Has synthetic CPB pheromone any future?

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- Cocoa Pod Borer moth, *Conopomorpha cramerella* (CPB), is the most destructive cocoa pest in South East Asia (Zhang *et al*., 2006).
- CPB larvae tunnel into the pod to feed on the pulp disrupting bean development and, in heavy infestations, making them unextractable.

Southeast Asia Regional IPM Network

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- The female sex pheromone was identified and synthesised at Natural Resources Institute in 1984 (Beevor *et al*., 1986).
- The pheromone has 7 components, 4 of which were found essential in field tests.
- The pheromone was ineffective against CPB when it first spread to West Malaysia in 1986 prompting fears that a 2nd pherotype had emerged.
- Shapiro *et al*., (2008) and Zhang *et al*., (2008) quashed the 2nd pherotype hypothesis which had stifled research on exploitation of the sex pheromone for 20 years

CPB pheromone usage

- **Population monitoring.**
  - **Combined with insecticide sprays or release of an egg parasitoid.** Data : Mumford & Beevor (1987).

Treatment	Control efficiency (%)
4 traps/ha + pyrethroid sprays	65
4 traps /ha + parasitoids	55
Pyrethroid sprays only	50
4 traps/ha only	35
Untreated	0

A similar experiment combining traps with spraying was conducted in Sulawesi between March 2007-April 2008 (Hebbar, 2008).

  - **Quarantine surveillance**. CPB was first found in Papua New Guinea in Mar 2006. The outbreak was declared eradicated in Feb 2007 based on the absence of CPB males in pheromone traps. (seasia.ipmnetwork.net/review/index.html)

CPB pheromone usage

- **Mating disruption.**
  - Anon ., (1990,1991). Unreplicated , 22 ha treated. Two separate experiments in two years. Three rates were compared with spot-spraying .

Treatment	% pods unextractable	
330 lures/ha	18.7	10.1
500 lures/h	16.8	14.5
1000 lures/ha	6.8	3.7
Spot-spraying	1.3	2.0
5% Least Sig. Diff.†	3.93	2.75

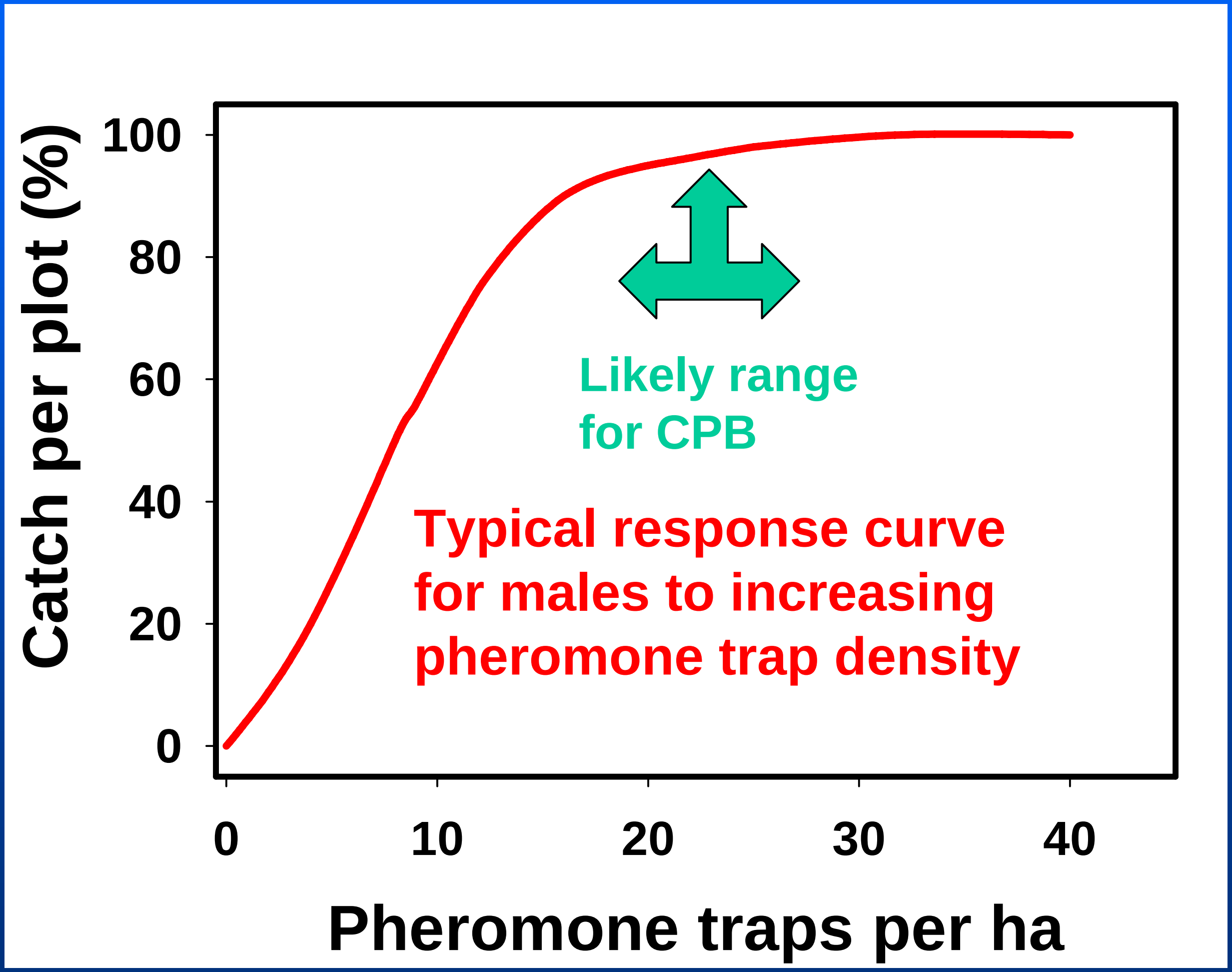
† Caution! The trial was unreplicated so the ANOVA compares plot – plot variation , not necessarily treatment effects.

CPB pheromone usage

- **Mating disruption (continued).**
  - Awang et al., 1995. Unreplicated 1.7 ha treated and untreated plots. 1 lure/tree ca 1100/ha. Mating was disrupted with a complete shut-down of monitoring traps for 1 month, but insufficient control was achieved.

- **'Mass trapping'.**
  - Sabah. Results from October 1984- February 1988 were summarised by Beevor et al., (1993), but the experiment continued until September 1989 (Anon., 1990, 1991).
  - Java. Ongoing experiment started in January 2008 (Virdiana, 2009, pers. comm.). 25 ha plots, 3 replicates of 4 treatments.
  - Sulawesi. An unpublished experiment from September-November 2006 (Lambert, 2009, pers. comm.). 4 trap densities.

Optimal trap density for mass-trapping



BAL, Sabah 'mass-trapping' trial (Beevor *et al*., 1993)

- **Unreplicated, 200 ha treated, 74 + 31 ha untreated plots**
- **Oct 84-Feb 1986, 4 traps/ha**
- **Feb-Jul 1986, increased to 8 traps/ha "...results ...showed a significantly higher catch in 8/ha compared to 4 traps" (Anon., 1986)**
- **Jul 1986-Feb 1988, 8 traps/ha on 160 ha and 16 traps/ha on 40 ha "With 16 traps/ha ... moth counts ... consistently twice those at 8 traps/ha" (Anon., 1987).**

Results for period Sep 1986-Feb 1988 (Anon., 1987, 1988)†

Treatment	Mean % pods unextractable‡
Pheromone traps 8-16/ha	15.0
Untreated plot A	11.7
Untreated plot B	4.9
5% Least Significant Difference	1.85

† Caution! As the trial was unreplicated the ANOVA compares plot-plot variation, not necessarily treatment effects

‡ Weighted for seasonal cropping cycle

BAL, Sabah 'mass-trapping' trial (Anon, 1988, 1990)

- Unreplicated, 200 ha treated, 74 + 31 ha untreated plots
- 8 traps/ha on 160 ha and 16 traps/ha on 40 ha.
- The experiment was halted in September 1989 because the level of CPB pod damage was unacceptable.

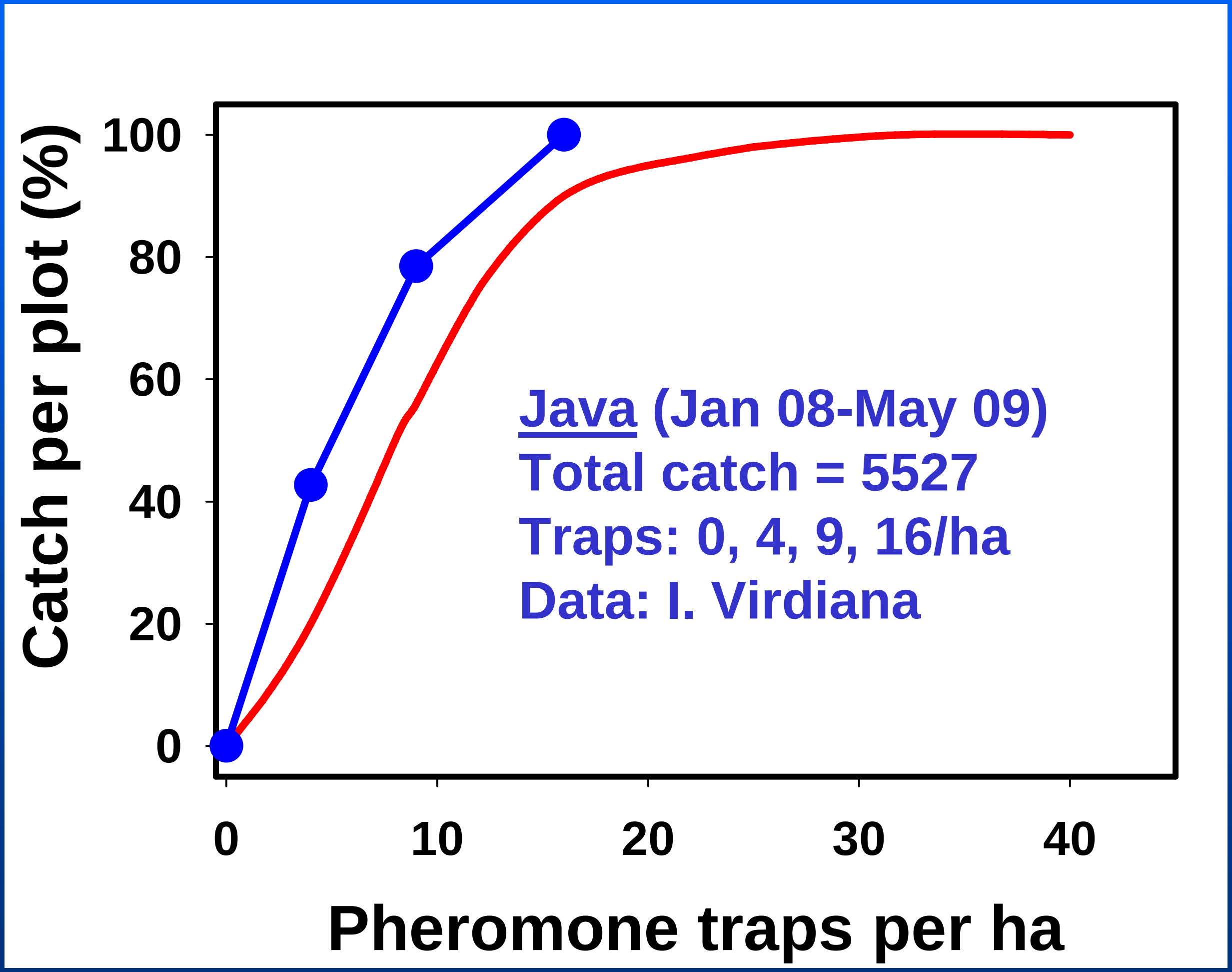
Results for period Feb 1988-Sep 1989†

Treatment	Mean % pods unextractable‡
Pheromone traps 8-16/ha	29.8
Untreated plot A	28.9
Untreated plot B	21.2
5% Least Significant Difference	3.35

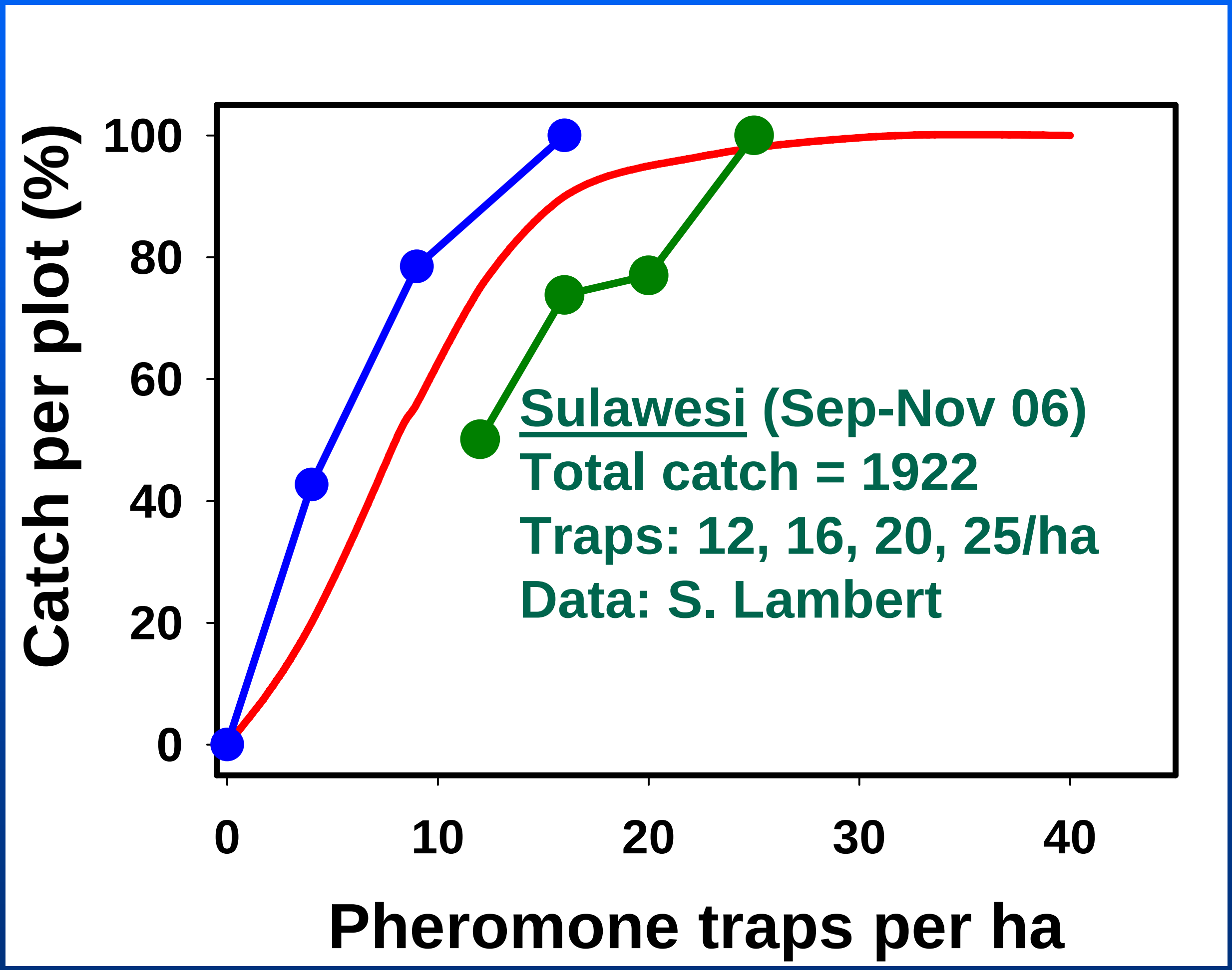
† Caution! As the trial was unreplicated the ANOVA compares plot-plot variation, not necessarily treatment effects

‡ Weighted for seasonal cropping cycle

Optimal trap density for mass-trapping



Optimal trap density for mass-trapping



Java ‘mass-trapping’ trial (Virdiana, 2009, pers comm.)

- Randomised Block Design replicated 3-fold, 25 ha/plot
- Treatments: 0, 4, 9 and 25 traps/ha

Results for period Jan 2008-May 2009 show:

- The % of unextractable pods was 4.4x greater with 9 traps/ha , and 2.5x greater at 16 traps/ha ,than in the untreated (both P<0.05).

- Damage with 4 traps/ha was not significantly different from the untreated.

- Counts of larval entry and exit holes suggest a possible explanation. Larvae may be fitter in the 9 traps/ha plots than the untreated, possibly because females mated at a younger age.

Conclusions:

Population monitoring .

1. Pressure to reduce pesticide usage presents an opening to exploit the pheromone combined with pesticide spraying, but timing sprays to break CPB's lifecycle in the low crop season does not depend on trap data and 1-4 traps/ha has little direct impact on population size.
2. Calibration of pheromone trap catches with crop damage would benefit the exploitation of egg parasitoids for biological control, but high costs of rearing beneficials may hamper development.
3. Quarantine surveillance. The ability of pheromone traps to detect low-level infestations is unrivalled, but the market is small!

Mating disruption.

1. Results of 1980's trials show 'proof of concept', but robust data are needed from replicated experiment s for progress .

Mass-trapping.

1. The optimal trap density to trap-out male CPB is unknown. Once established, mass-trapping may become a usable control option.

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