiptera: Diaspididae))

a. Adult, b. ± 60 eggs surrounding female adult, c. the transparent cover-scale. ± 2 mm in diameter. ± 25-30 individuals/cm²
The Taruna coconut scale insect (Kutu Perisai Taruna) 
(*Aspidiotus destructor rigidus* Reyne (Hemiptera: Diaspididae))

a. Adult, b. ± 12 eggs not surrounding female adult, c. the untransparent cover-scale. 
± 2 mm in diameter.
KONDISI KELAPA DALAM YG TERSERANG HAMA KAMPUNG MANOPI
-2.77957, 134.52267, 141°
12 Sep 2021 12.20.38
The bioecology of Coconut Scale Insects

- a. eggs
- b. nymph with legs
- c. nymph without legs
- d. female inside its scale
- e. uncovered young female with full of eggs
- f. post oviposition of female with eggs at posterior body side
- g. hatched egg shells
- h. male pupa underside its cover scale
- i. male pupa without its cover scale
- j. winged adult male

| = 1 mm
Biology

- Simple metamorphosis, the developmental stages: egg, nymph, and adult (imago)
- Nymphs and adults actively attack plants by pinching and sucking plant sap
- Reproduction type is parthenogenesis, females without mating produce fertile eggs and can hatch.
- Once the eggs hatch, the nymphs immediately dispersing and crawling to find a suitable place and then their stylets stick into the host plant tissue and stays there with the stylet stuck to the leaf tissue until reproduce and die.
- The formation of the scale lasts for 12 hours.
- This coconut scale insects actively spreading by creeping or passively being carried by the wind or by infested fruits and seedlings from place to place.
- In dry conditions, nymphs of Taruna species can only survive for 1-3 hours and in humid air conditions at least 2 days.
- Development time 32 – 42 days
Host plant.
Coconut, oil palm, banana, cocoa, gambier, pepper, betel, tea, guava, areca nut, nutmeg, papaya, coriander, mango, avocado, orange, various palms, Vitis, Annona, Hevea, Loranthus, mangosteen (manggis), sago, nipah, and several types of palms

Natural enemy
Predators, parasitoids, pathogen

The Geographic distribution of Coconut Scale Insect

- Irregularly distributed throughout the tropics, including Africa and Southeast Asia, as well as in places around the world where coconut is grown. Meanwhile, the Taruna species is found in West Java, East Java, Bali, South Sulawesi (from Makassar to the south, on the east coast to Watampone), North Sulawesi (Gorontalo area and on the north coast), Sangir Island (north of Manado) and the islands Palau in the Pacific Ocean (Kalshoven, 1981). In the last 2 decades the Taruna shield tick exploded in Ende Regency (2002), Southeast Maluku Regency (2004), Lembata Regency (2008), and Tambrauw Regency (2018), Nabire (2004), Teluk Wondama Regency (2021), and also in East Timor (2005).
The Bionomy of Coconut Scale Insect

Disasters occurred in Taruna in 1925-1927, the death of coconut trees in healthy planting areas was 30-40% and 50% in unhealthy plantations. In the area of the terrible attack, the farmers have not harvested for years. In 1934 about 90% of the coconut trees on the hillsides were still unfruitful. Losses were estimated at around F. 1,000,000 Guilders. This pest attack also occurred in Bali in 1934-1935. Losses reach 25-50% of the usual yield (Mo, 1953). The area of attack in Ende Regency in 2001 was reported to be 12,110.63 ha, 148,050 dead coconut trees, heavily attacked and 469,750 trees were still able to be saved, and 51,200 clumps of banana kepok trees that were attacked. The estimated loss due to this pest attack is Rp. 24,501,510,000,- (Wagiman, 2006).
How this pest destroys coconut palm trees

The plant sap substance including chlorophyll is sucked

The insect saliva is phytotoxic

Yellow, wilted and dry

Plant growth inhibited and stopped due to lack of energy

Trees stop fruiting, leaves fall, bare and die, stems are brittle
Ende, 2002. Fx Wagiman
The Outbreks of Coconut Scale Insects
In Ende, Flores Island, East Nusa Tenggara
2002-2004

El Nino 1998 suspected triggered the outbreak
Weakness of the role of mortality factors mainly natural enemies
The pest outbreaks in Flores Island started from an seriously infested tree (kelapa gading) at Ende village which was not allowed to cut by the owner.
Ende, 2002.
Fx Wagiman
Pest attacks reduce the function of coconut trees as cocoa shadows.

Ende, 2002.
Fx Wagiman
Productive coconut trees were bare and died.
The Strategy to Cop the Outbreaks of Coconut Scale Insect Pest

The following five important items are need to be considered as a strategy to cop the pest outbreaks (Wagiman, 2006).

1. **Technology**: mechanic (pruning) and physic (burning infested leaves), systemic insecticides, biological control with predator – *Chilocorus politus* Mulant.

2. **Institutional**: all involved stakeholders – the government, farmers, traditional figures, religious figures, private companies. Socialization on landscape IPM.

3. **Human resources**: training on control technologies – biocontrol with predator

4. **Facilities, infrastructure, costs**: the three items should be available

5. **Evaluation**: the successfulness of the control program to be evaluate monthly, inhibited and supported factors are analyzed.
Introduction of coccinellid predator *Chilocorus politus* Mulsant from Yogyakarta

Pruning and burning infested leaves, injection of systemic insecticides, are aimed to temporarily relieve the pest attacks, they were only effective for about 2 months. The biocontrol technology is the one that able to sustainable and permanently solving outbreak problems.

The steps of biocontrol programs such as follows.
1. Collecting predators in Yogyakarta
2. Packing predators
3. Quarantine
4. Delivery and shipment
5. Release predators
6. Evaluation of control successfulness
Koloni kumbang kubah *C. politus* koeksistensi dengan koloni kutu perisai Jawa pada pelepah kelapa di daerah Yogyakarta.

Cara mengemas predator jenis kumbang kubah *C. politus*, 100% predator hidup selama 4 hari pengiriman dari Yogyakarta sampai lokasi predator dilepas
Surat keterangan karantina Yogyakarta
Predator (anak panah) dengan pesawat terbang (a) tiba di bandara Langor, Tual, Maluku Tenggara, dan dengan *speed boat* (b) tiba di Pulau Kei Besar, Maluku Tenggara, kemasan predator (c dan d) aman sampai tujuan.

Sosialisasi program pengendalian eksplosi hama kutu perisai kelapa dengan predator di Kecamatan Wasior, Kabupaten Teluk Wondama, Provinsi Papua Barat, 16-11-2022
Melepas predator *C. politus*, tutup tabung dibuka (a) agar predator keluar dari tabung dengan sendirinya (b, anak panah) dan berburu kutu perisai serta menyebar ke perkebunan kelapa.

Melepas predator *C. politus* tanggal 07-11-2004 di Taar, Pulau Kei Kecil (a dan b) serta di Pulau Kei Besar, Maluku Tenggara (c).

Video predator moving after release
Skema kinerja kumbang kubah *C. politus* mengendalikan eksplosi kutu perisai Taruna

Imago kumbang kubah *C. politus* memangsa koloni kutu perisai Jawa pada permukaan bawah daun kelapa, anak panah menunjukkan perisai kutu tidak dimakan

Kondisi perkebunan kelapa dan kakao di Kabupaten Ende, sebelum dan sesudah dilepasi predator *C. politus*.
Kondisi perkebunan kelapa rakyat di Kabupaten Ende, sebelum dan sesudah dilepasi predator *C. politus*.
Perkiraan potensi kerugian, kerugian riil, biaya pengendalian, dan perkiraan kerugian yang dapat dicegah akibat eksplosi hama kutu perisai Taruna A. destructor rigidus setelah berhasil dikendalikan dengan predator yaitu kumbang kubah C. politus di Kabupaten Ende, NTT, tahun 2002-2004

Sumber: Analisis data sekunder, Dinas Perkebunan Kabupaten Ende
The benefit of biocontrol using predator

1. Effective
2. Save
3. Economic
4. Permanent
5. Sustainable