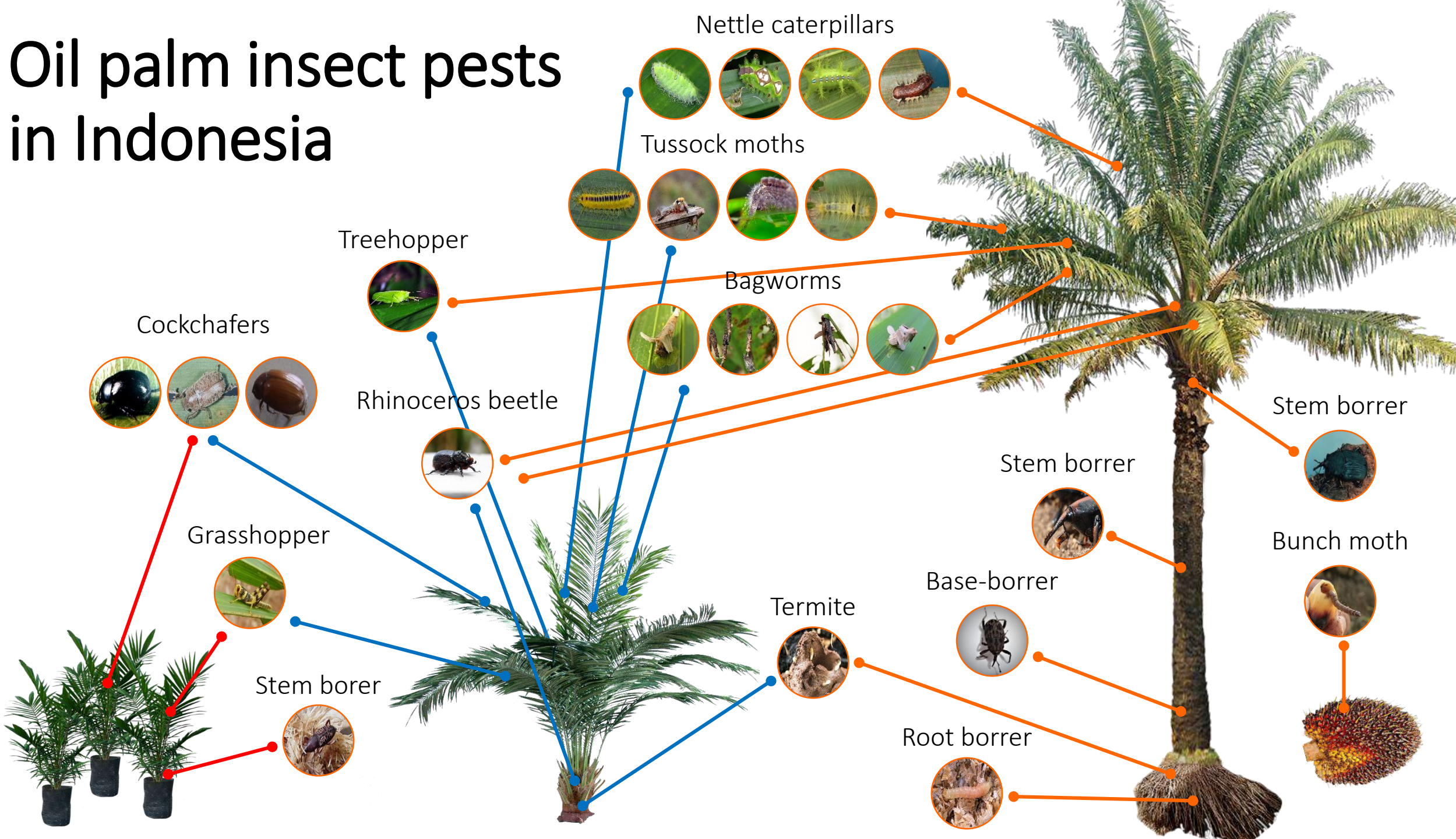
fedepalma | cenipalma

BIOLOGICAL CONTROL OF OIL PALM INSECT PESTS IN INDONESIA

Hari Priwiratama*, Agus Eko Prasetyo, Agus Susanto

INDONESIAN OIL PALM RESEARCH INSTITUTE
Jln. Brigjen Katamso 51 Medan 20158, Indonesia
*Phone: +6281310236551,
*e-mail: hari.priwira@iopri.org; hari.priwiratama@gmail.com

Oil palm insect pests in Indonesia



Insect pests control

- Insecticide application
- Drawbacks:
  - Kills beneficial insects
  - Trigger resistance to target pest
  - Pests resurgence

Insect pest resurgence

2012

Outbreak of *Pseudoresia desmierdechenoni* in area where recurring attacks of *Setothosea asigna* often occur

A turning point to biological control in Indonesia

- Mandatory implementation of the Indonesian Sustainable Palm Oil regulation by the government
- Implementation of IPM for pests management emphasizing biological control as the first alternative

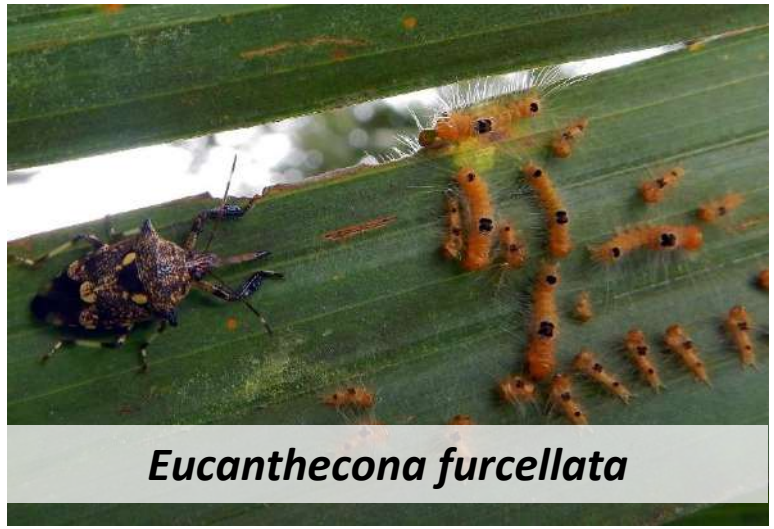
First choice in IPM of insect pests

- Biological control
  - Predators & parasitoids
  - Entomopathogenic fungi
  - Viruses
  - Bacteria
  - Entomopathogenic nematodes
- Ecofriendly product
  - Insect pheromones

Predators of leaf-eating caterpillar

Predator	Prey	Stadia
Sycanus sp.	Nettle caterpillar, bagworm, tussock moth	Larvae
Cosmolestes sp.	Nettle caterpillar, bagworm, tussock moth	Larvae
Eucanthecona sp.	Nettle caterpillar and tussock moth	Larvae and moth
Callimerus sp.	Nettle caterpillar and bagworm	Larvae

Sycanus dichotomus



Eucanthecona furcellata

Parasitoids of leaf-eating caterpillars

Parasitoids	Host	Stadia
Trichogrammatoidea thoseae	*S. asigna, S. nitens*	Eggs
Brachymeria lasus	*M. plana, Clania tertia*	Larvae
Fornicia ceylonica	*S. asigna, S. nitens*	Larvae
Spinaria spinator	*S. nitens*	Larvae
Apanteles aluella	*D. trima*	Larvae
A. metisae	*M. plana, M. corbetti*	Larvae
Chlorocryptus purpuratus	*S. asigna*	Larvae & Pupae
Chaetexorista javana	*S. asigna, S. nitens*	Larvae & Pupae

Enhancing the role of predators and parasitoids

- Restoring or maintaining weedy strips increase predator occurrences as well as predation rates

in: Nurdiansyah et al. 2016

Enhancing the role of predators and parasitoids

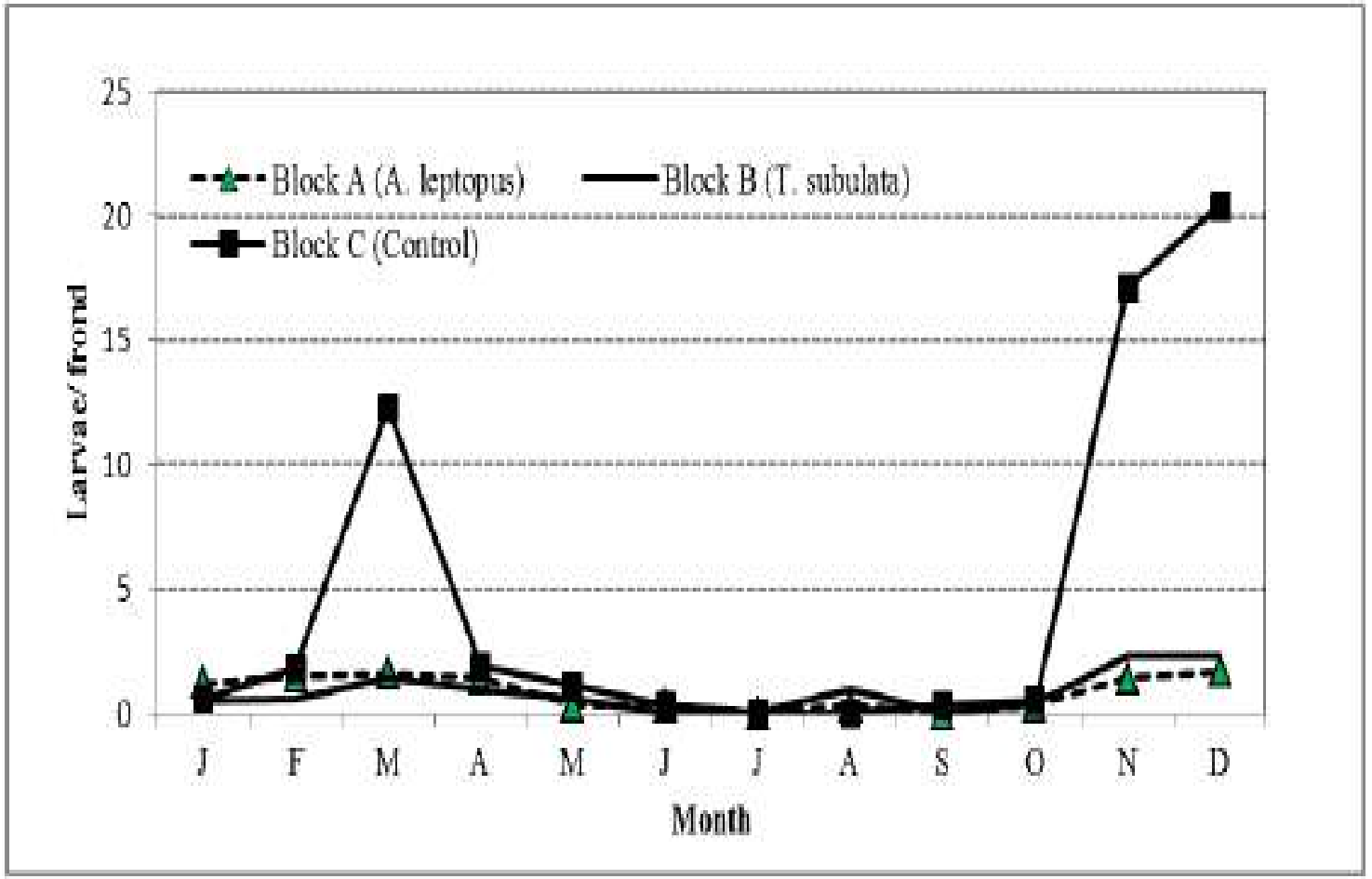
The abundance of natural enemies in planting block

Flowering plant	Average insect/plant	Total number of insect
Block A (*A. leptopus*)	5.5 ± 0.77 a	250.3 a
Block B (*T. subulata*)	5.0 ± 0.57 a	227.0 a
Block C (Control)	0.6 ± 0.10 b	28.5 b

in: Saleh and Siregar 2017

Increasing vegetation diversity by introducing flowering plants such as *Turnera subulata* or *Antigonon leptopus* increase beneficial insect visitation in the block

Enhancing the role of predators and parasitoids



Outbreak of *S. asigna* occurs twice in block without flowering plant introduction

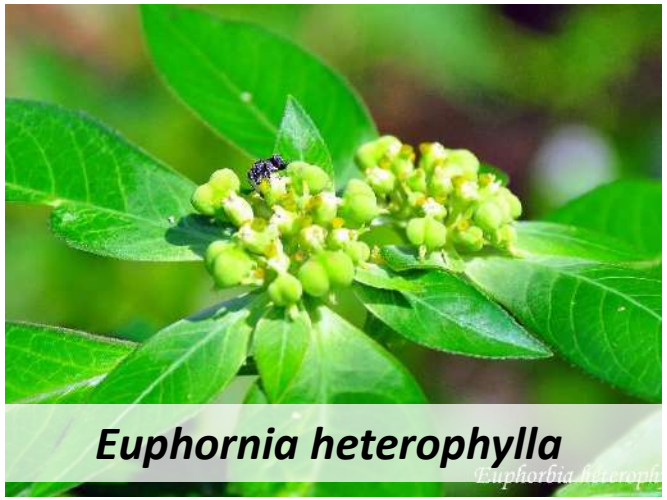
The population dynamics of *Setothosea asigna* in Gunung Melayu Estate in 2015

in: Saleh and Siregar 2017

Beneficial plants for natural enemies

Antigonon leptopus

Turnera subulata / T. ulmifolia



Euphornia heterophylla

Cassia tora

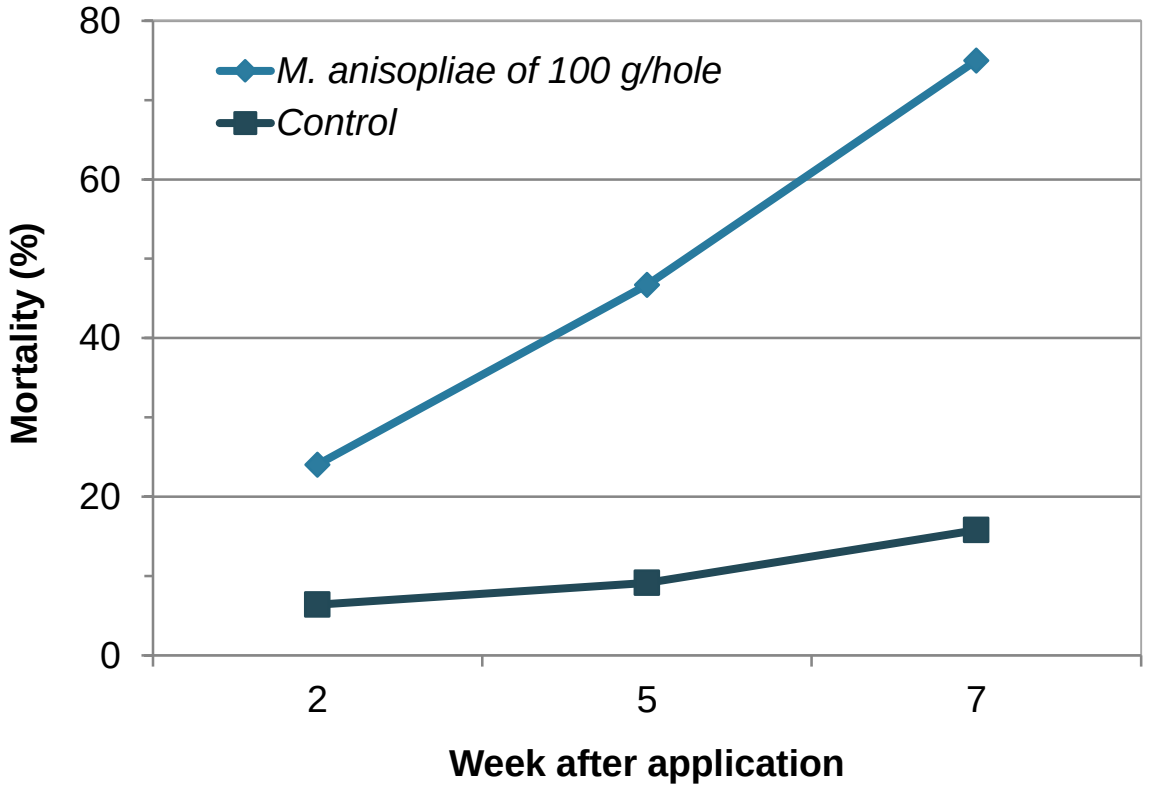
Elephantopus scaber

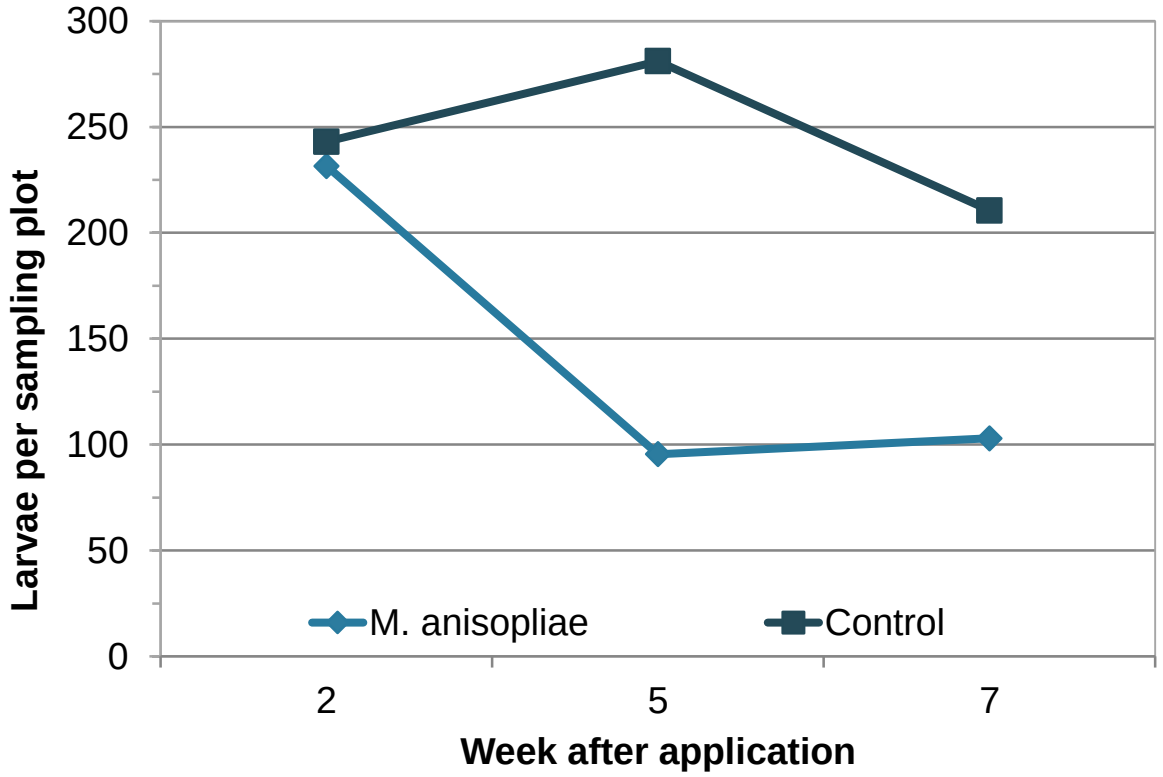
Entomopathogenic Fungi – *Metarhizium anisopliae*

Development of *M. anisopliae* on *O. rhinoceros* larvae

- The most widely studied
- Highly pathogenic to *O. rhinoceros* larvae
- Commercial formulation is available

Large scale field application





- *M. Anisopliae* application reduces 70% population of *Oryctes* larvae in Teluk Dalam Estate, Riau Province

- *M. Anisopliae* application reduces 50% population of *Oryctes* larvae in Gunung Bayu Estae, North Sumatra

in: Susanto *et al.* 2007

In peatland oil palm plantation

- Abundant source of organic matters
- Larvae often found in the inter row
- Need more targeted approach!

Organic trap!

Integration with other methods

Organic trap (EFB, *M. anisopliae,* pherotrap) in peatland plantation

- Improves beetle's trapping
- Lures beetles to lay eggs in the trap

M. anisopliae vs termite

Coptotermes curvignathus

- Major pest in peatland plantations
- Attacks immature and mature palms

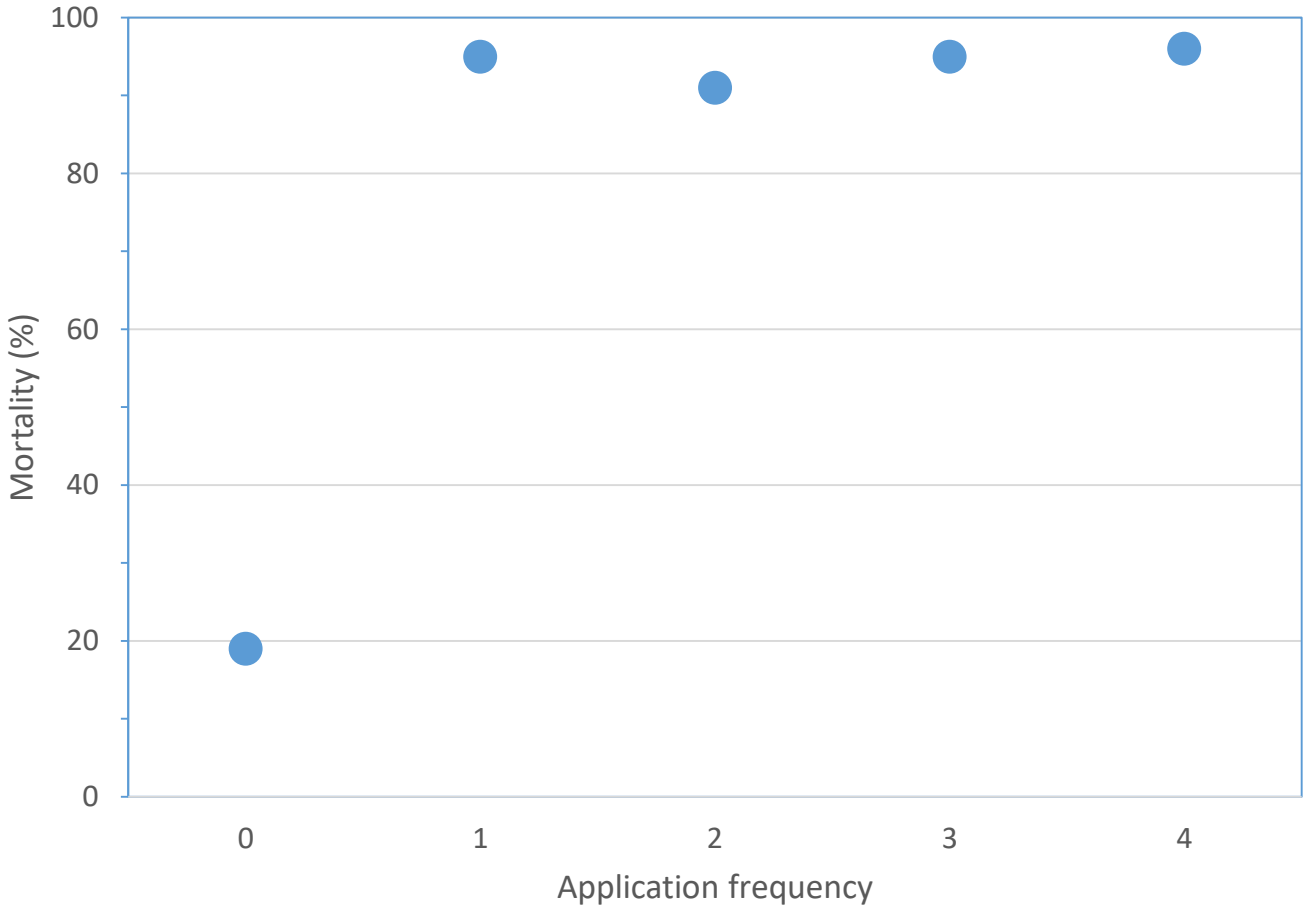
- Direct application of *M. anisopliae* on soil is not effective
- Need trapping!

Mixture of *M. anisopliae* - EFB Compost

Application of mixture *M. anisopliae* - EFB compost on oil palm circle

in: Ginting *et al.* 2014

Mixture of *M. anisopliae* - EFB Compost



- High mortality on worker and soldier
- BUT the queen is not affected

Mortality of *C. curvignathus* at 5 weeks after pre-mixed *M. anisopliae* – EFB compost application

in: Ginting *et al.* 2014

Another approach: Termite baiting system

in: Rozziansha *et al.* 2012

Entomopathogenic Fungi – *Beauveria bassiana*

Infection of *B. bassiana* on nettle caterpillar, *Darna trima*

- Wide host range yet unpopular in oil palm in Indonesia
- Highly pathogenic to nettle caterpillar
- Causes 100% mortality of *Darna trima* in green house
- Causes 43.3% mortality on *Setothosea asigna*

Entomopathogenic Fungi – *Cordyceps militaris*

- Narrow host range
- Less studied
- Mass application in 1990s
- Pupae infection ranged from 40% - 80%

Infection of *C. militaris* on nettle caterpillar pupae, *S. asigna*

in: Pardede *et al.* 1996

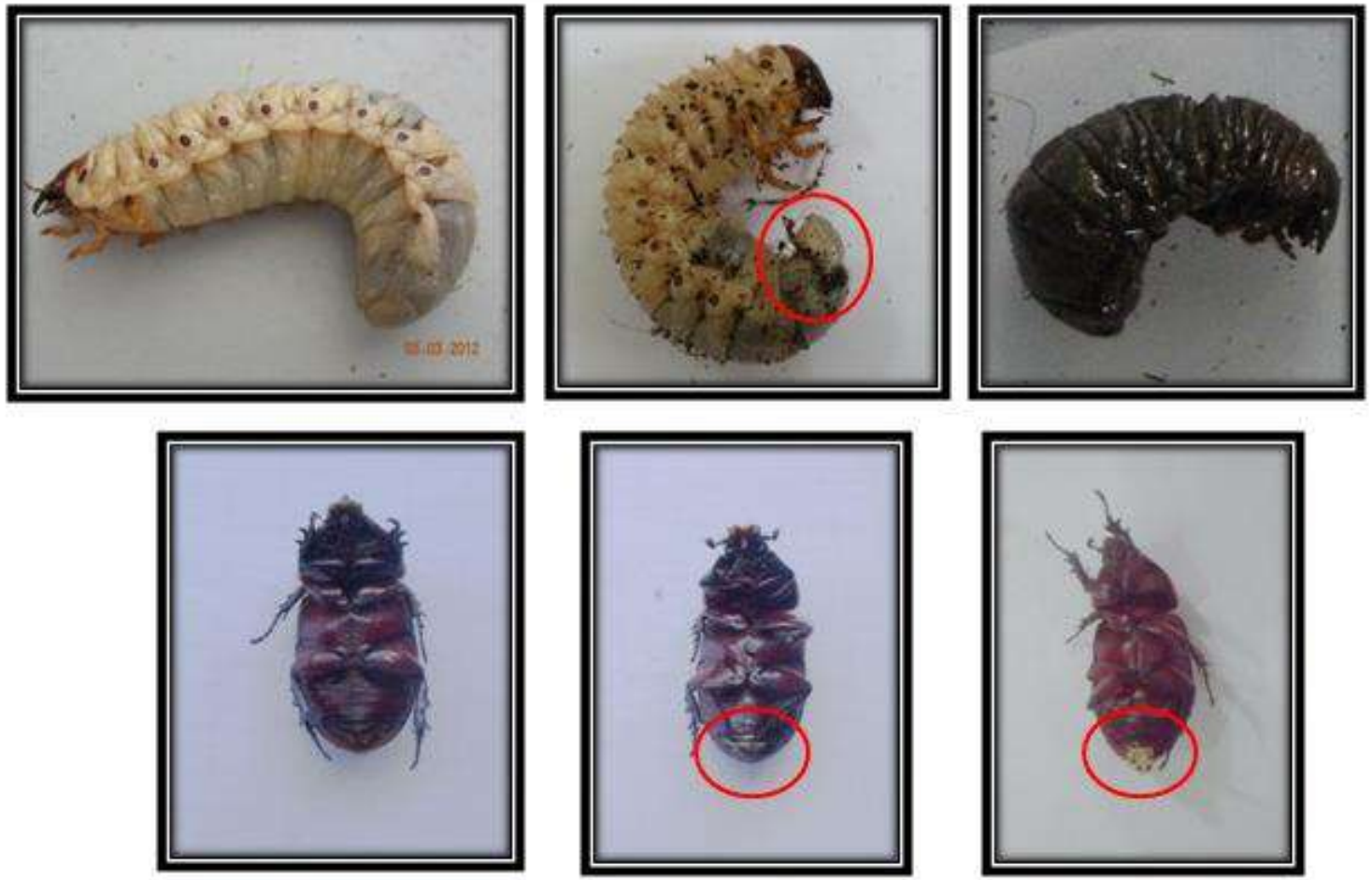
S. nitens larvae infected by SnNPV

Viruses

Host specific:

- *Oryctes* nudivirus (OrNV),
- *S. asigna* nuclear polyhedrosis virus (SaNPV),
- *Setora nitens* NPV (SnNPV)

Oryctes nudivirus (OrNV)

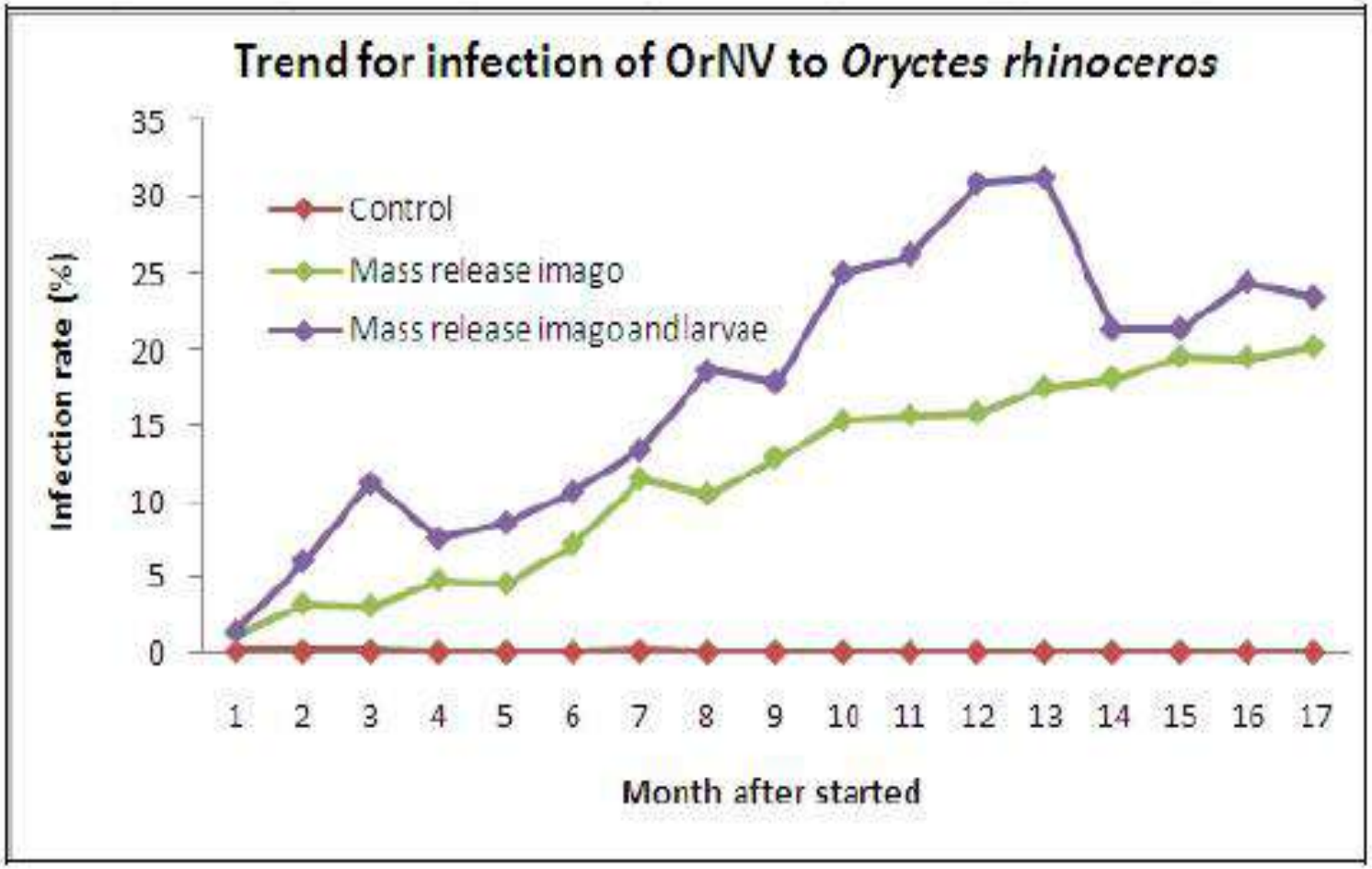


- Infection occurs on larvae and beetle
- Field application by releasing infected larvae and beetles

Symptoms of OrNV infection on the rhinoceros larvae and beetle

in: Mohd Naim *et al.* 2016

Oryctes nudivirus (OrNV)



- Re-release of infected larvae and beetle could increase infection rate

in: Mohd Naim *et al.* 2016

Oryctes nudivirus (OrNV)

Mean population of *Oryctes rhinoceros* at breeding sites during the study

Treatment	Mean individual per m2 (IPMS) (± SD)
Control (No release of OrNV)	12.2 ± 1.9 a
Mass release infected imago only	10.8 ± 1.3 a
Mass release infected imago and larvae	3.3 ± 0.3 b

Mean imago captured in pherotrap/trap/day

Treatment	Imago captured/trap/day (± SD)
Control (No release of OrNV)	17.5 ± 1.6 a
Mass release infected imago only	14.8 ± 2.3 b
Mass release infected imago and larvae	11.8 ± 1.2 c

- Re-release of infected larvae and beetle could decrease *Oryctes* population

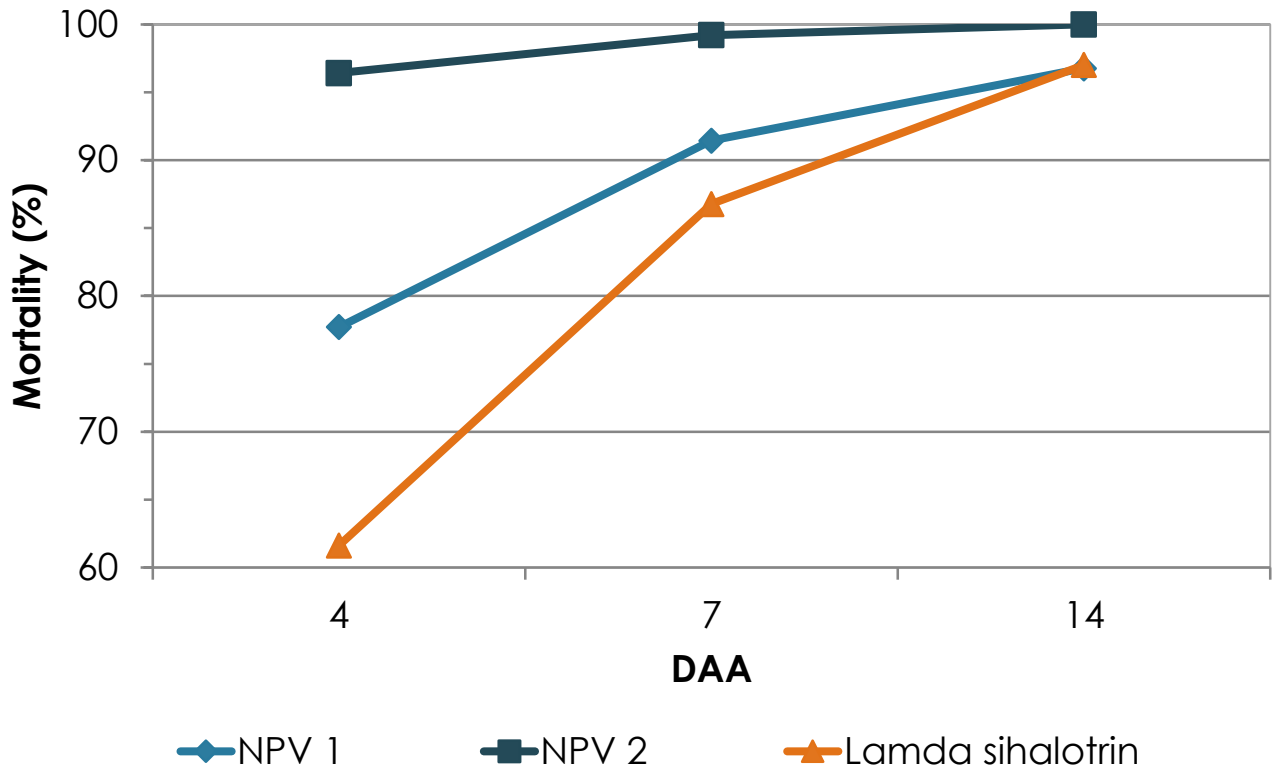
in: Mohd Naim *et al.* 2016

NPV

- Application of 400 g crude sap/ha reduce *S. asigna* population by more than 90%. Successive application maintains the population in check for 6 month in Bukit Sentang Estate
- Application of 250 – 500 ml virus suspension/ha decrease population of *S. asigna* from 8.8 to 1.9 larvae per frond. The population maintained in check for 2 consecutive years in Gunung Malayu Estate.

Symptoms of SaNV infection on the S. asigna larvae

Field application in *S. asigna* – endemic area in North Sumatra



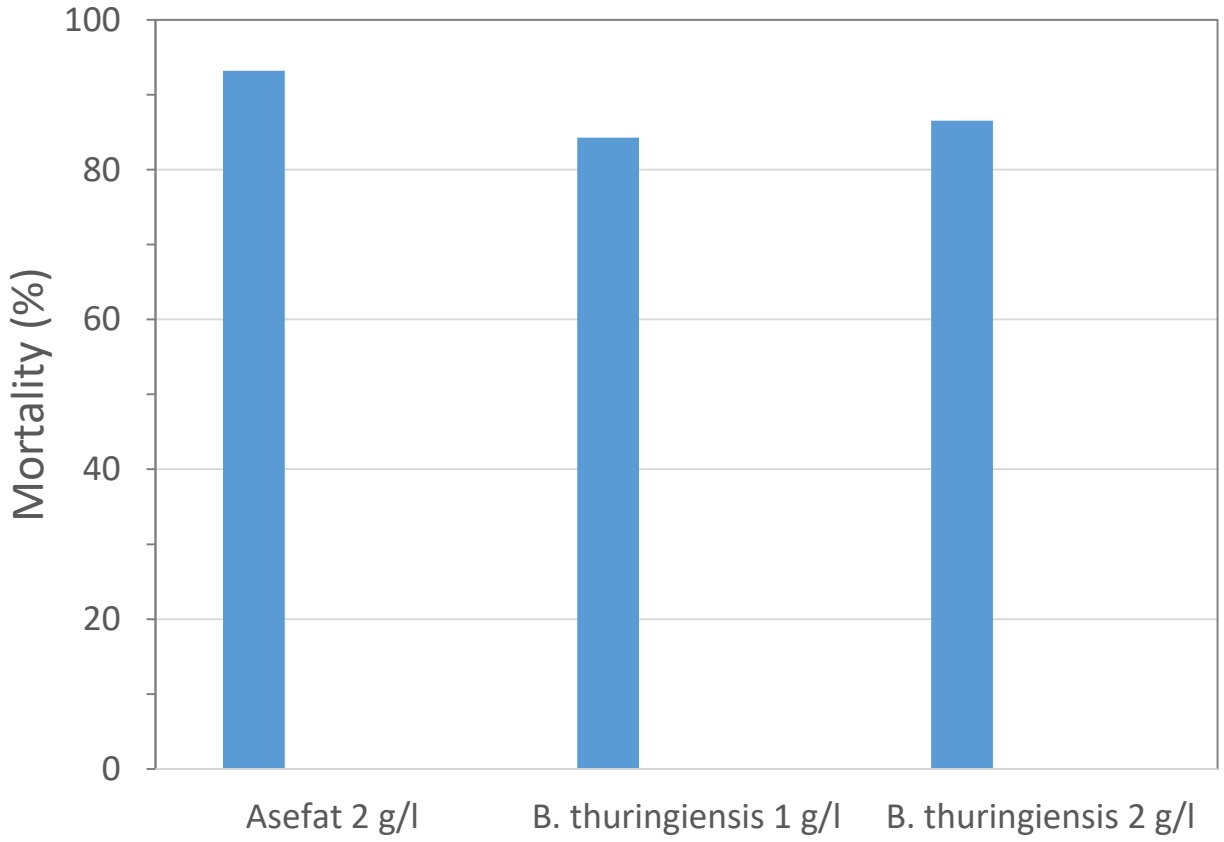
- SaNPV has better efficacy against lamda sihalotrin

Bacillus thuringiensis

- Widely been studied
- Used for controlling leaf-eating caterpillar
- Single-continuous application of *B. thuringiensis* to control *D. trima* in Bukit Sentang Estate was gradually reduce total infested area from 163 ha in 1992 to only 3 ha in 1993 and maintained total infested area of < 9 ha until 1996

in: Pardede *et al.* 1996

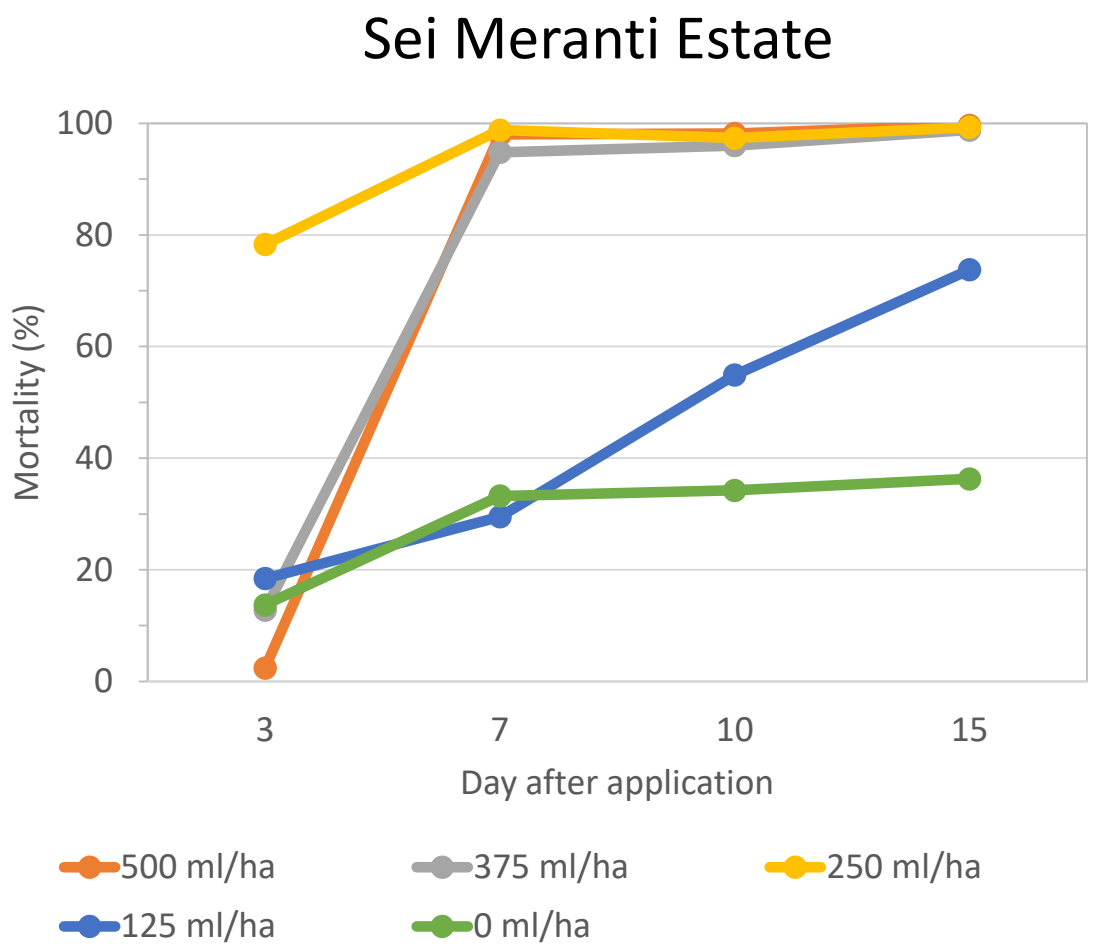
Spraying application of Bt for controlling *Metisa plana* in Tinjowan Estate, North Sumatra

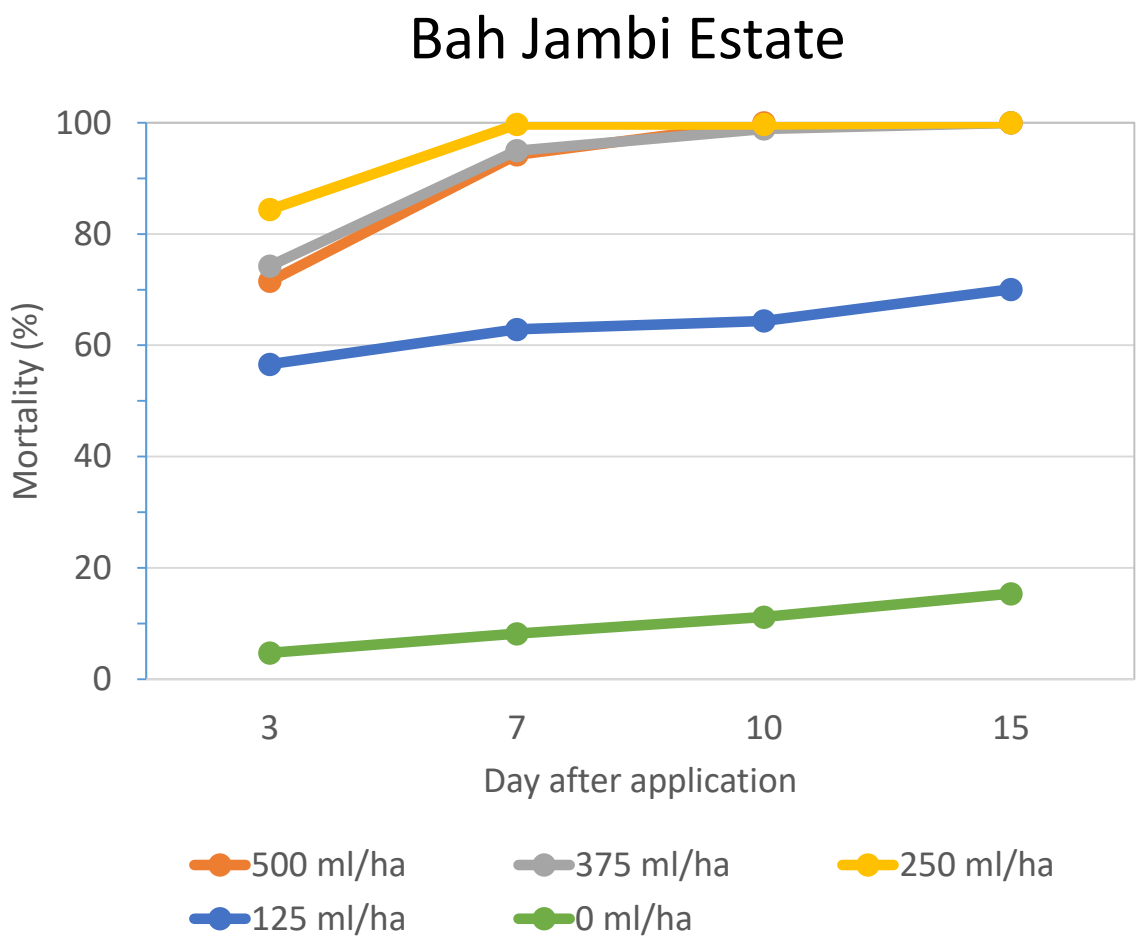


- Causes more than 80% mortality at 18 days after application
- Successive applications overcome the outbreak

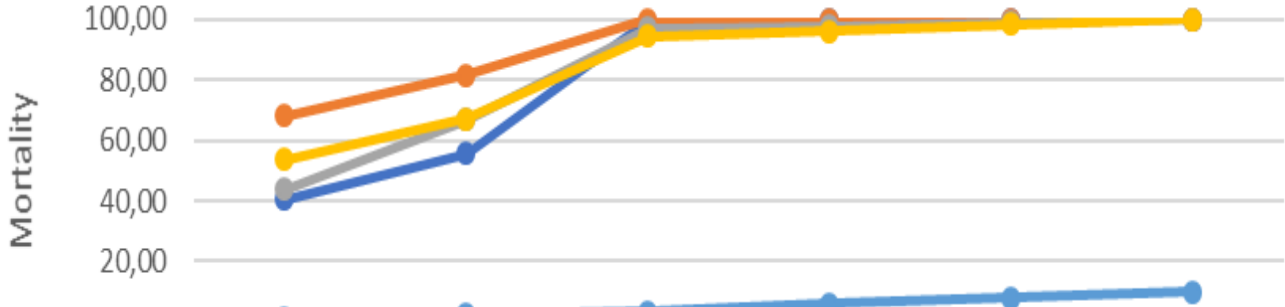
in: Susanto *et al.* 2010

Spraying application of Bt for controlling *Metisa plana*





Fogging application of Bt for controlling *Mahasena corbetti* in Bah Jambi Estate, North Sumatra



	3	7	14	17	21	28
500K1	40,42	55,75	99,48	100,00	100,00	100,00
1000K1	68,13	81,56	100,00	100,00	100,00	100,00
500K2	43,69	66,92	97,08	97,85	99,23	100,00
1000K2	53,70	67,12	94,52	96,16	98,36	100,00
UTC	1,12	2,24	3,36	5,97	7,84	10,07

- Optimum dose for fogging application is 500 ml/ha
- Compatible with single and double tank fogging

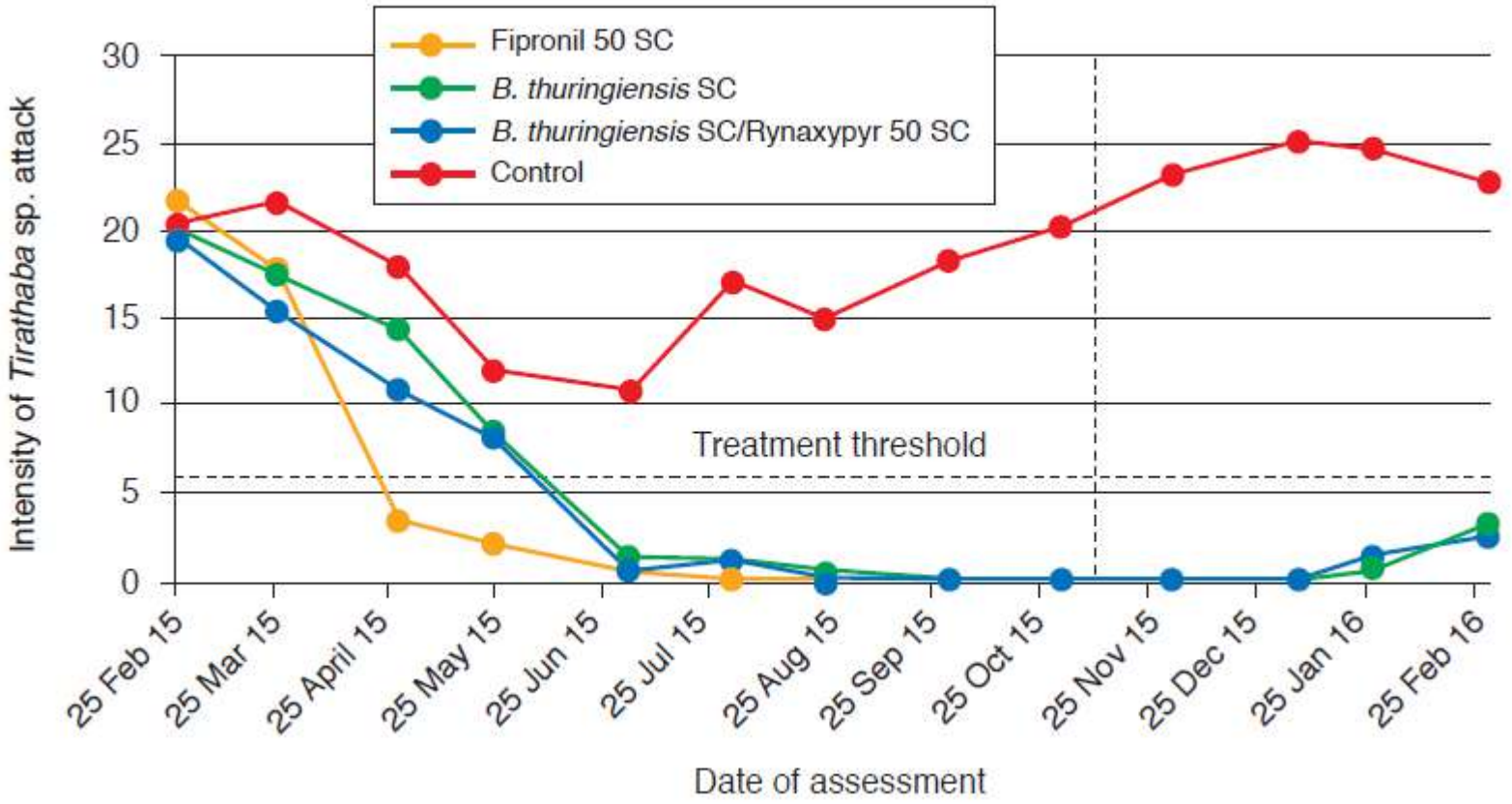
K1:

K2:

Ensure homogenous solution prior application!!

Need an appropriate ratio of bioagent (or insecticide), diesel fuel, water, and **surfactant**

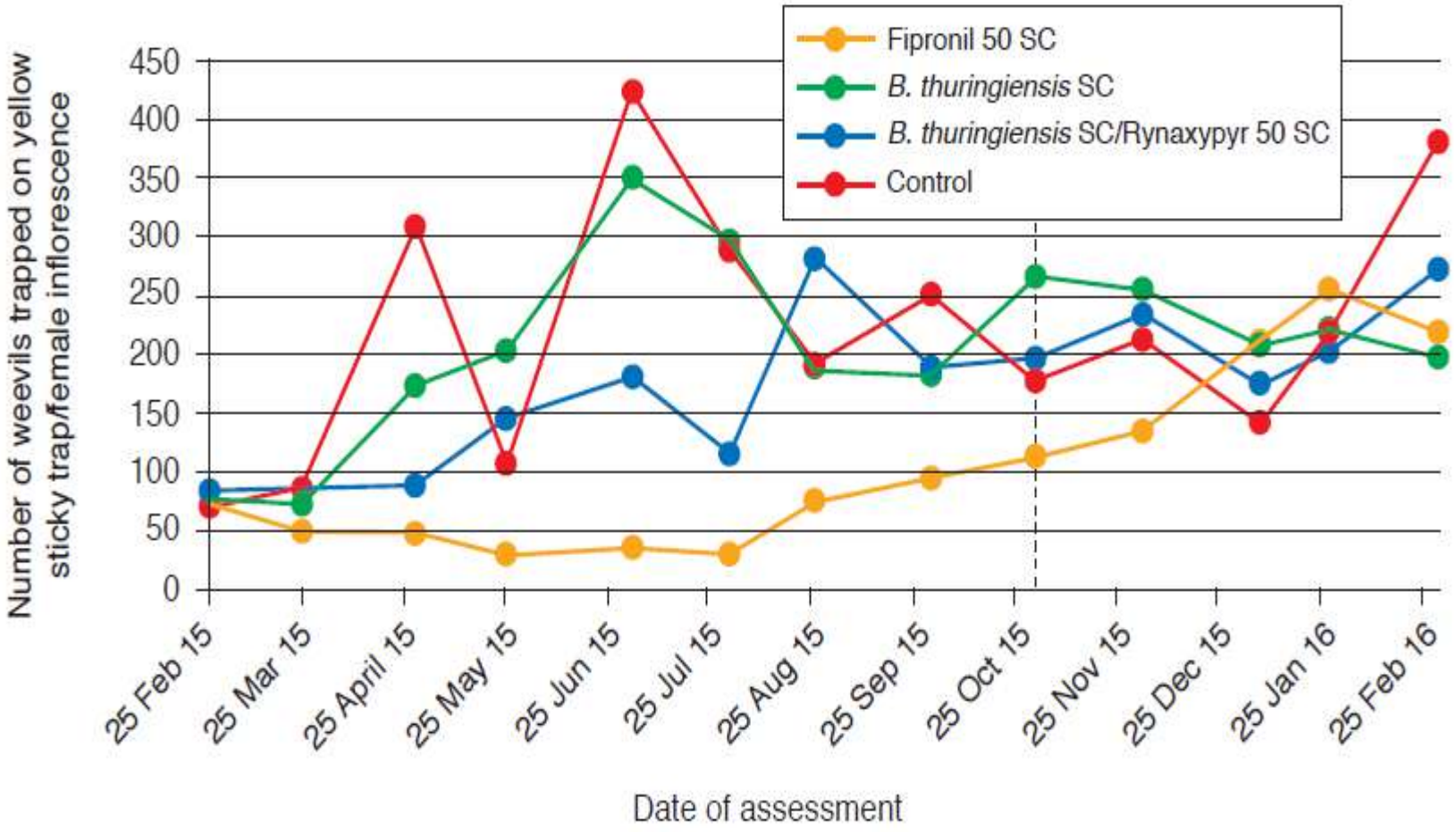
Longterm application of Bt for controlling bunch moth *Tirathaba rufivena* in Indragiri Hulu, Riau



- Successive Bt application at 2 weeks interval for 9 months
- Intensity declines dramatically after 4 months of application

in: Prasetyo *et al.* 2018 (in press)

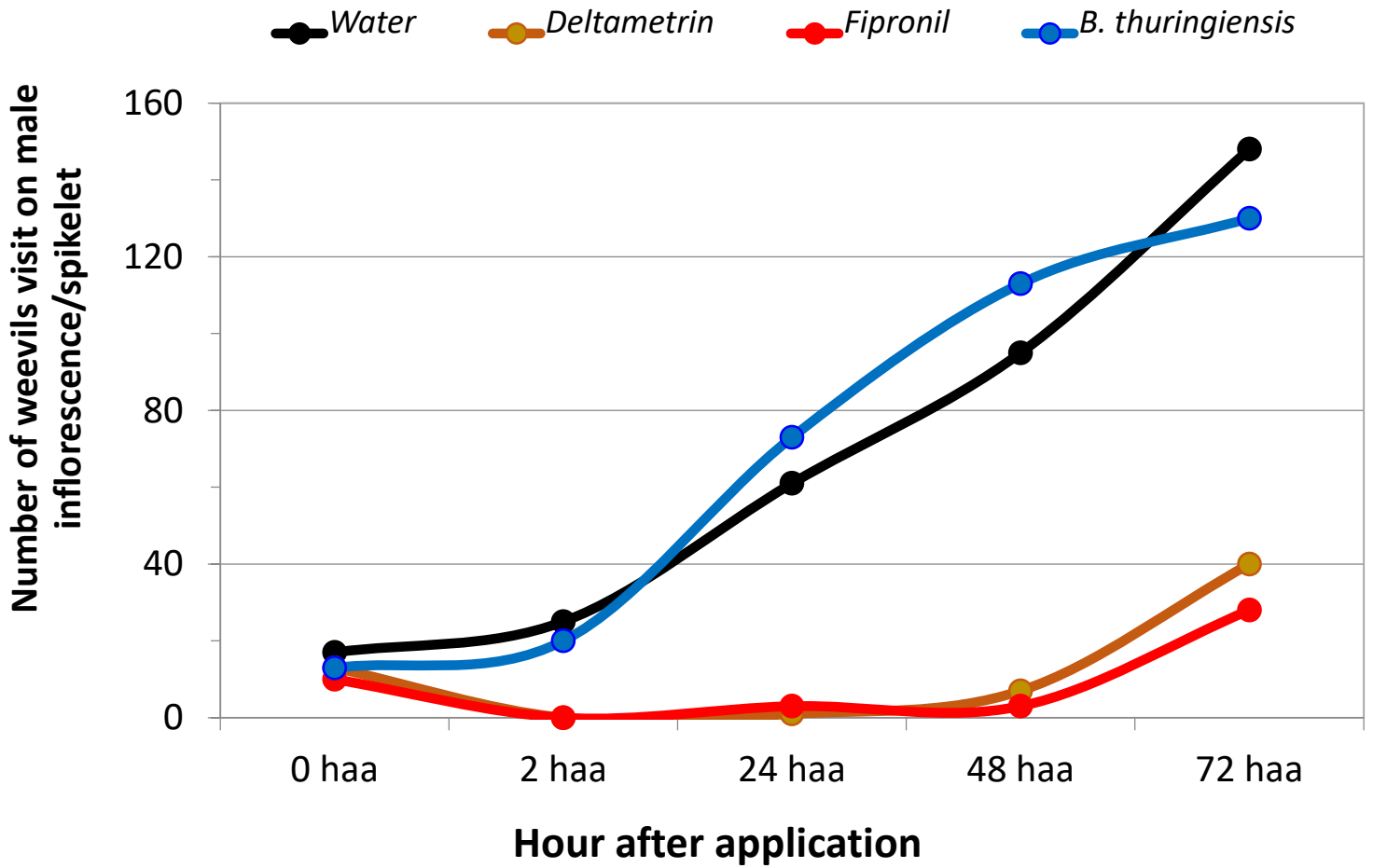
Impact on *Elaeidobius kamerunicus*



No adverse effect on *E. kamerunicus* under long term application of Bt

in: Prasetyo *et al.* 2018 (in press)

Impact on *Elaeidobius kamerunicus*

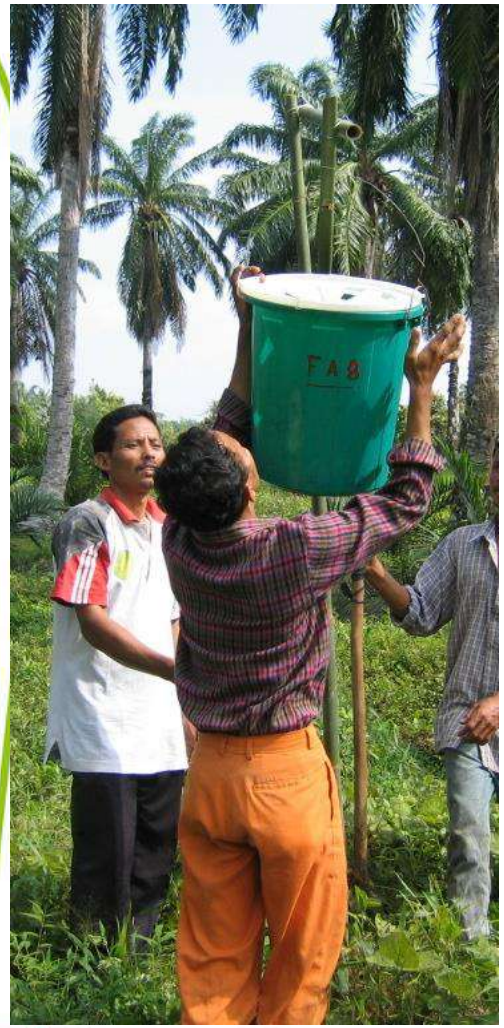


Normal visitation of *E. kamerunicus* on male anthesis inflorescense

Aggregate pheromones

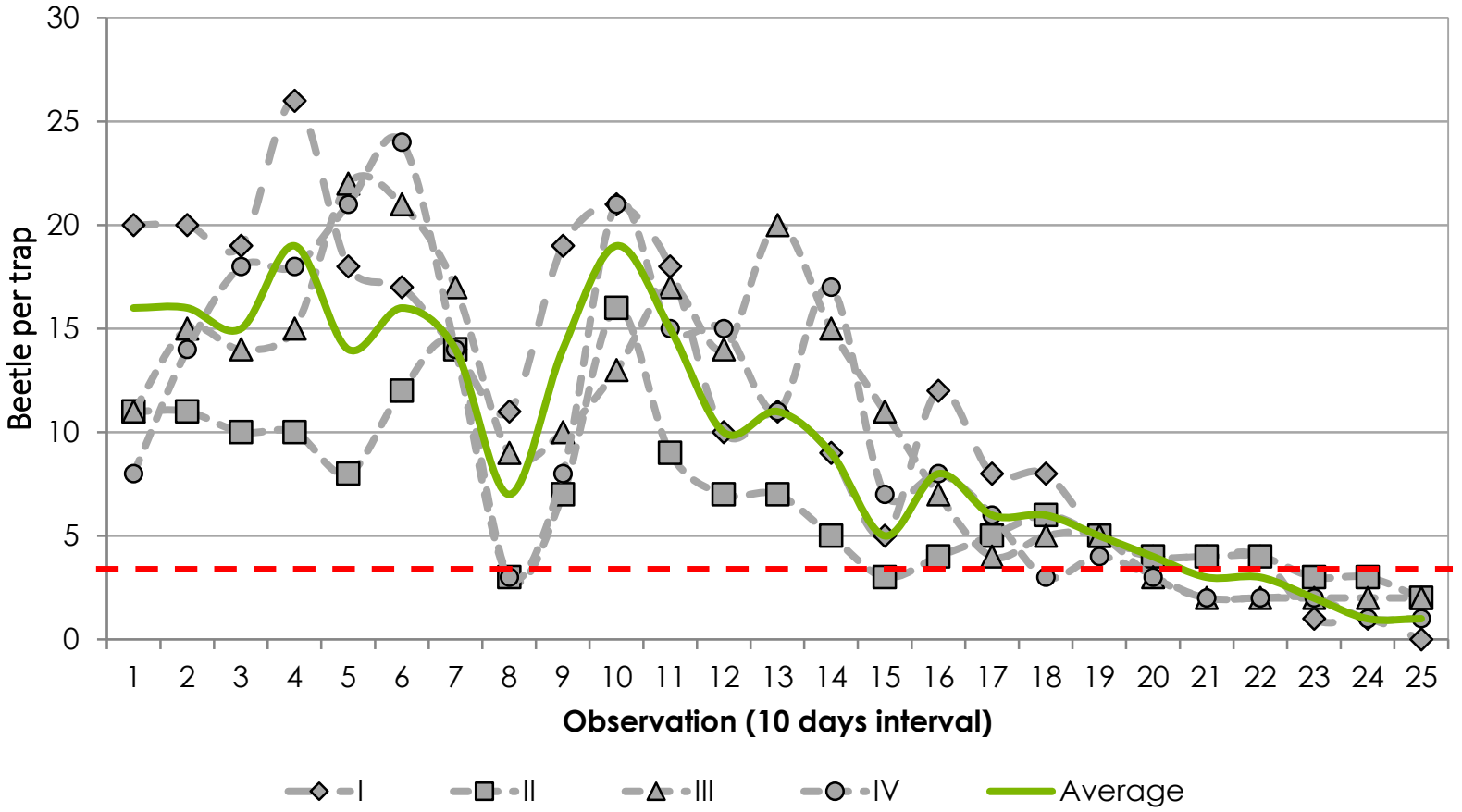
- Ecofriendly
- An integral part in IPM for rhinoceros beetle management
- Ethyl-4-methyl-octanoate
- Widely use for monitoring and management purposes
- Highly efficient for mass trapping *O. rhinoceros* beetles

Design of pherotraps





The role of E4-MO in suppressing rhinoceros beetle population in Sei Rokan Estate, Riau



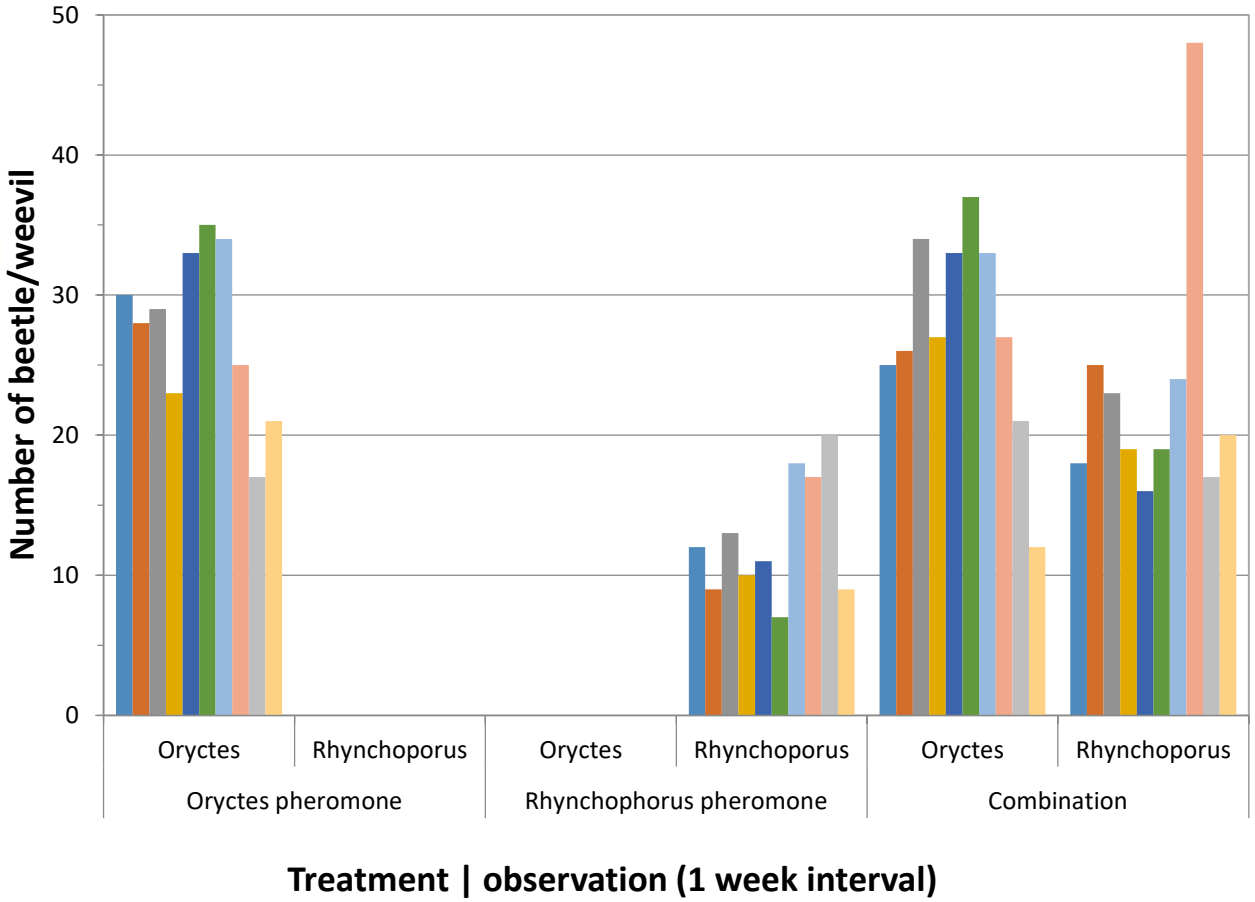
Total beetle trapped: 146,289

Average beetles trapped in Afdeling I – IV, Sei Rokan estate since October 2005 to September 2006

Integration with other methods

Combined with OrNV to improve catch-release beetles and so increase the potency of virus transmission in the field

Double pheromones application



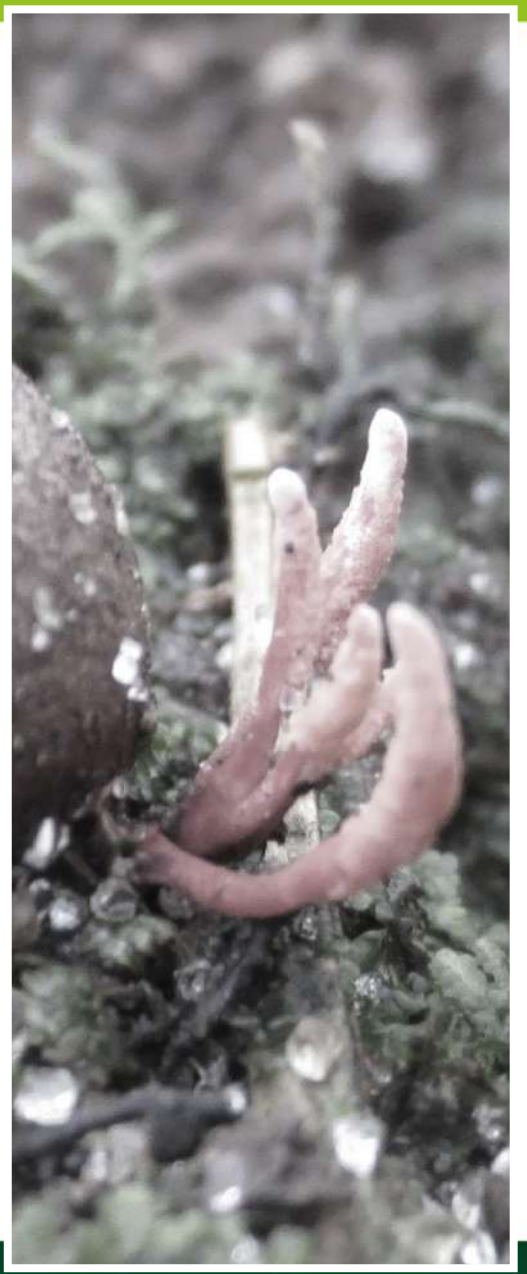
Pre-mixture of E4-MO with 4-methyl-5-nonanol increases *R. ferrugineus* trapping

More insect pheromones are expected to come in the near future!

Challenges

Limited use of biocontrol products is mainly because some technical issues:

- Short storage period
- Bulky, high volume application needed
- Availability in large quantities
- Lack of promotion
- Planters mindset



Terima Kasih