

USDA-Mars CRADA-2004-2009



# Semiochemicals for the Cocoa Pod Borer, *Conopomorpha cramerella*, Control

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Reading University, May 2007

# At USDA - Expertise in Entomology



1

**SEL: Better understanding cacao pod borer systematics, center of diversity, host range**



3

**IBL: Biological Control of CPB, entomopathogens as endophytes, artificial diets**

2

**CAIBL: Development of Pheromones for monitoring, mass-trapping and mating disruption, QC**



4) Malaysian Cocoa Board

5) Natural Resources Institute, UK and

6) Pest Control India, PCIL: Scale up pheromone production, Commercialization

7) GTZ and Bioletsari, Indonesia, ICCRI-Registration, LONSUM

8) Mars

**Mars Inc. USDA-ARS CRADA-2004-09**

# Objectives of the Collaborative Project

- Re-evaluate the effectiveness of CPB pheromones Identified by Natural Resources Institute
- Field monitoring studies in Malaysia (Peninsular and Sabah) and Indonesia
- Correlation of CPB (male) population and related pod losses (to be determined)
- Determining the suitability of various pheromone application technologies in small holder farms and large estates (to be determined)

# CPB Control Effort - Mass Trapping

- Experiment using 16 traps/hectare, 0.1 mg/lure in ~200 hectares were conducted in Sabah, Malaysia for several years. A 30% reduction in pod damage was observed.
- However, the outbreak of CPB in Peninsular Malaysia in 1986 did not respond to the same pheromone blend.
- Existence of more than one pheromone strain of CPB was suspected.
- Research on pheromone stopped in the late 1980's/early 1990's

# Chemical Composition of CPB Sex Pheromone



(*EZZ*)-4, 6, 10-Hexadecatrienyl Acetate

Ratio

40



(*EEZ*)-4, 6, 10-Hexadecatrienyl Acetate

60

Beevor, P.S. et al.  
J. Chemical Ecology  
12:1-23, 1986



(*EZZ*)-4, 6, 10-Hexadecatrienyl Alcohol

4



(*EZZ*)-4, 6, 10-Hexadecatrienyl Alcohol

6



Samples: Sulawesi, Sumatra, Java, Bali, Flores, West Papua (Indonesia), Sabah, Peninsular Malaysia, PNG; Luzon, Palawan, Mindanao (Philippines)

Results:

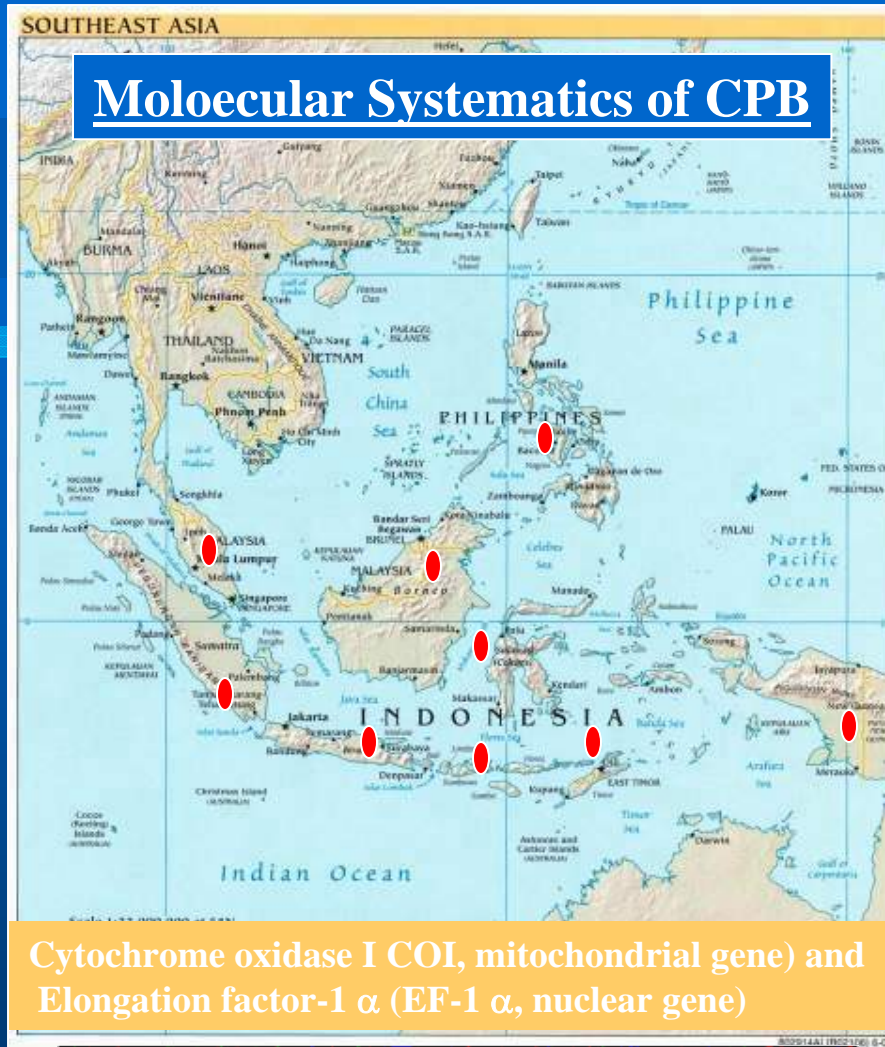
-Very Little Geographic DNA variation observed

Conclusion: Low variation and lack of geographic pattern suggests that,

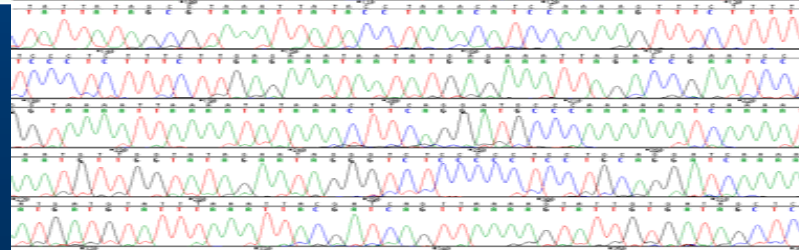
CPB on cacao is a single species in the cacao farms and

Has been moved extensively throughout much of southeast Asia

## Molecular Systematics of CPB



Cytochrome oxidase I COI, mitochondrial gene) and Elongation factor-1  $\alpha$  (EF-1  $\alpha$ , nuclear gene)



Electropherogram showing partial CPB COI sequence<sup>6</sup>

# Pheromones



- Pheromones can be used for
  - Monitoring
  - Mass trapping
  - Mating disruption
- 05 & 06 1-2 ha trials, Sulawesi, Sabah, Sumatra, Java, Malaysia, PNG
- 2006, larger trials & QC and backstopping at USDA/NRI
- Low cost production of pheromones in India-commercialization





**CPB Sex  
Pheromone  
Trail in Tawau  
Malaysia  
2005**









2005 8 6

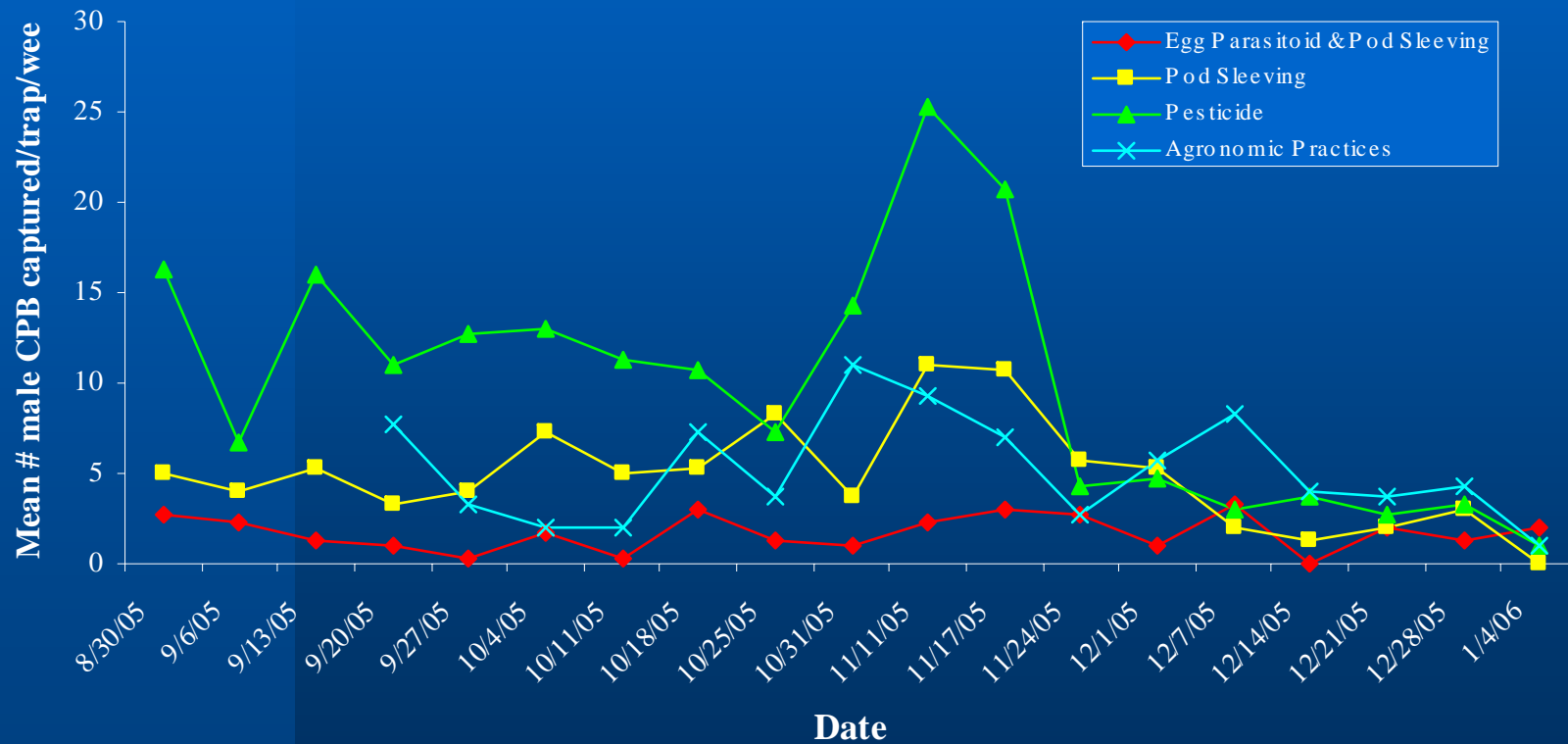






# Male CPB Population Monitoring

## MCB, Sabah, Malaysia

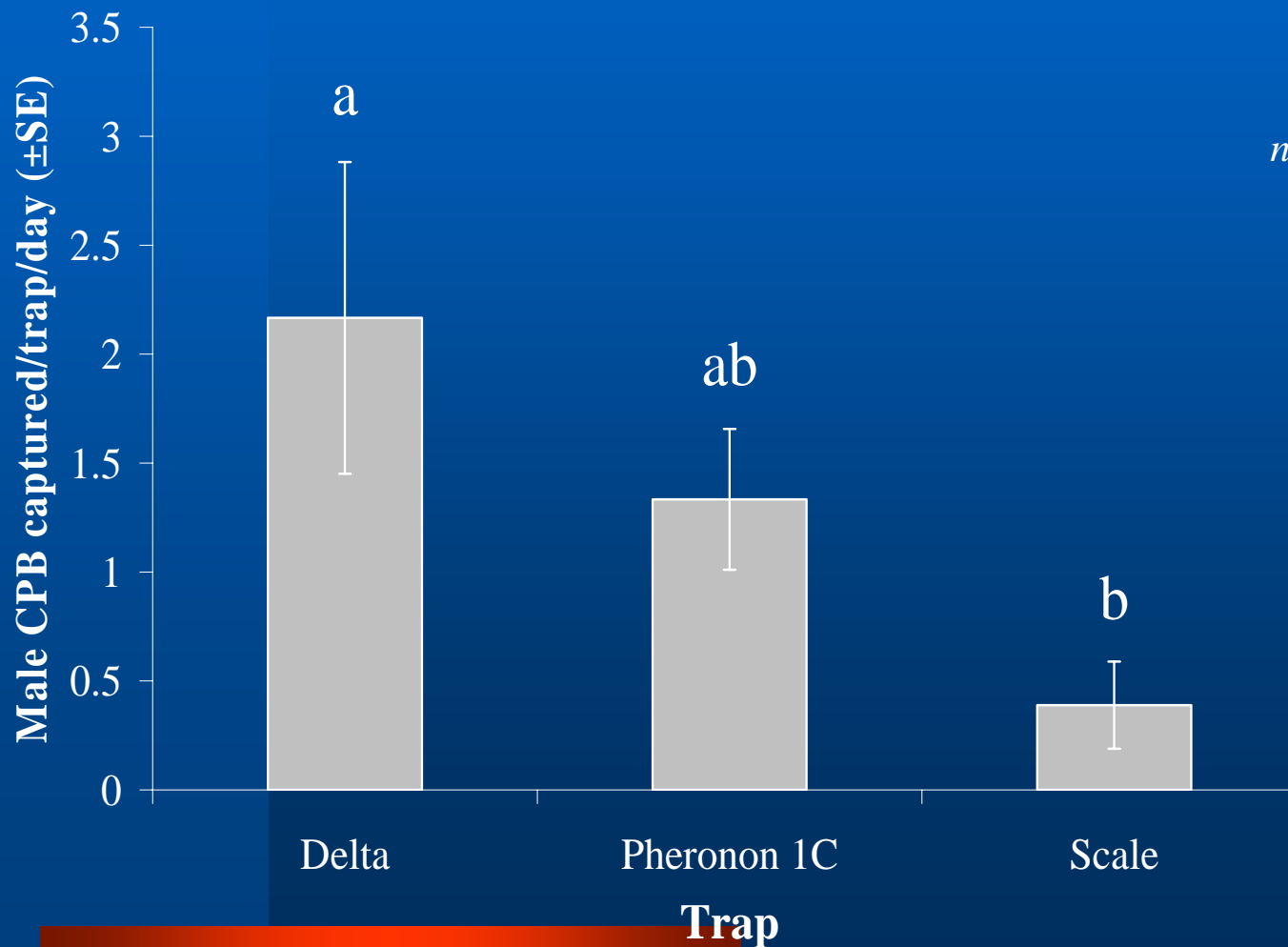


# Trap Comparison

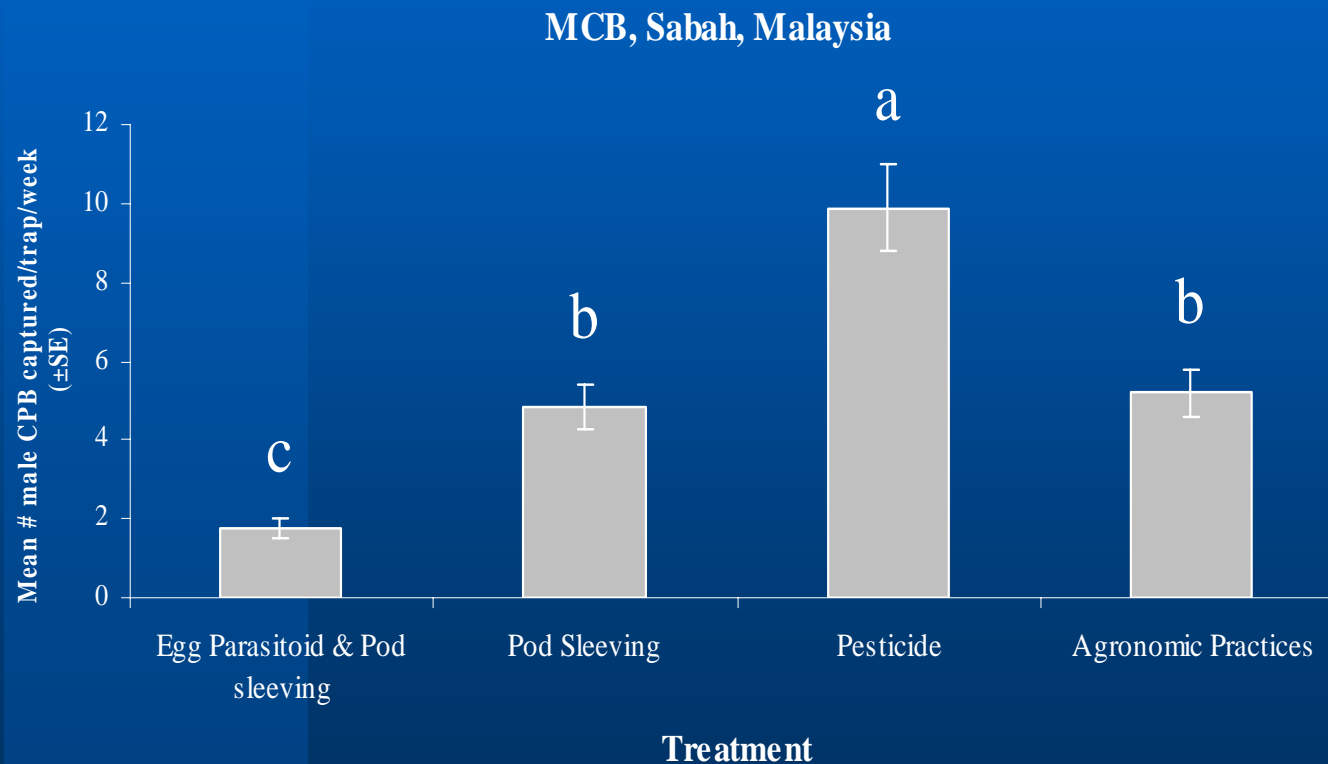
MCB, Sabah, Malaysia

8/6/2005-8/12/2005  
(6 Days)

# CPB captured = 70  
 $n = 18$ ,  $F(2,51) = 6.24$ ,  
 $P < 0.01$



# Male CPB Capture in Different Plots



8/23/2005-1/4/2006  
(19 Weeks)  
# CPB captured = 3,238  
 $n = 57$ ,  $F(3,125) = 25.58$ ,  
 $P < 0.01$

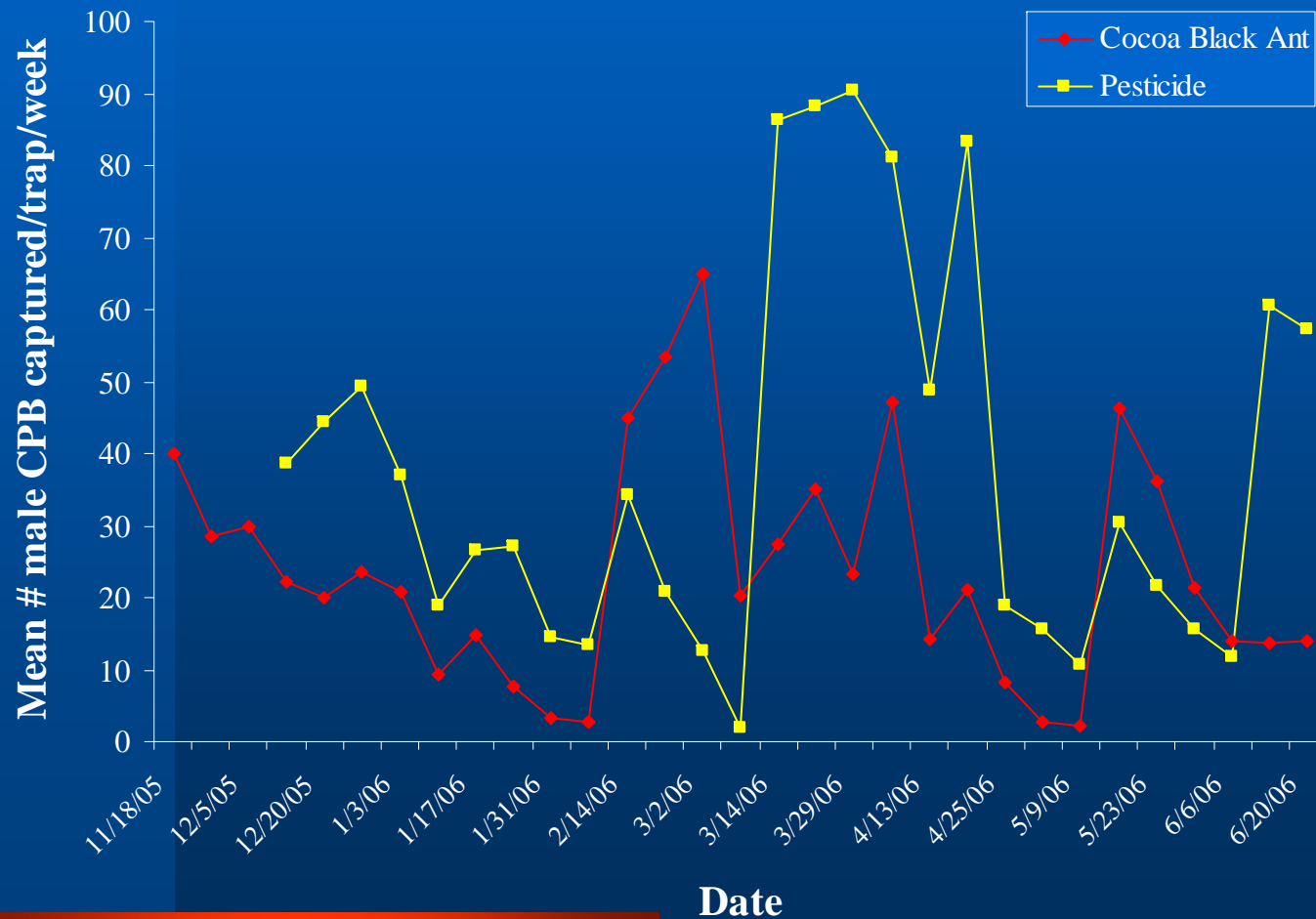




Sabah, Malaysia

# Male CPB Population Monitoring

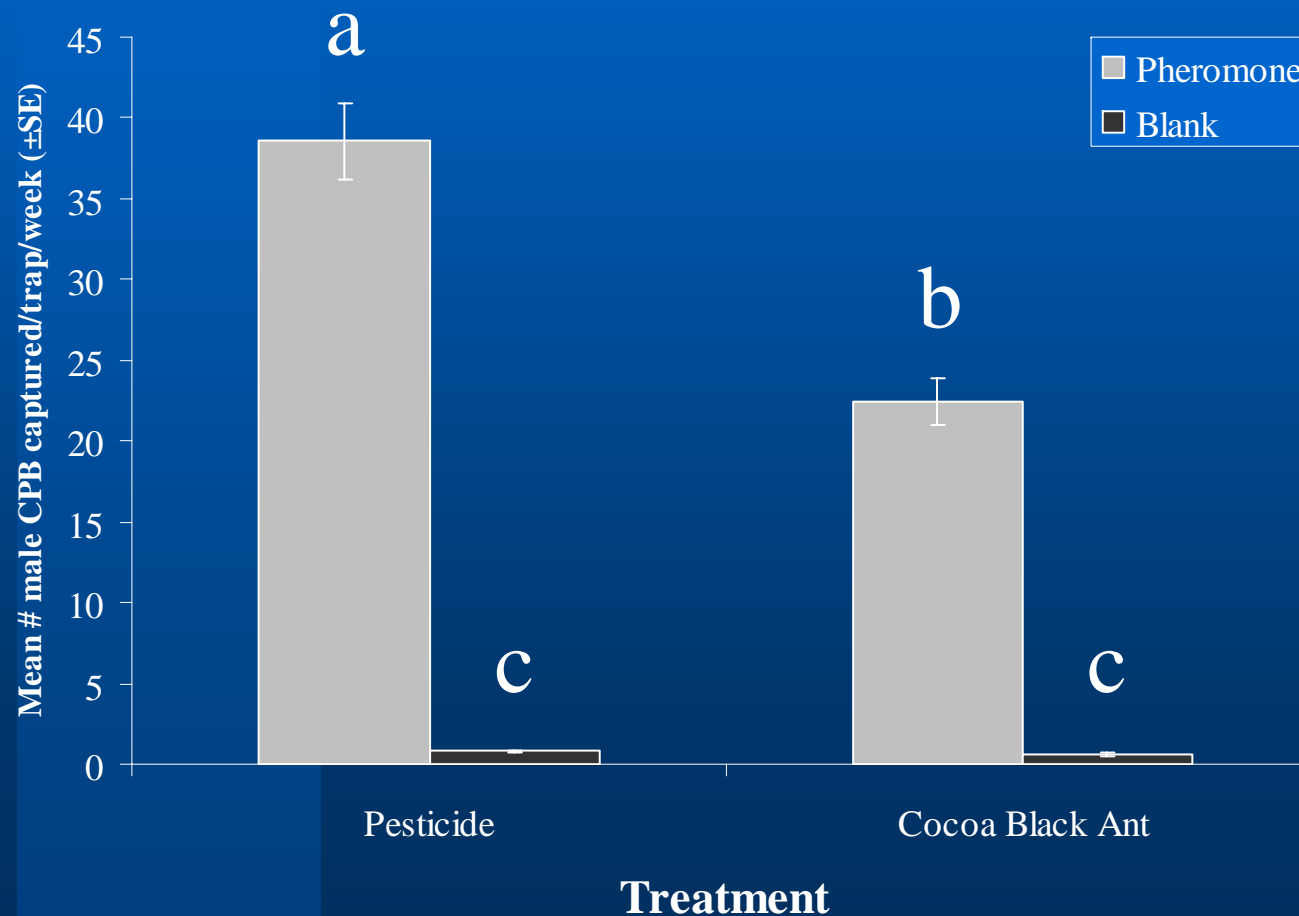
Teck Guan Regency, Sabah, Malaysia





# Male CPB Capture in Different Plots

Teck Guan Regency, Sabah, Malaysia

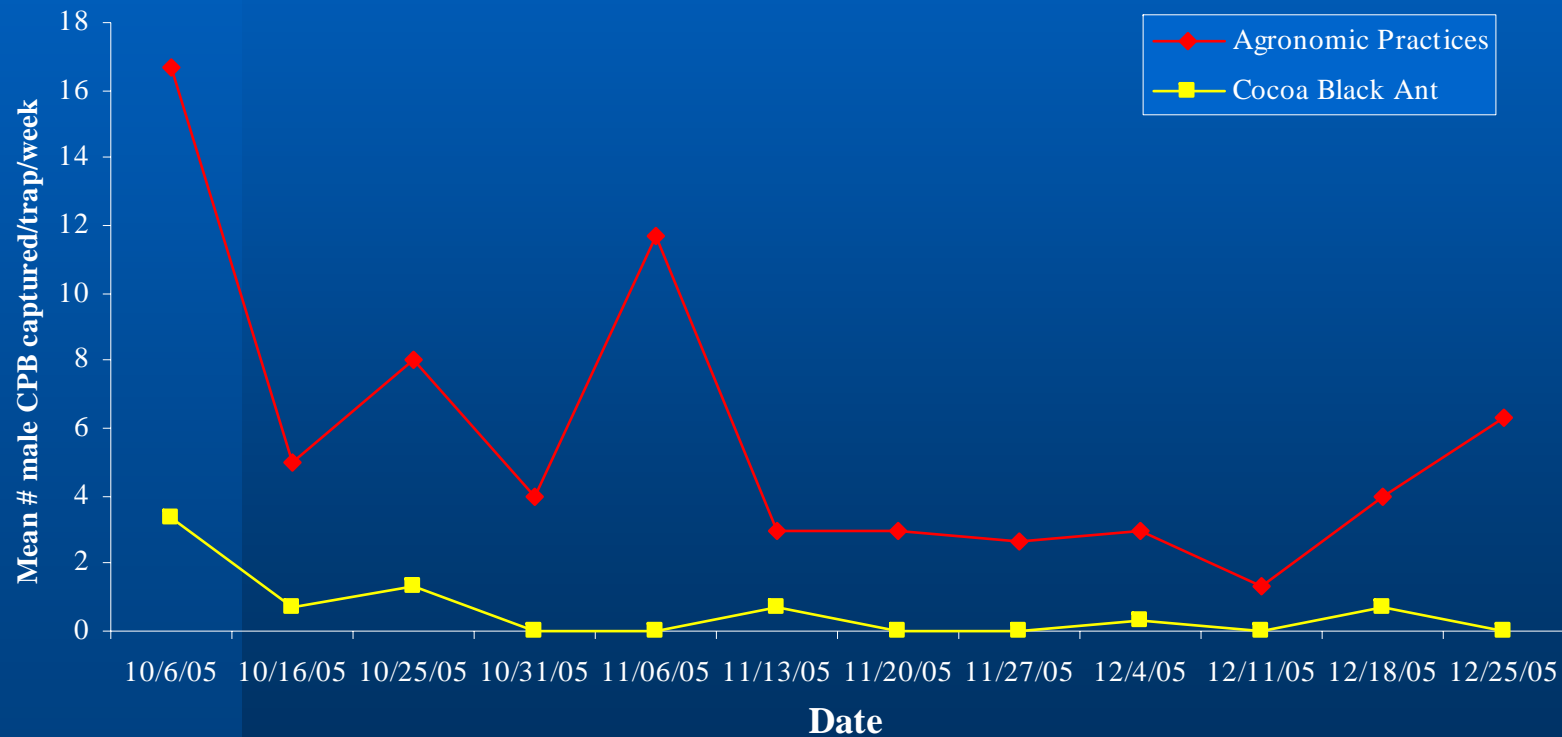


11/9/2005-6/20/2006  
(32 Weeks)  
# CPB captured = 7,905  
 $n = 186$ ,  $F(3,740) = 787.49$ ,  
 $P < 0.01$



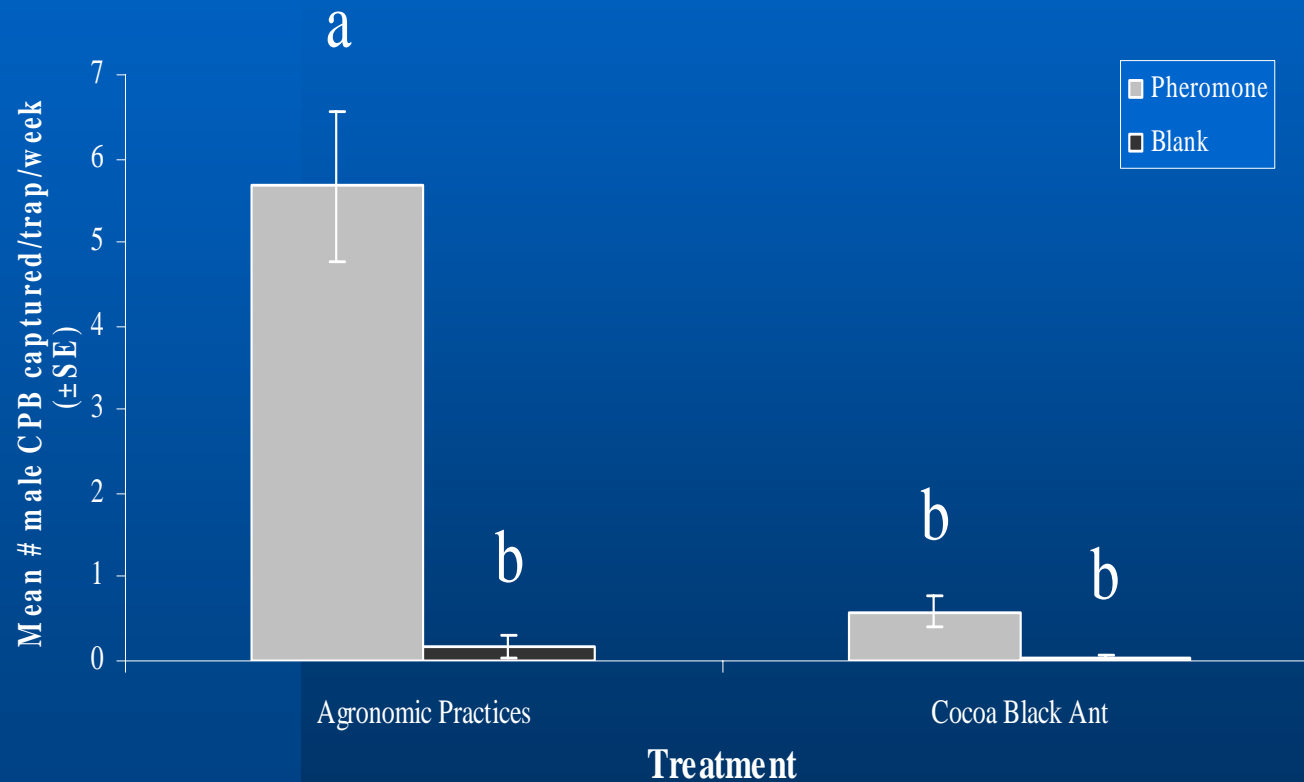
# Male CPB Population Monitoring in Peninsula Malaysia

## MCB, Peninsular Malaysia



# Male CPB Captured in Different Plots

MCB, Peninsular Malaysia



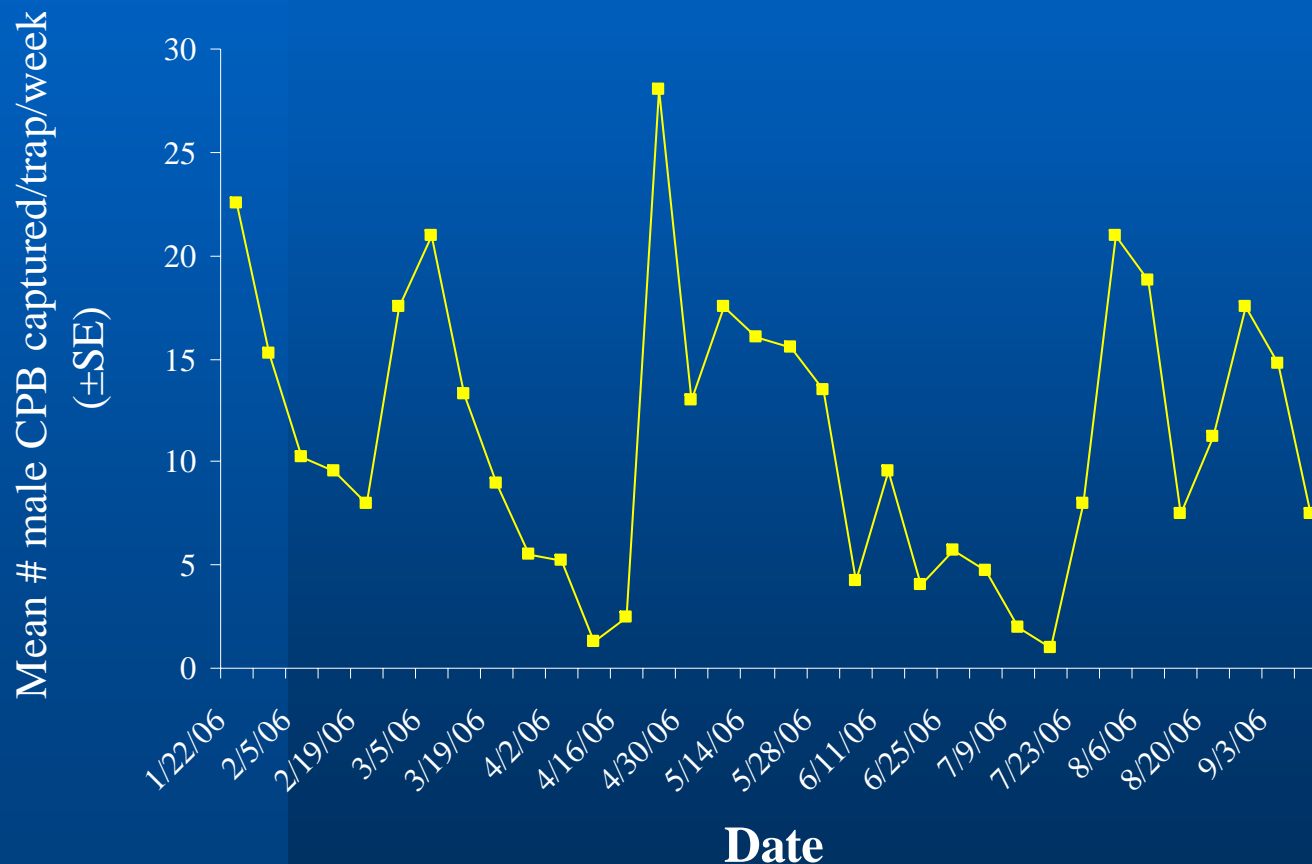
9/29/2005-12/25/2005  
(12 Weeks)  
# CPB captured = 249  
 $n = 36$ ,  $F(3,140) = 70.01$ ,  
 $P < 0.01$

# Male CPB Population Monitoring in Wonosary, Indonesia

Wonosary, Indonesia

1/16/2006-9/10/2006  
(34 Weeks)

Data were obtained  
from  
Hussin Purung  
Mars



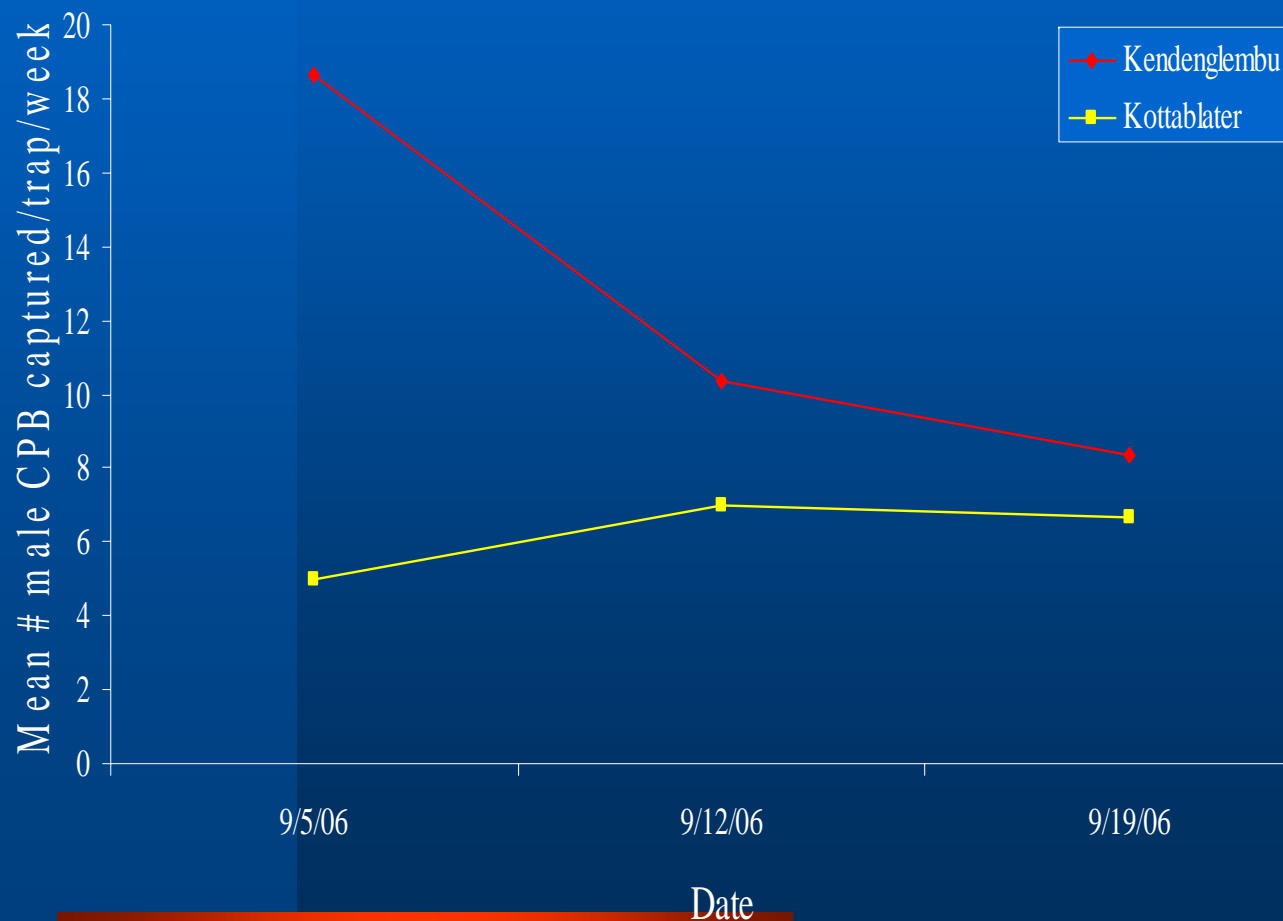


# Male CPB Population Monitoring in East Java, Indonesia

East Java, Indonesia

8/29/2006-9/10/2006  
(3 Weeks)

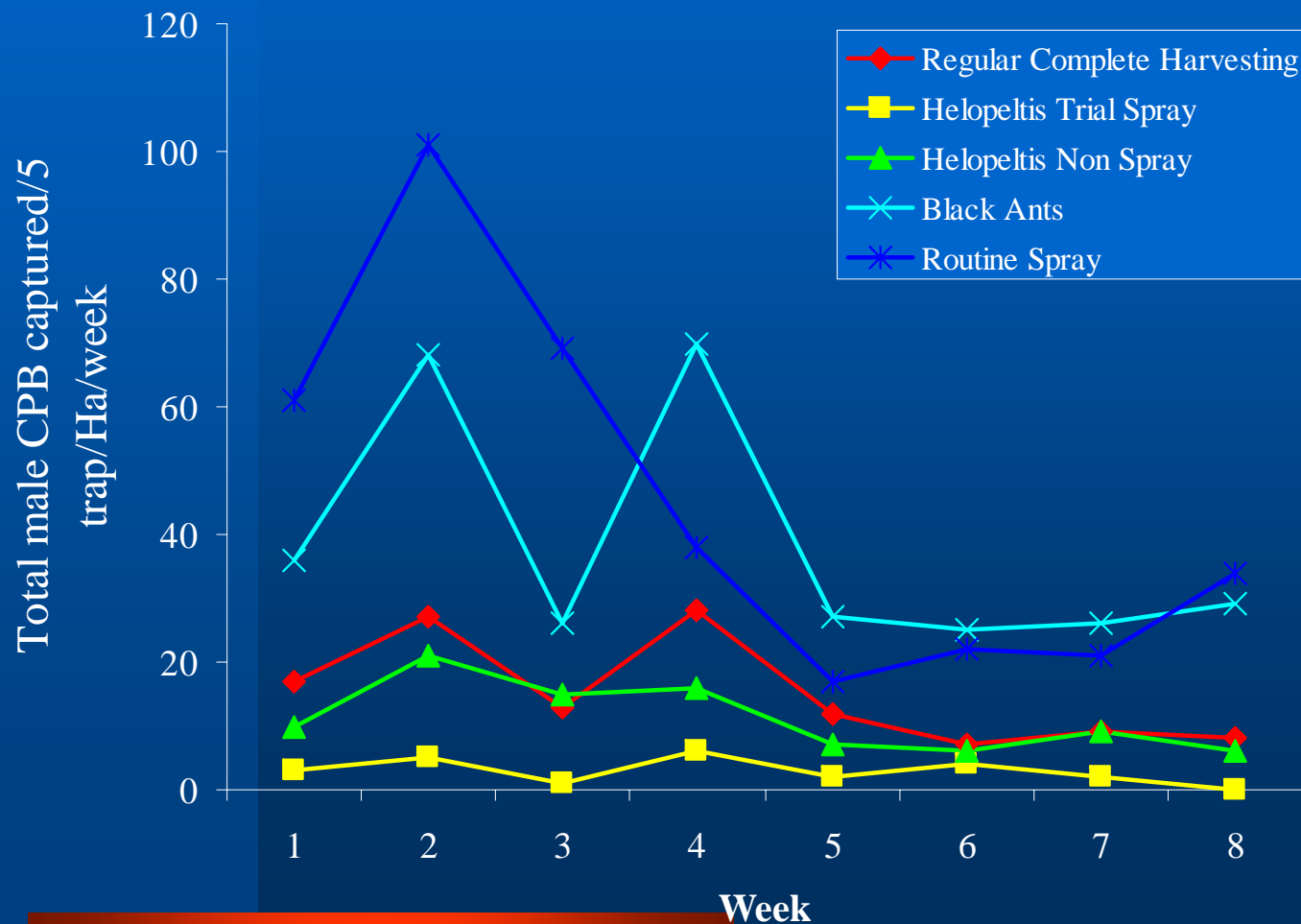
Data were obtained  
from  
Endang Sulistyowati  
ICCRI



# Male CPB Population Monitoring in Sumatra, Indonesia

Sumatra (Indonesia)

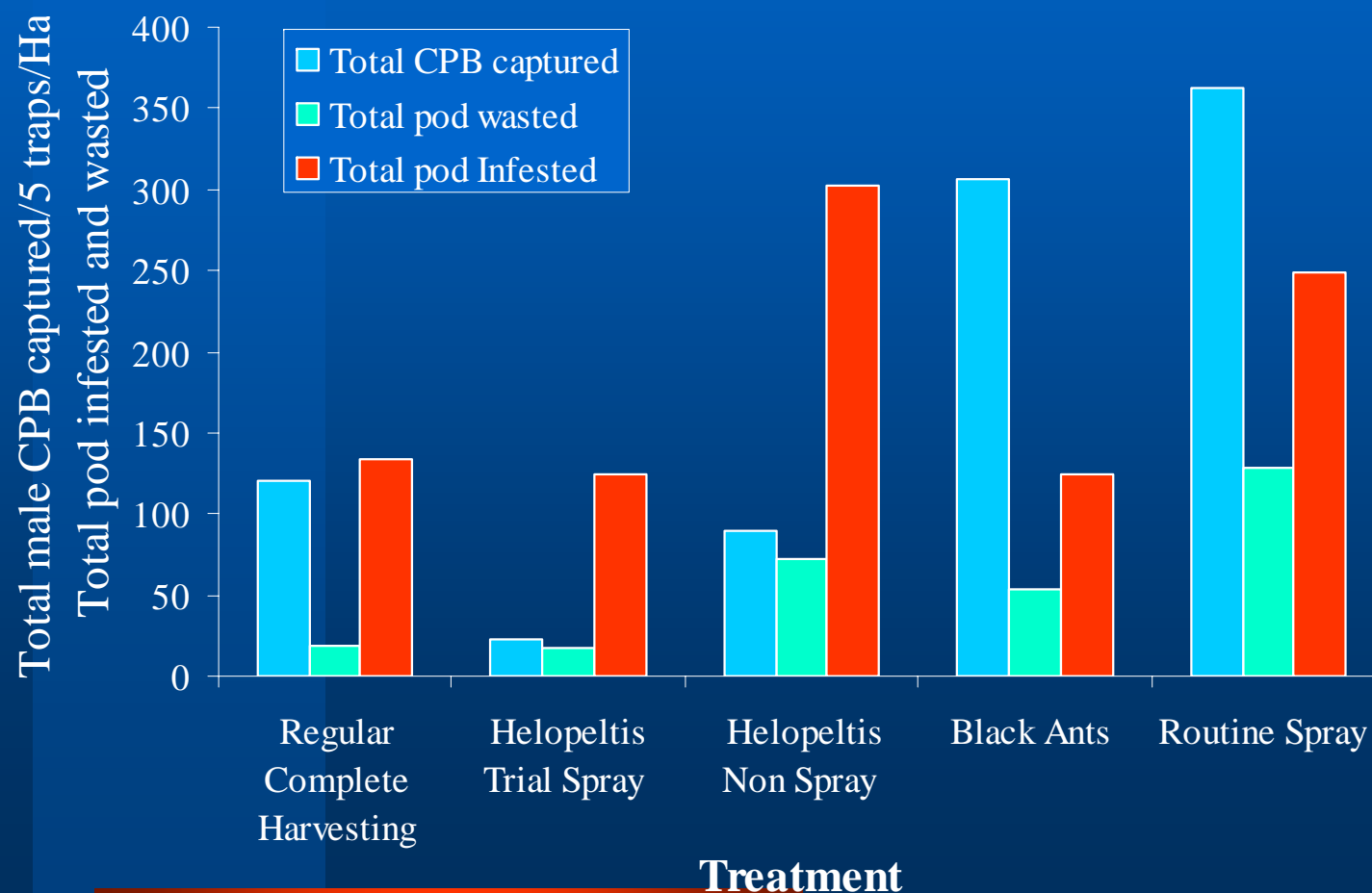
Data were obtained from  
**Ike Virdiana**  
**Lonsum Ltd.**  
**Sumatra**



# Correlation of Male CPB Population and Related Losses for 8 Weeks

Sumatra (Indonesia)

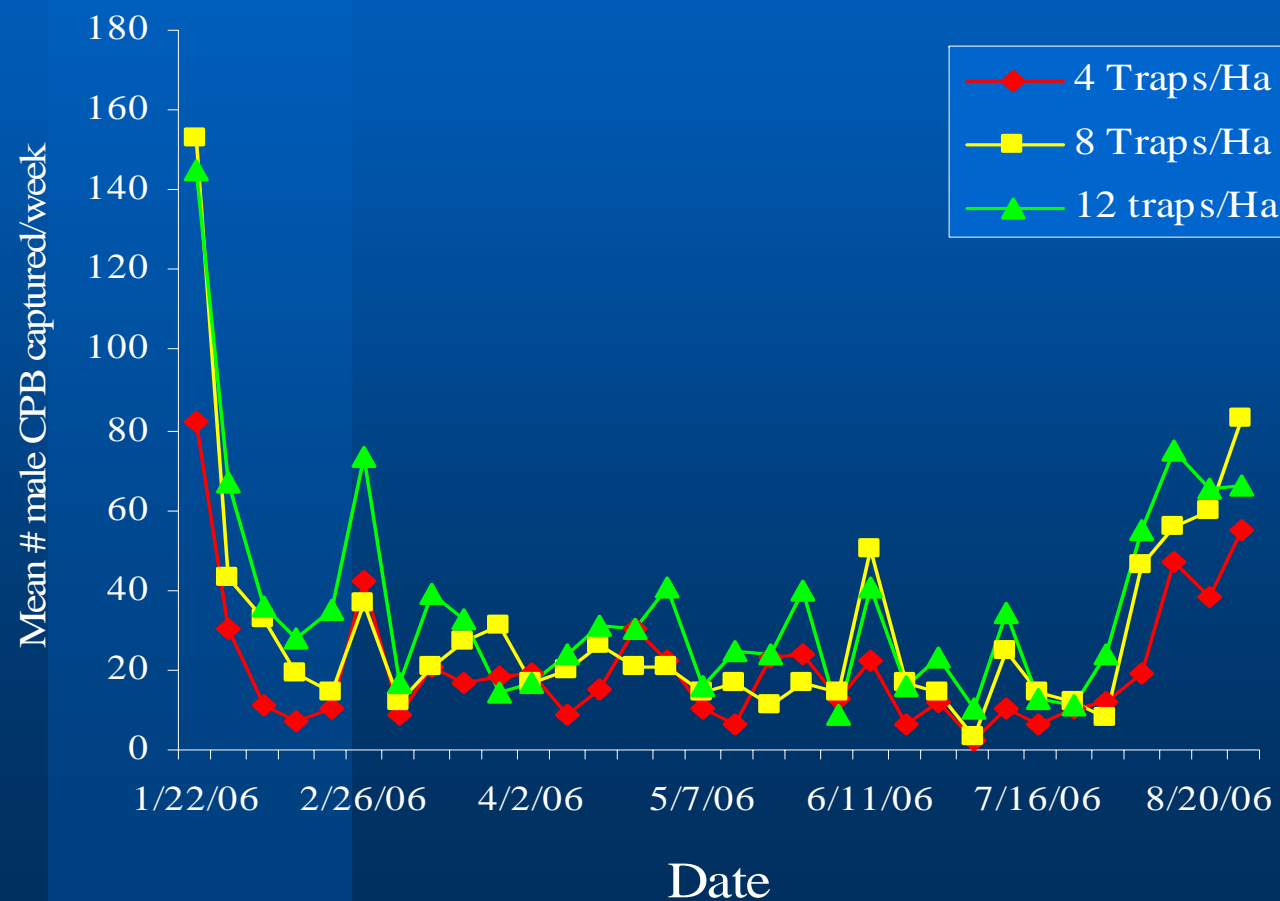
5 Traps/Ha



Data were obtained from  
Ike Virdiana  
Lonsum Ltd.  
Sumatra

# Mass Trapping Test in Sulawesi, Indonesia

Pinrang (Sulawesi), Indonesia



1/16/2006 – 8/26/2006  
(32 Weeks)\

Data were obtained  
From  
Hussin Purung  
Mars

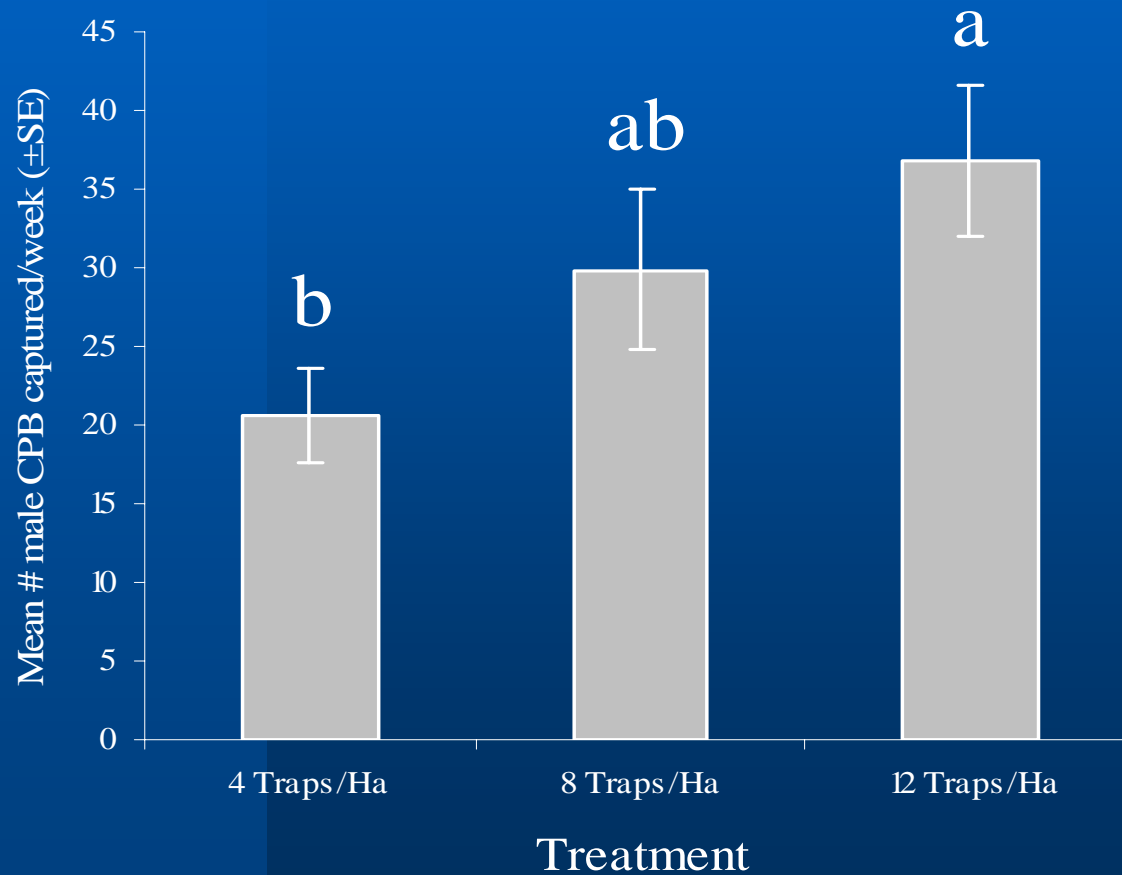


# Mass Trapping Test in Sulawesi

Pinrang (Sulawesi), Indonesia

1/16/2006-8/26/2006  
(32 Weeks)

# CPB captured = 2,790  
 $n = 32$ ,  $F(2,93) = 3.45$ ,  
 $P < 0.05$

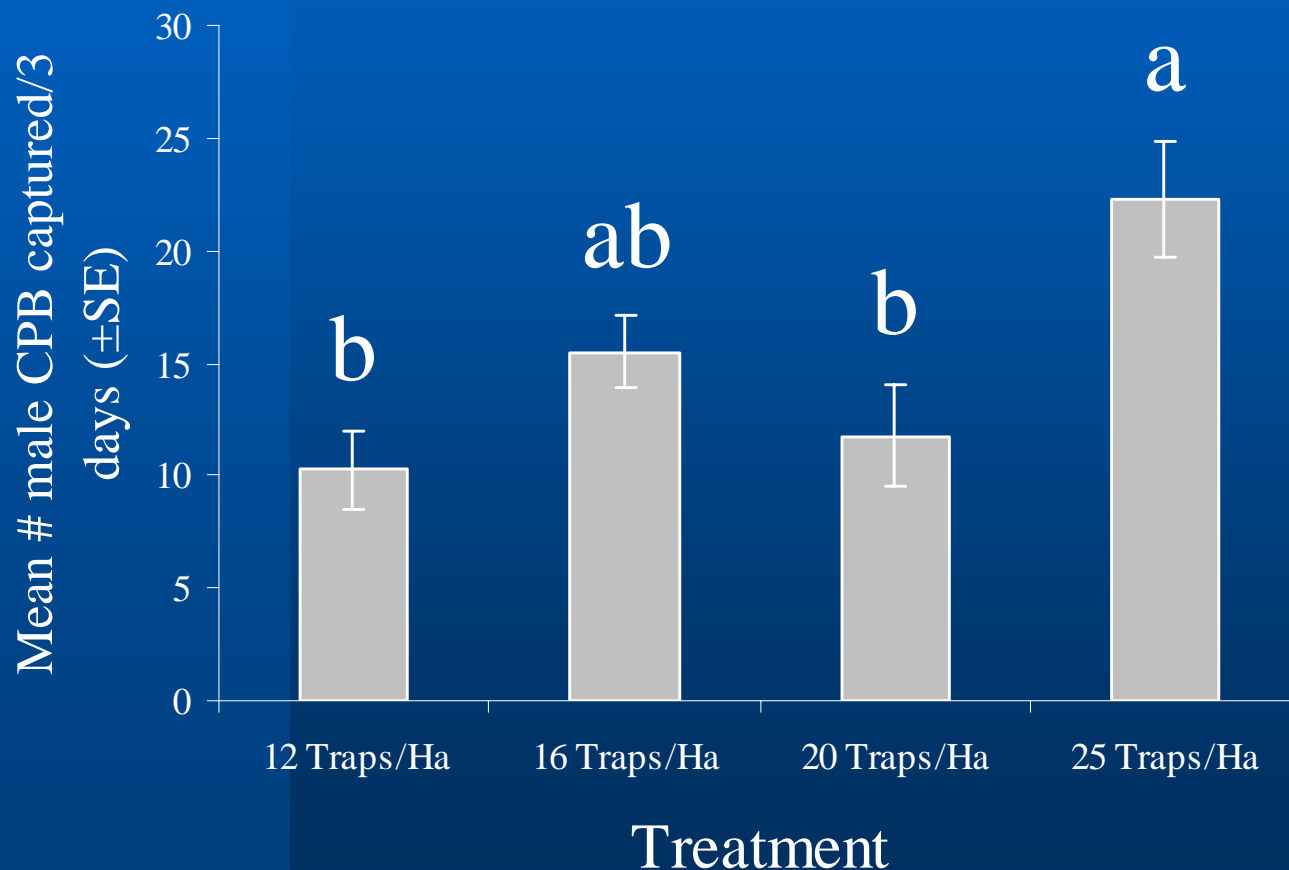


# Mass Trapping Test in Sulawesi Farm without Pesticide Spray

Pinrang (Sulawesi), Indonesia

9/20/2006-9/26/2006  
(6 Days)

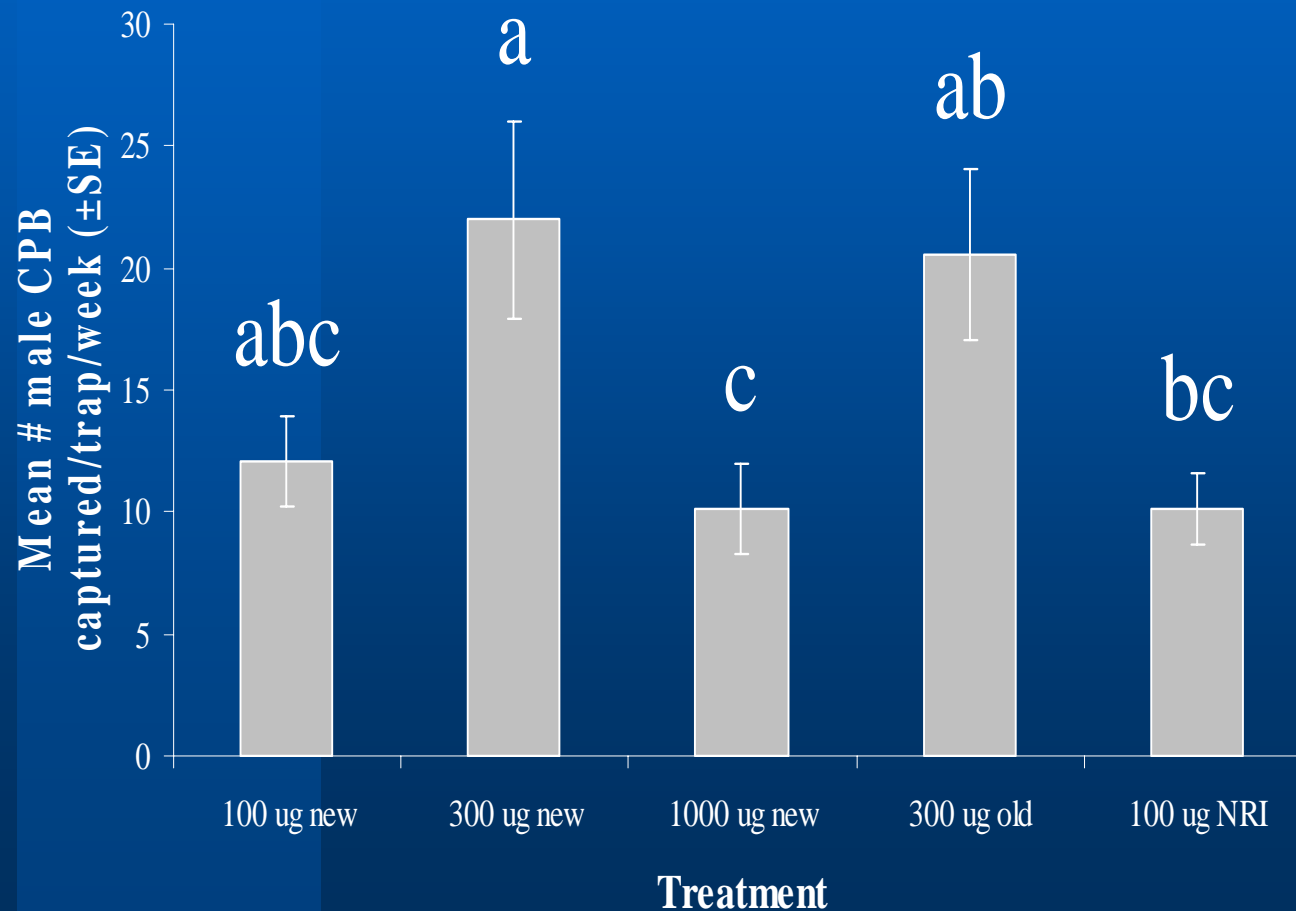
# CPB captured = 239  
 $n = 4$ ,  $F(3,12) = 6.51$ ,  
 $P < 0.01$



# Dose Response of Commercial Pheromone Produced by Pest Control India

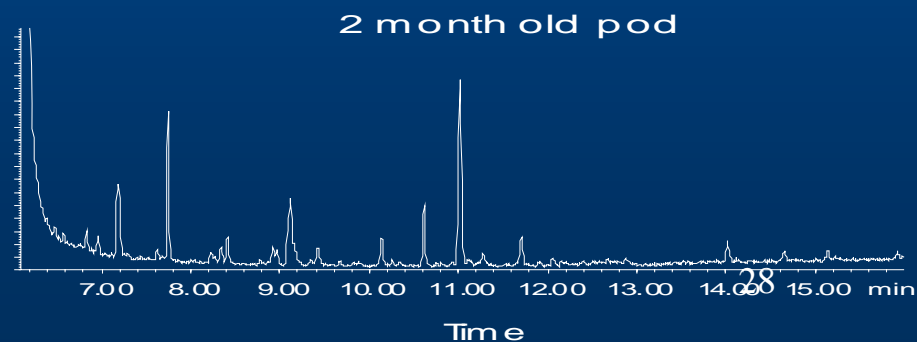
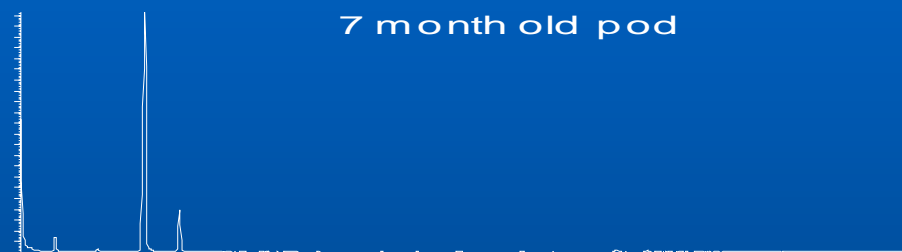
Yaminas (Sulawesi), Indonesia

Data were obtained  
from  
Hussin



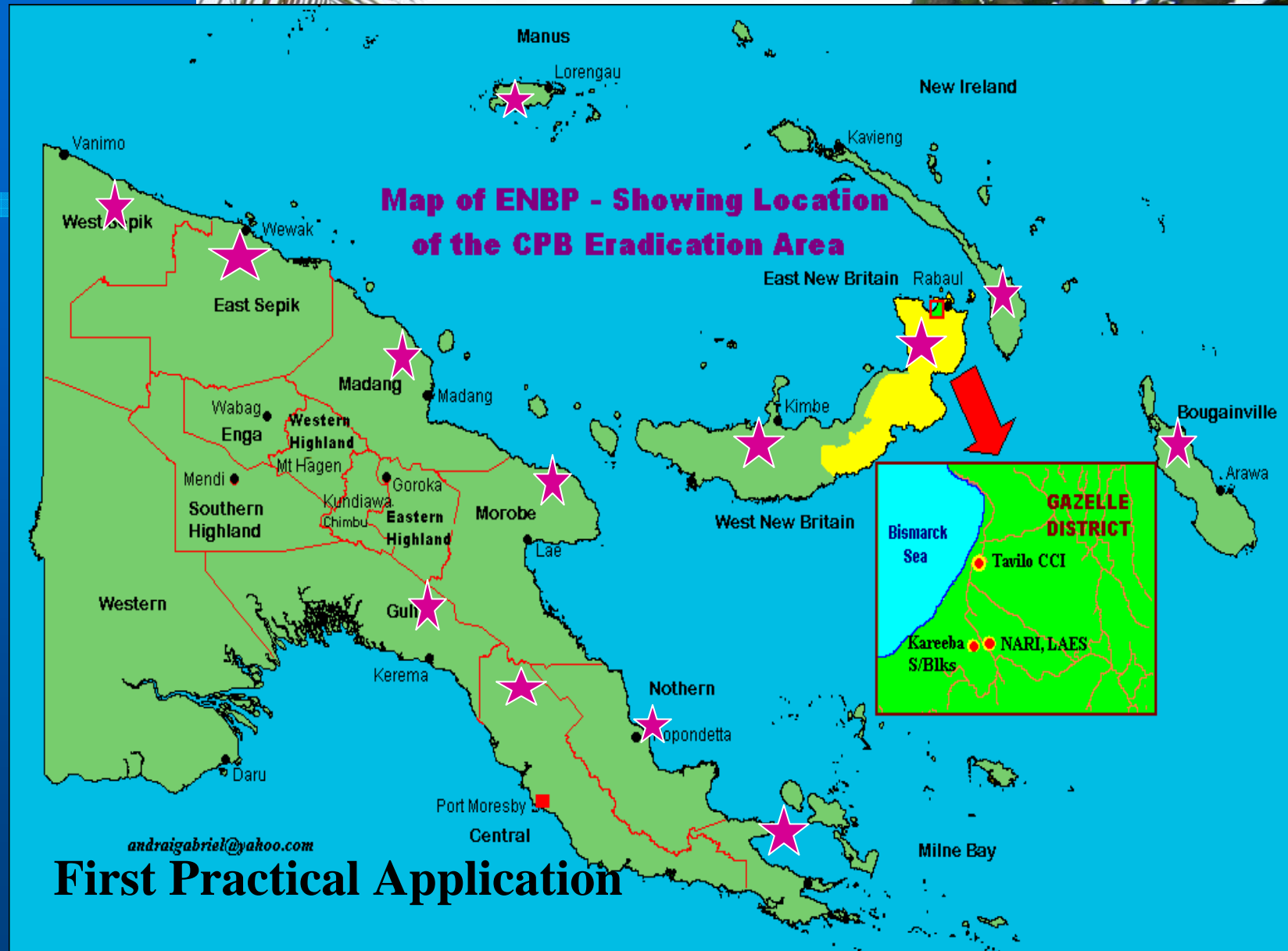
7/12/2006-9/12/2006  
(9 Weeks)  
# CPB captured = 844  
 $n = 4$ ,  $F(4,40) = 4.32$ ,  
 $P < 0.01$

# Volatiles Collection and GC Analyses from Cocoa Pods in Different Age





Cocoa is grown in 13 coastal provinces of Papua New Guinea.





# Cocoa Pod Borer Emergency Response Unit (CPB ERU)

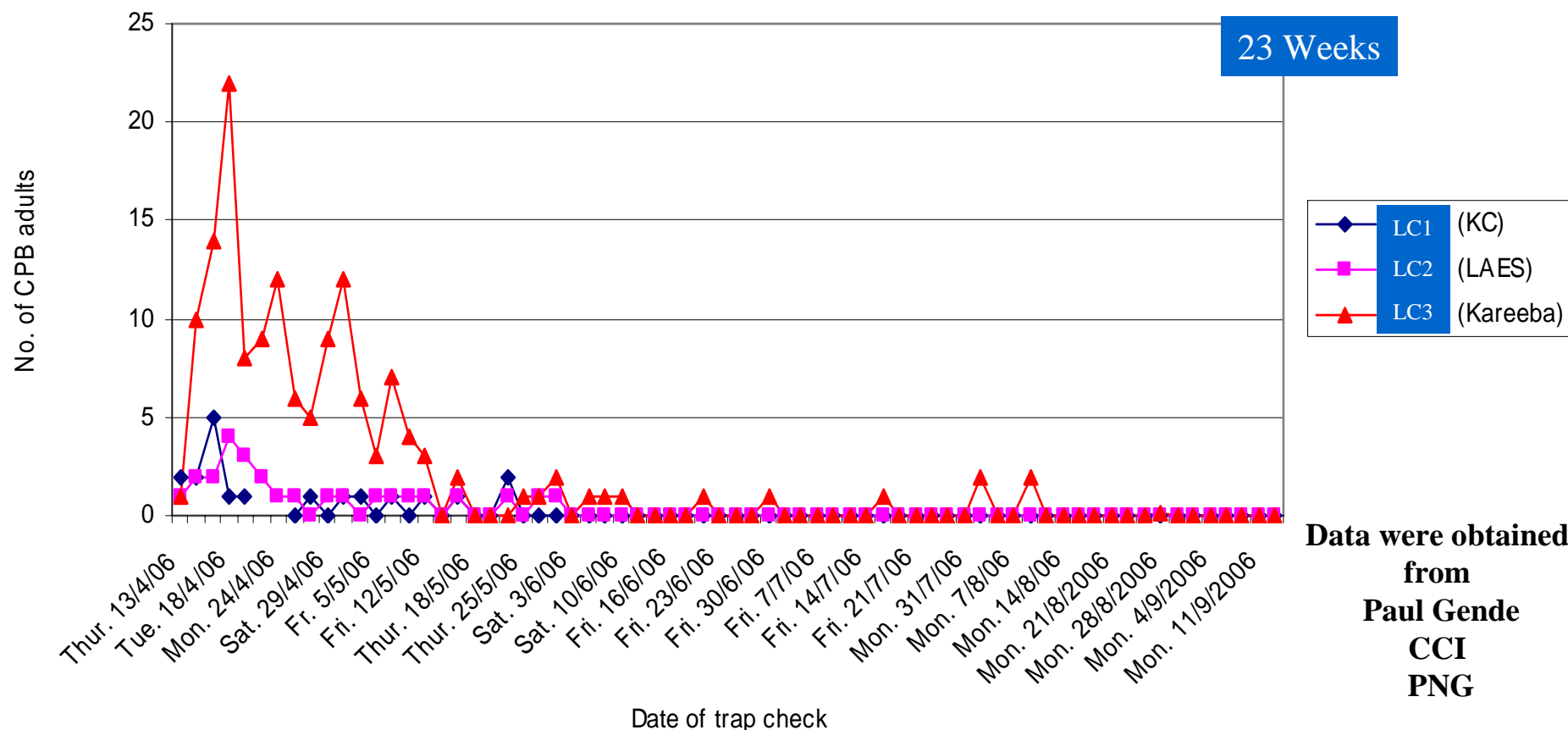




# Male CPB Population Monitoring in East New Britain, Papua New Guinea (Pruning and Spraying Continued)

CPB population monitoring in the hot spots within the Eradicartion Zone: Kavieng Compound (KC), LAES and Kareeba Plantation.

4/13/2006 to 9/11/2006



# Discovery of Conopomorpha Biotypes

T1A: Kerevat (EZ)



T1B: Sanbam Forest



T1C: Wild Dog Forest



T2B: Stokam Forest



T2A: Kerevat (EZ)



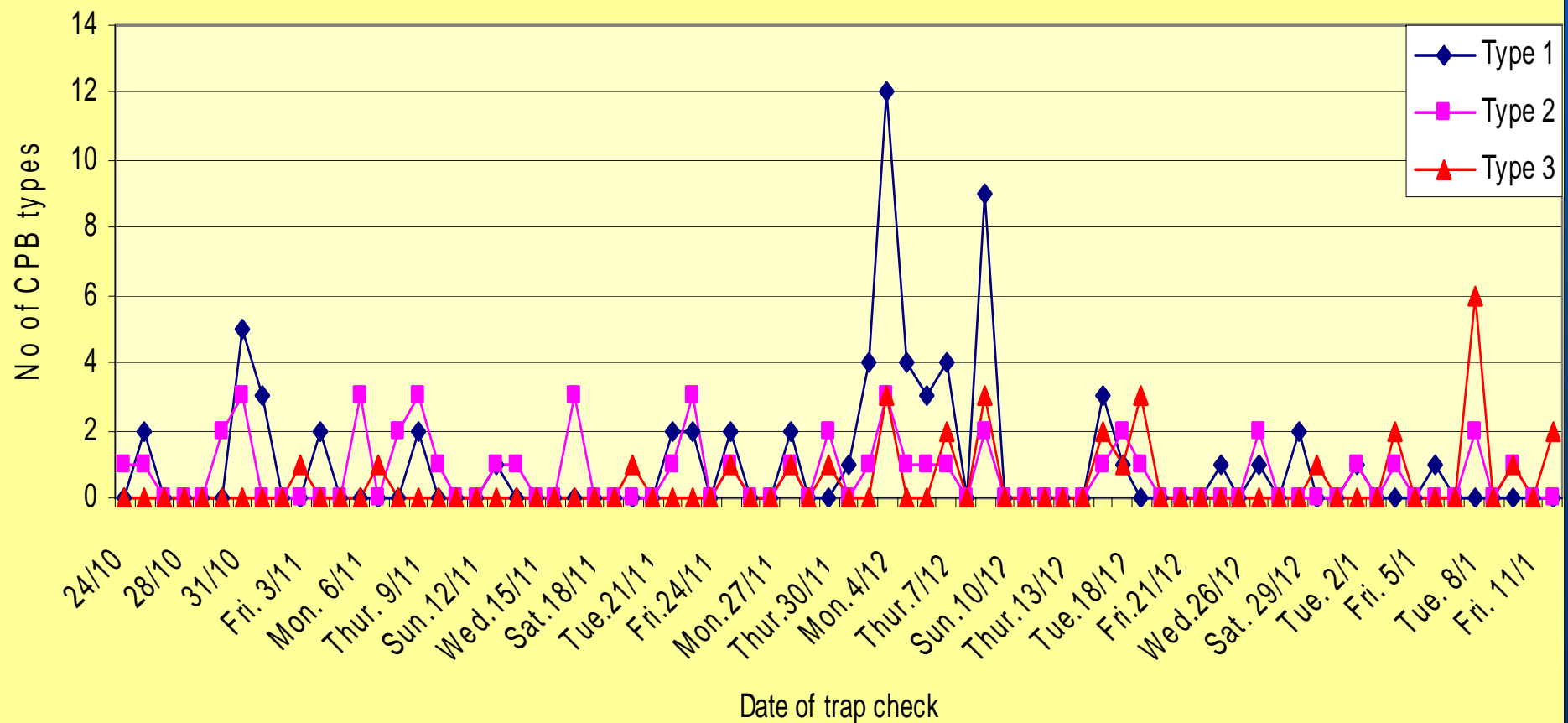
T2C: Wild Dog Forest





# Monitoring population of the types of CPB within the EZ, Kerevat.

Monitoring different types of CPB within EZ, Kerevat



# Conclusion

- The population monitoring results using sex pheromone indicated that the same pheromone strain of CPB,
- The available evidence also suggested that pesticides might be reducing natural enemies and other beneficial insect'?????
- Scaling up production at PICL has been successful
- development of mass trapping (and mating disruption) for small farms and for large plantations for CPB control
- Monitoring in PNG

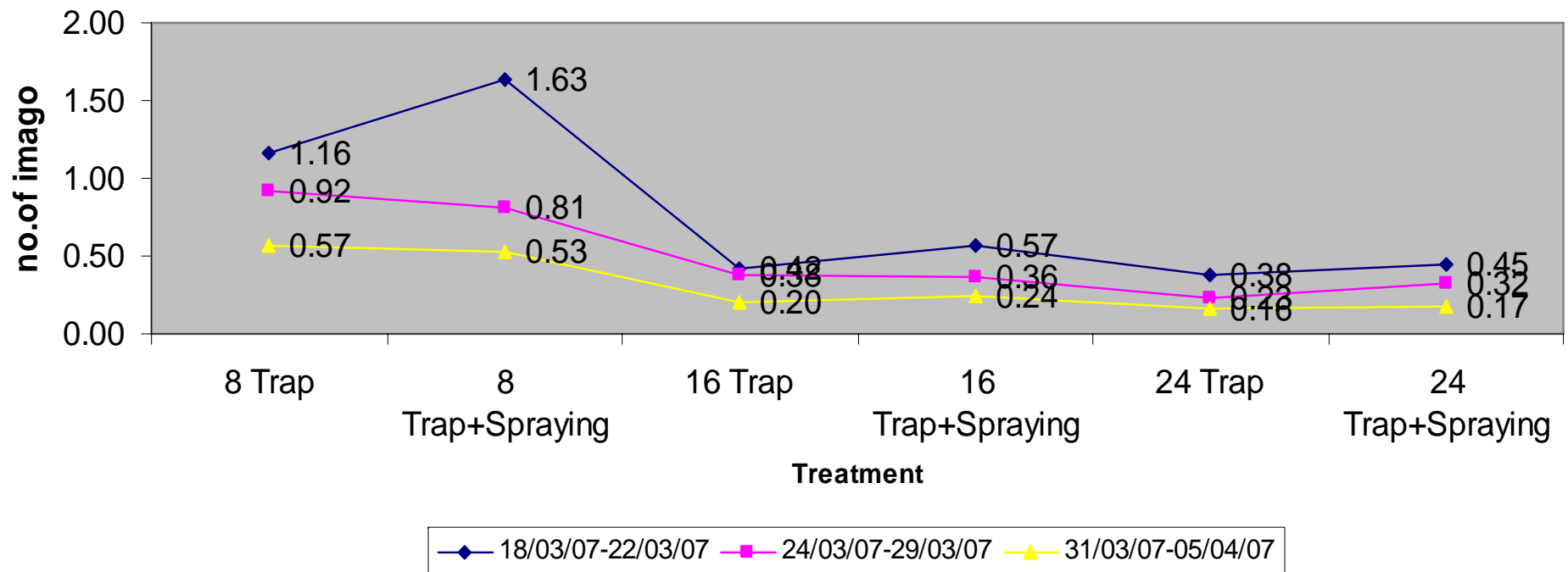
# Next Steps

- **Joint GTZ-Mars-LONSUM-ICCRI-PCIL-Bio Letsari mass trapping trials (Martin and Roy)**
- **Field Trials**
  - Small-holder farms in Sulawesi (Mars)
  - LONSUM estate in Treblasala and
  - Registration trials at ICCRI



# Field Trial Sulawesi

Daily Caught in Average in tree weeks from 18.3.2007-05.4.2007 at Trial 1(8,16,24 + 4 spraying/Control)-spraying commence on 01 & 02.04.2007





Thank You

