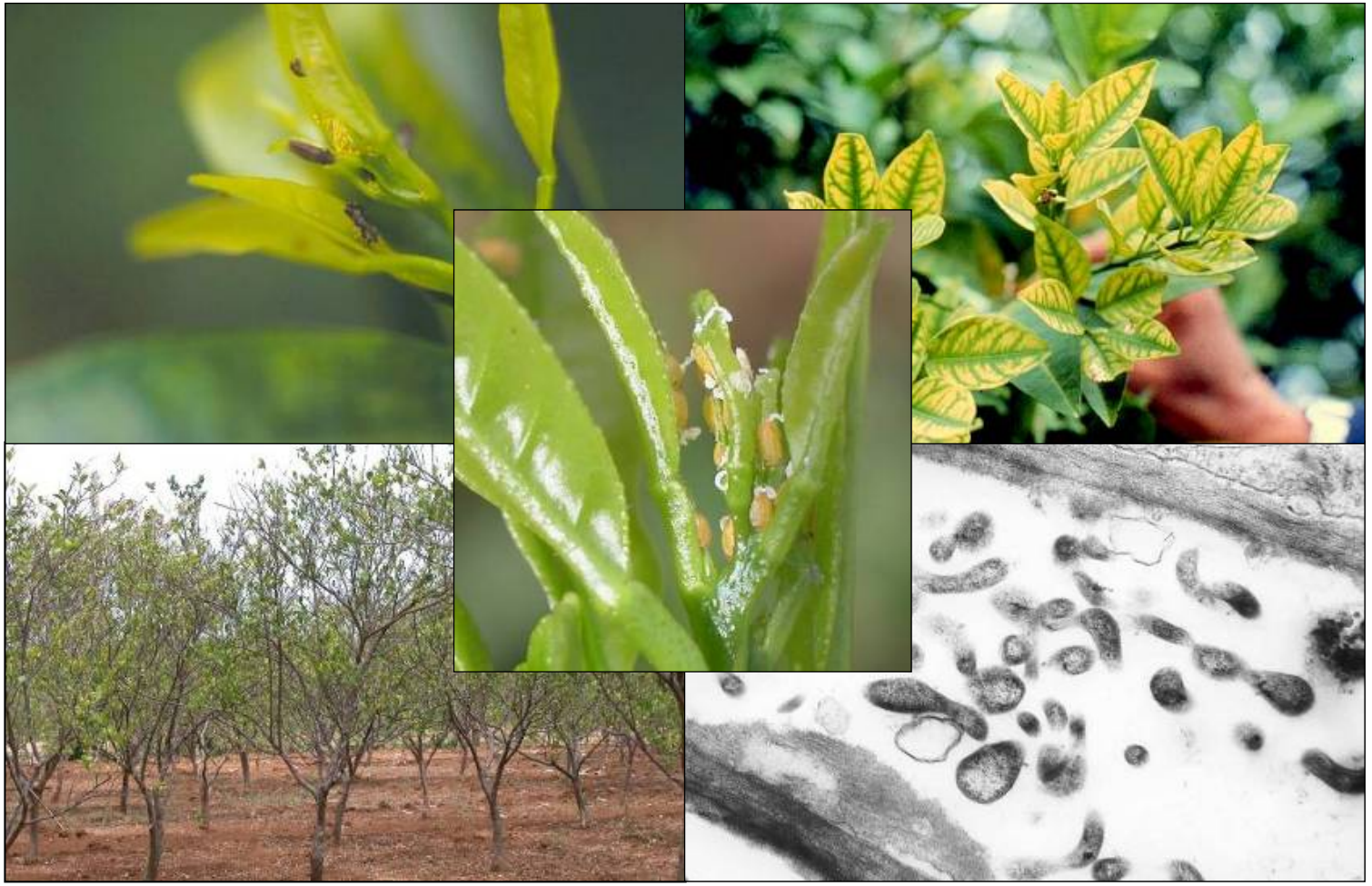
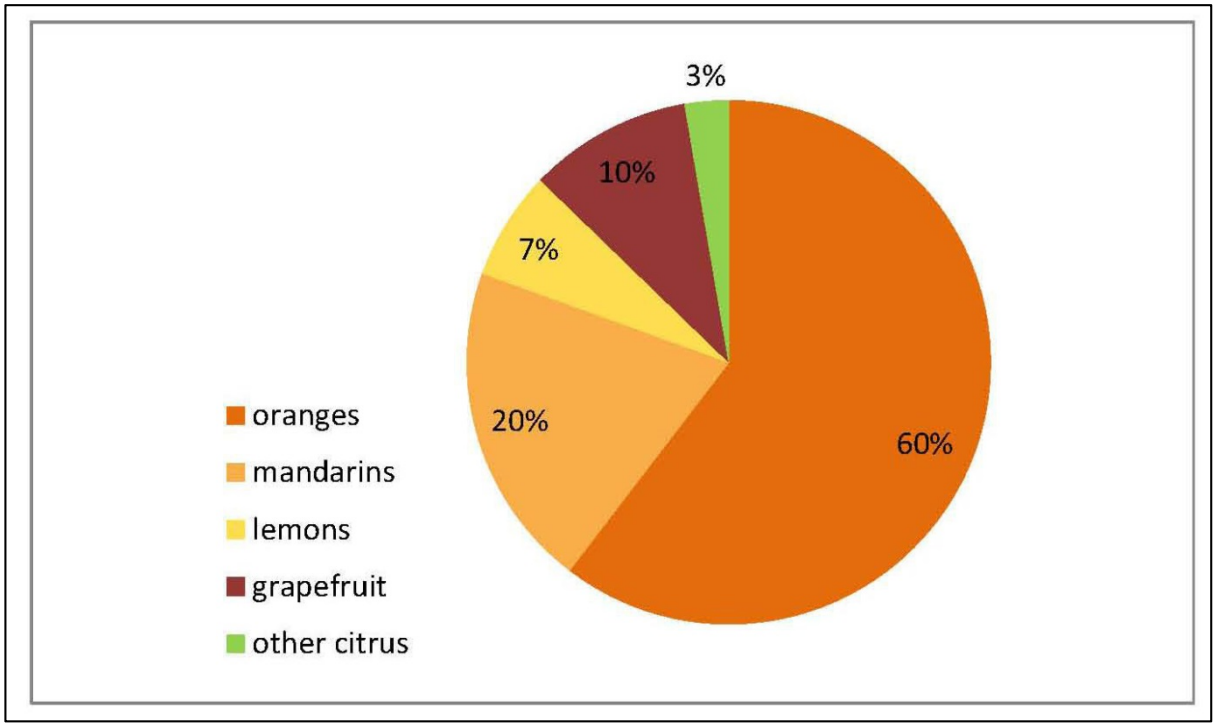


黄龙病

Citrus production in Australia

280,000,000 m^2

Brazil: > 600,000 ha

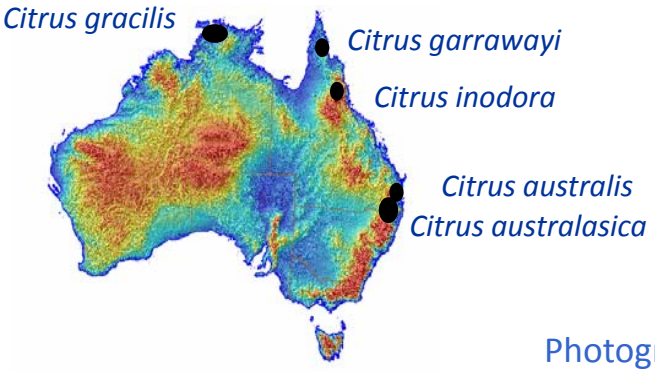


Orchards relatively small — but otherwise similar to orchards in Brazil

Area	2003	2008	2011
< 10 ha	1,560	1,294	1,198
10-20 ha	358	333	338
20-40 ha	217	187	190
> 40 ha	141	149	141
Total	2,259	1,957	1,867
Av. area	13.1 ha	14.2 ha	15.1 ha

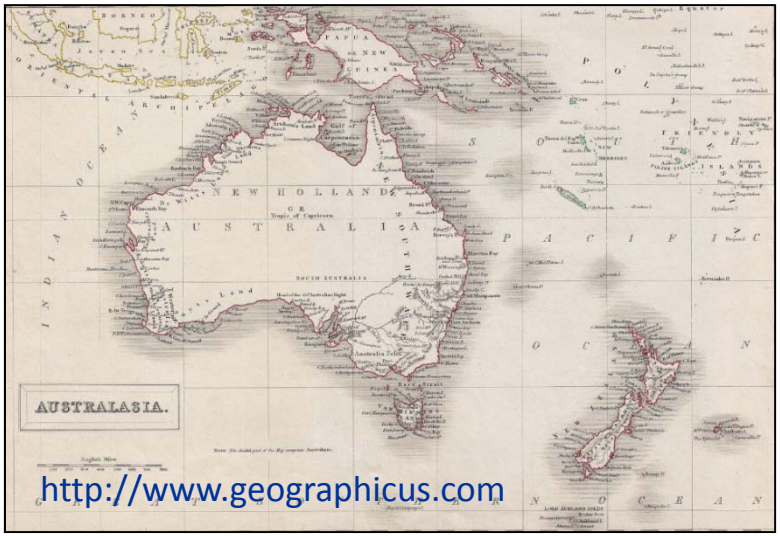
Diaphorina citri was recorded in Australia in 1915 in the Northern Territory.

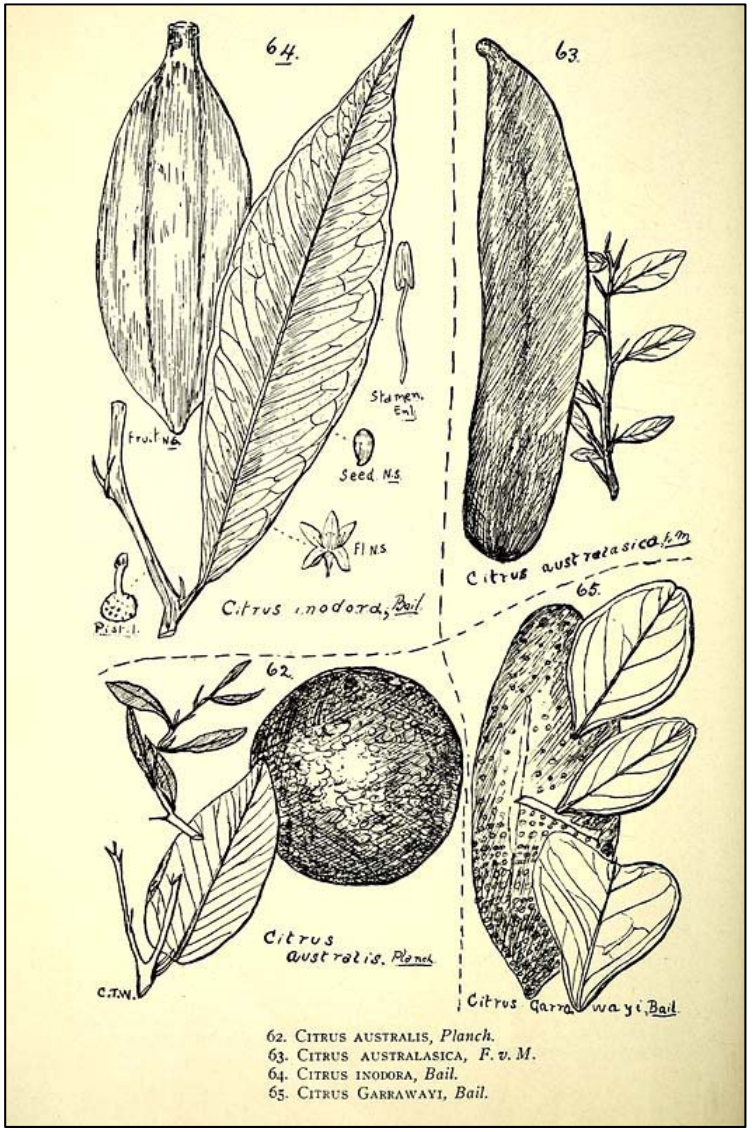
- It was probably introduced to Australia on plants imported by the Darwin botanic gardens
- It was eradicated when commercial species and varieties of *Citrus* north of 19°S were destroyed during a successful campaign from 1912 to 1922 to eradicate citrus canker (*Xanthomonas citri* subsp. *citri*)
- No other psyllid species have been recorded on native or introduced *Citrus* and other Aurantioideae in Australia



Photographs: Glenn Bellis

About 60% of true species of citrus species are Australasian





Examples of orchards in Asia

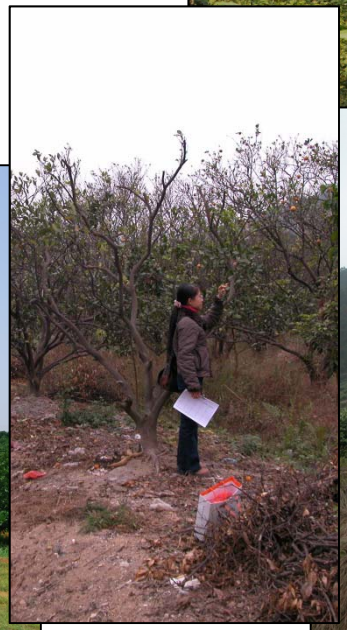
- Generally small, average size probably less than 1 ha
- Limited or no regional collaboration in pest and disease management
- Terrains often limit effective management
- Many nurseries not protected
- Production of pathogen free trees negated by ineffective management of pests and diseases in orchards
- Initially pathogen-free trees may not bear fruit before death

Bhutan

- Important export income
- Virtually no irrigation
- Mostly tall seeding mandarins
- Effective spray application difficult
- HLB has devastated production below 1200 m ASL

China

- Orchard sizes relatively larger than elsewhere regionally
- HLB and ACP largely limited geographically to coastal provinces
- Management variable, from poor to good
- Some terrains steep



Guava interplanting—Mekong Delta

- King orange (*C.* × *aurantium*) orchard
- Trees planted in October 2003 on '3 m × 3 m' grid between existing guava trees
- 6 treatments — 2 mineral oil (**OT**), 1 farmer practice (**FPT**), 1 imidacloprid (**IT)** and 2 controls (**CT**): 5 treatments planted with '*C*Las'-free trees, 1 CT with trees from 'local' nursery. Trees grew rapidly.

2004

- 5–3 mL Confidor 100 SL 3–5× to **all trees** May to December in the IT
- Alternating fortnightly applications of 0.19% fenobucarb and 0.00625% lambda cyhalothrin sprays in the FPT from October to December
- Oils 6× in the OTs from October to December
- No synthetic pesticides in CTs

2005

- Confidor 100 SL 12× at 2 mL/tree trunk in the IT
- Fenobucarb and lambda cyhalothrin, both 12× in FPT;
- Oils 15× in both OTs;
- No synthetic pesticides in CTs

2006

- Confidor 100 SL 3–4× to late March in the IT, **not** thereafter
- Alternating fenobucarb and lambda cyhalothrin fortnightly to late March in the FPT, **not thereafter**
- Oils 15× to entire orchard from April
- Guava trees pruned in late 2006

April 2006 to June 2009

- Oils 9–12× annually to entire orchard

- **No oil phytotoxicity**
- 2 adult **ACP** observed in June 2004, none thereafter—counts suspended in January 2006 due to tree height
- **No differences among treatments for ACP populations and HLB over 5+ years**
- **26% of trees dead in early 2009**—most killed by phytophthora, gummosis and pink disease
- **28.6% of live trees PCR+ve for '*C*las' in early 2009**

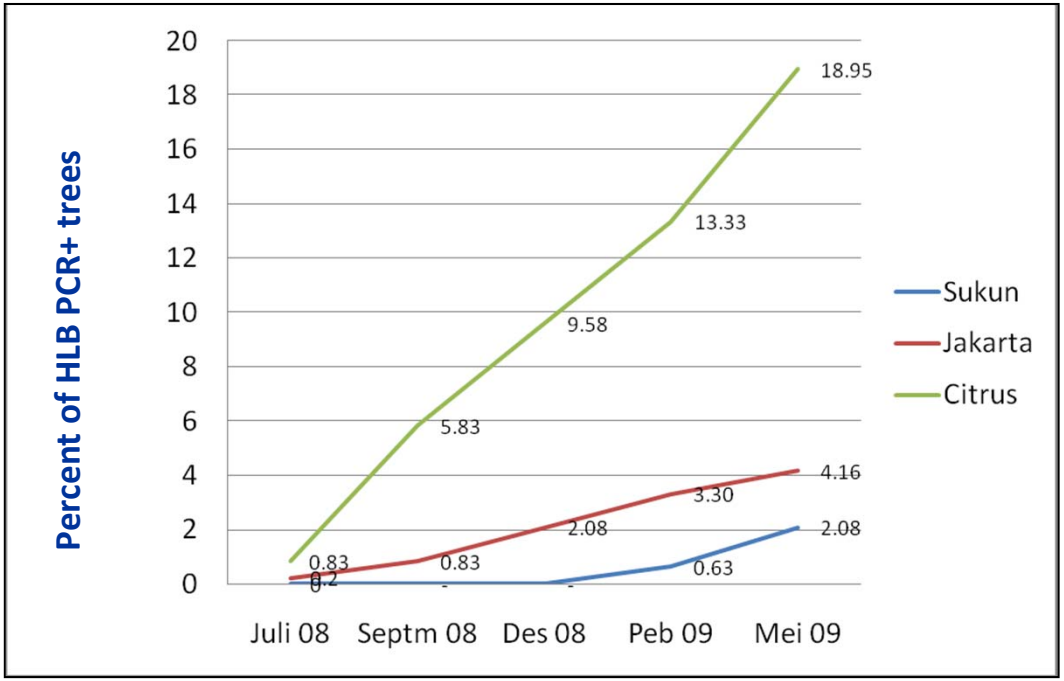
In contrast

- An orchard (right) planted in March 2004 without guava was abandoned after 2 years due to **HLB**
- Gatineau et al. (2010) recorded outcomes below after treatments were applied to 2 year-old King orange trees in 0.5 ha plots over 2 years from planting
- Ichinose et al. (2012) considered impacts of guava to be limited to 1–2 years

Treatment	**% trees with HLB at 24 months**	**Incidence of 5th instar *D. citri* nymphs**
untreated	**94**	**abundant**
250 g ai/ha **fenobucarb** as fortnightly sprays	**74**	**some**
0.15 g ai/tree **imidacloprid** monthly to trunks	**24**	**none**

Guava interplanting—Central Java

- Interplanting with guava in Indonesia also slowed ingress of **HLB** into Siem mandarin plantings
- A seedless white-fleshed guava variety (Sukun) appeared have greater impacts on **ACB** and **HLB** than a seeded red-fleshed variety (Jakarta)

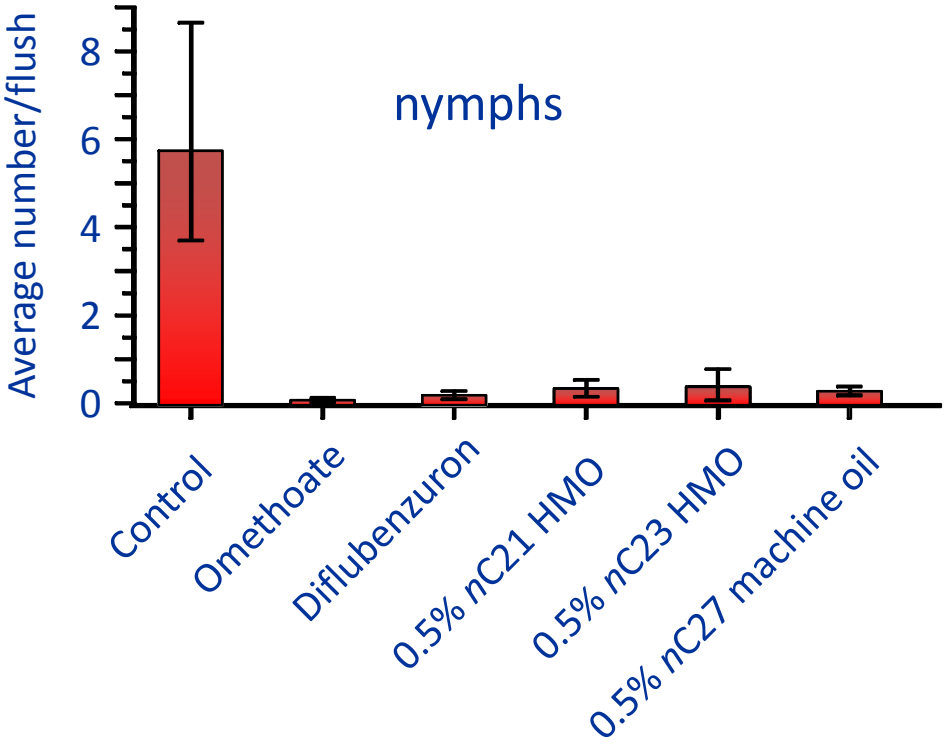


Development of HLB in Siem mandarin trees over 25 months from planting

Impacts of mineral oils

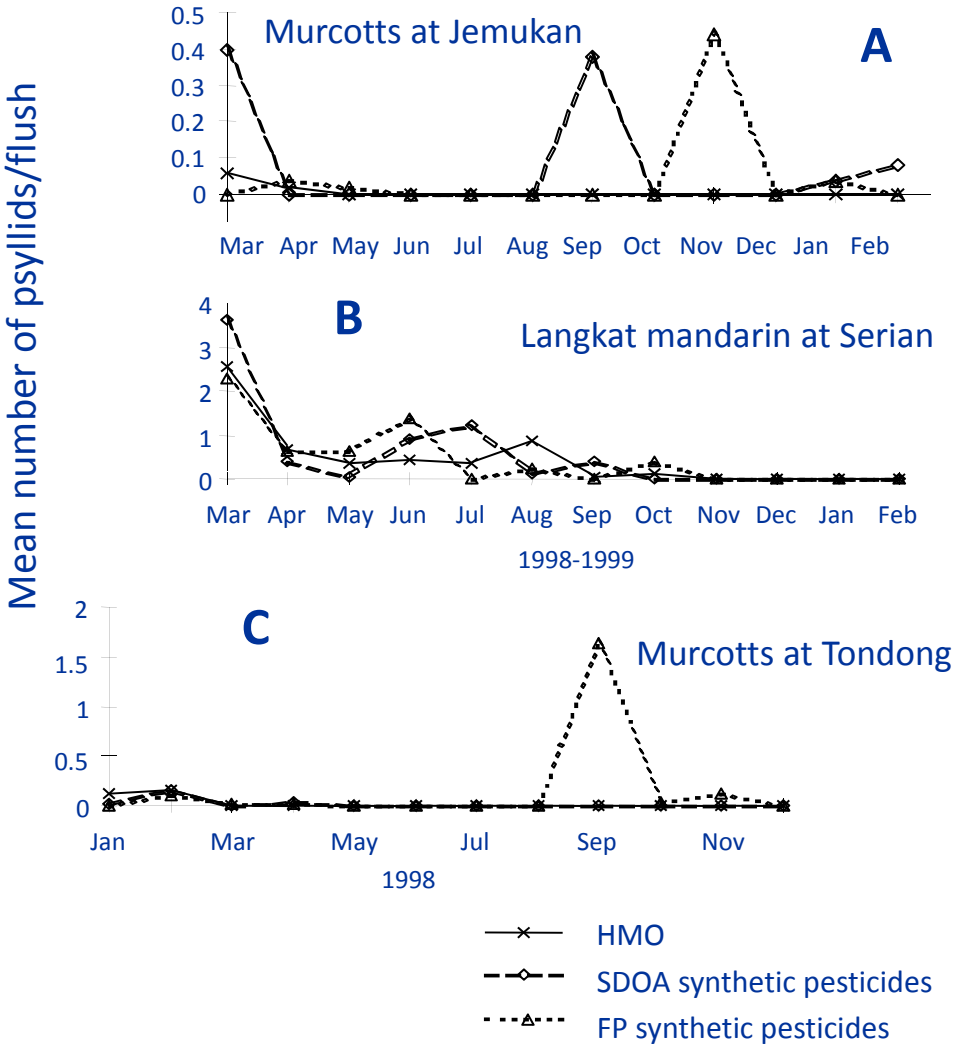
In China

- Rae et al. (1997) showed that oil deposits **suppress ACP oviposition** on leaves of potted calamondin trees
- Impacts were as effective as omethoate and diflubenzuron



In Sarawak, Malaysia

- Leong et al. (2002) applied sprays **weekly** (**A**) or **fortnightly** (**B** & **C**)
- Treatments were ***n*C24 HMO** & **synthetic programs** determined by the Department of Agriculture (**SDOA**) and farmer practices (**FP**)
- 0.3% to 0.5% (v/v) oil was **as, or more, effective** than synthetic chemicals against **ACP** and range of other pests and foliar diseases



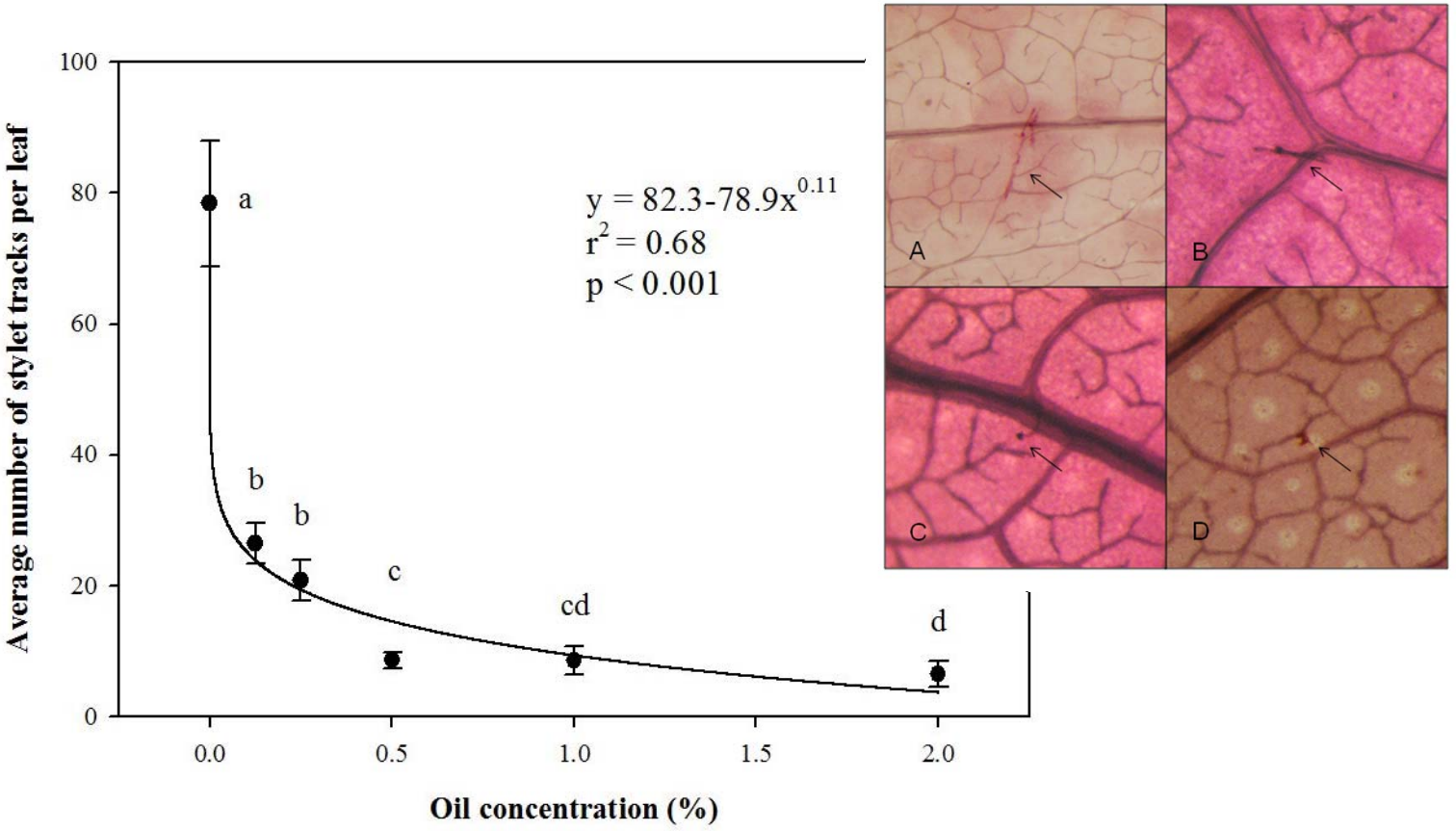
In similar studies (Leong et al. 2012) over 3 years (January 1999 to December 2001)

- **‘*C*las’** infections determined by PCR rose quite rapidly to reach **9.4, 11.4, 22.7 and 42.2%**
  - **imidacloprid;**
  - ***n*C24 HMO;**
  - **triazophos-cypermethrin-chlorpyrifos;** and
  - **control** treatments, respectively

Studies in **Viet Nam** showed that mineral oil deposits significantly reduced landing and feeding by adults, oviposition, egg hatch and survival of first instar nymphs

- Effects generally differed significantly from controls for deposits of **≥ 0.5%** sprays or dips
- Most impacts of deposits of **≥ 0.5% oil led to > 50% reductions for each parameter**: some as high as 94%

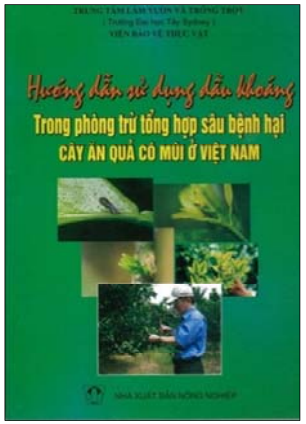
Studies based on stylet tracks by **Yang Yueping** in China showed that spray deposits of an *n*C24 agricultural mineral oil reduced ACP feeding on mature calamondin leaves (Yang et al. 2013)

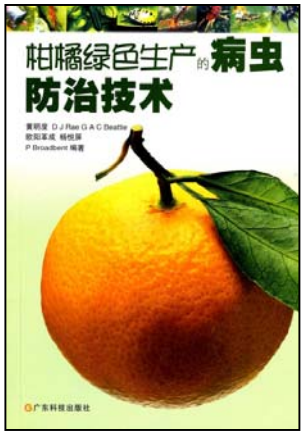


- Data for adults released 24, 48 and 72 h after application of sprays

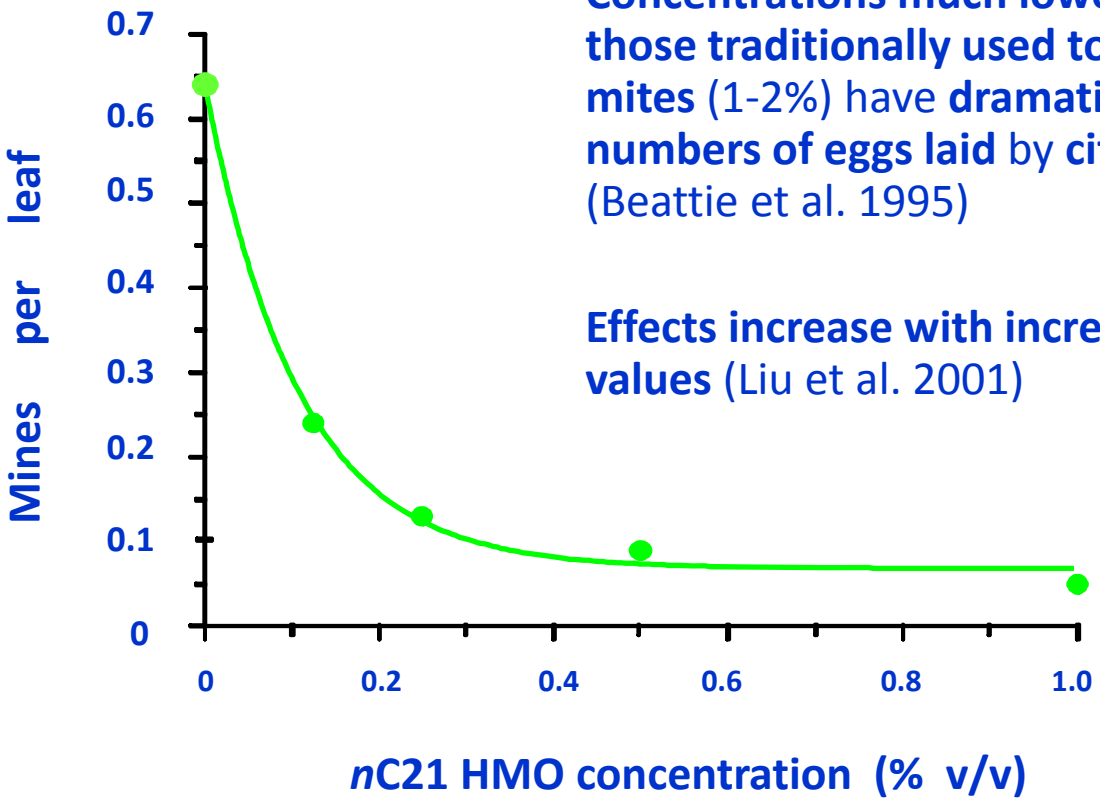
Rae et al. (2003) and **Rae et al. (2006)** published recommendations in Vietnamese and Chinese based on use of sprays during flush cycles to reduce feeding and oviposition

- **Spraying** from when the first buds in a flush cycle begin to open (**20% of trees with buds**)
- Applying up to **4 sprays at 7 to 10 d** intervals — until most **flushes** are longer than **50 mm**
- Applying the first two sprays thoroughly at **0.4 to 0.5%** (v/v) to mature leaves, buds and immature leaves
- Then **0.25% sprays** thoroughly to buds and immature leaves, and sparingly to mature leaves
- Addition of 0.03 to 0.05% imidacloprid or acetamiprid to the sprays was recommended in China





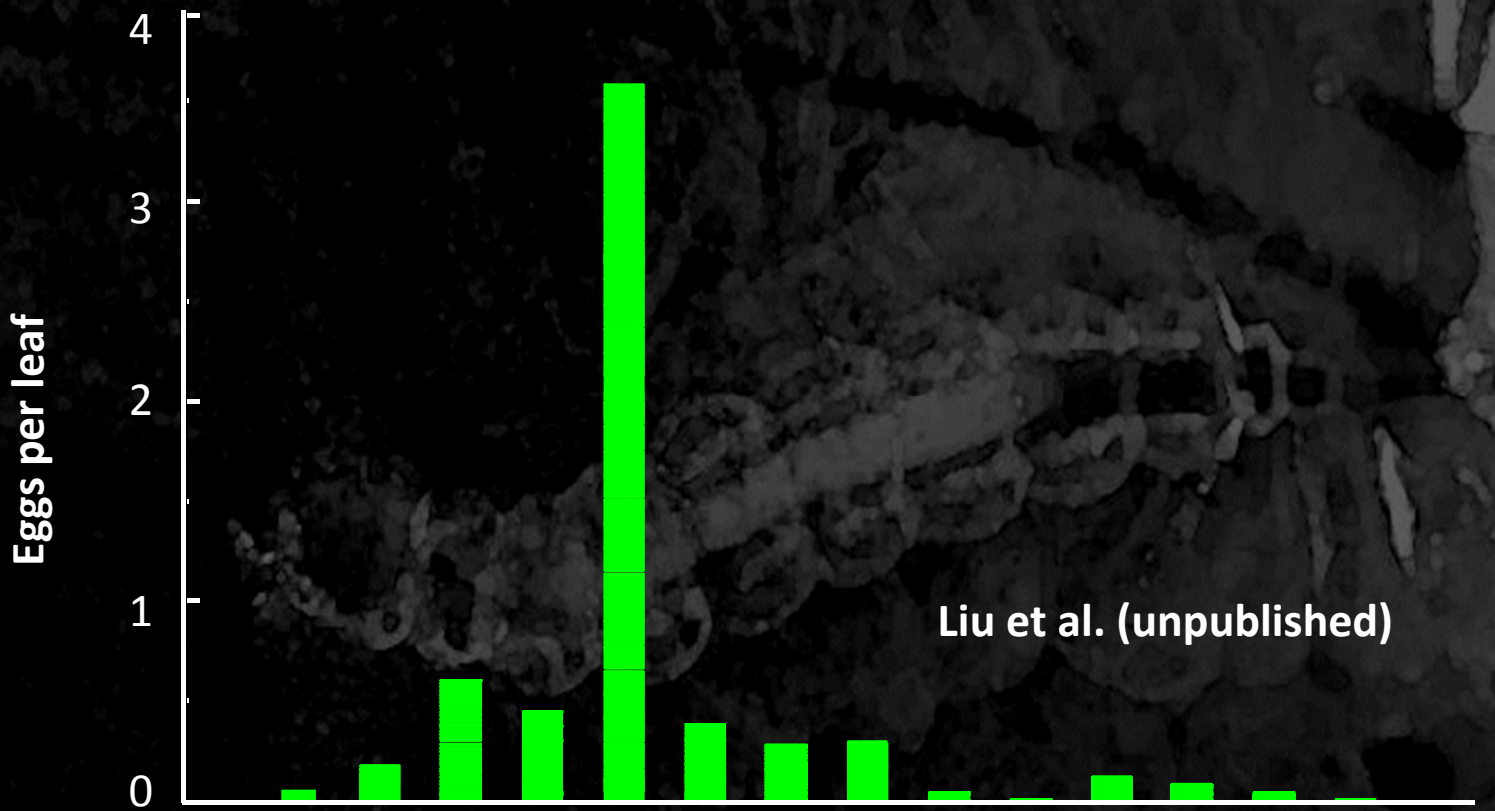
Mineral oil deposits reduce citrus leafminer infestations by reducing oviposition (numbers of eggs laid) and therefore mines per leaf



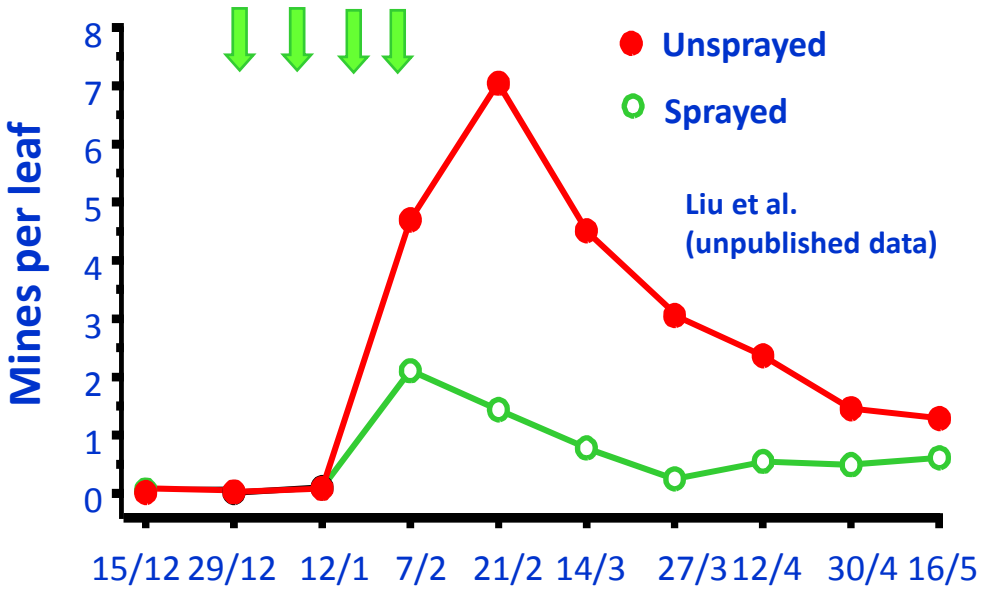
Concentrations much lower (0.125%) **than those traditionally used to drown scales** and **mites** (1-2%) have **dramatic effects on numbers of eggs laid** by **citrus leafminer** (Beattie et al. 1995)

Effects increase with increasing median *n*C*y* values (Liu et al. 2001)

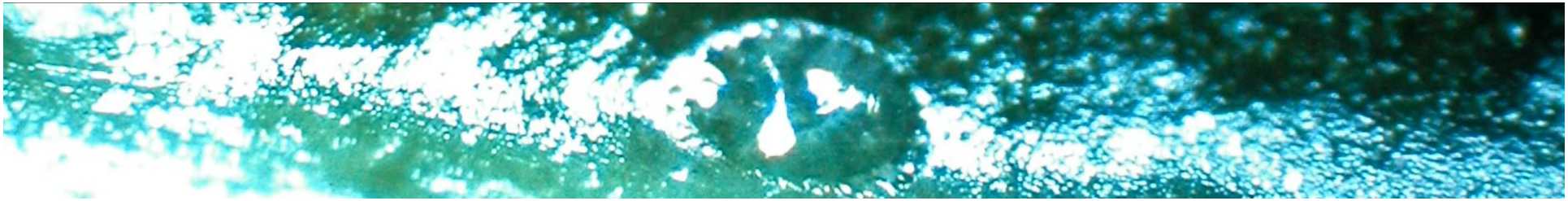
Seasonal counts of citrus leafminer eggs on lemon trees at Somersby, New South Wales

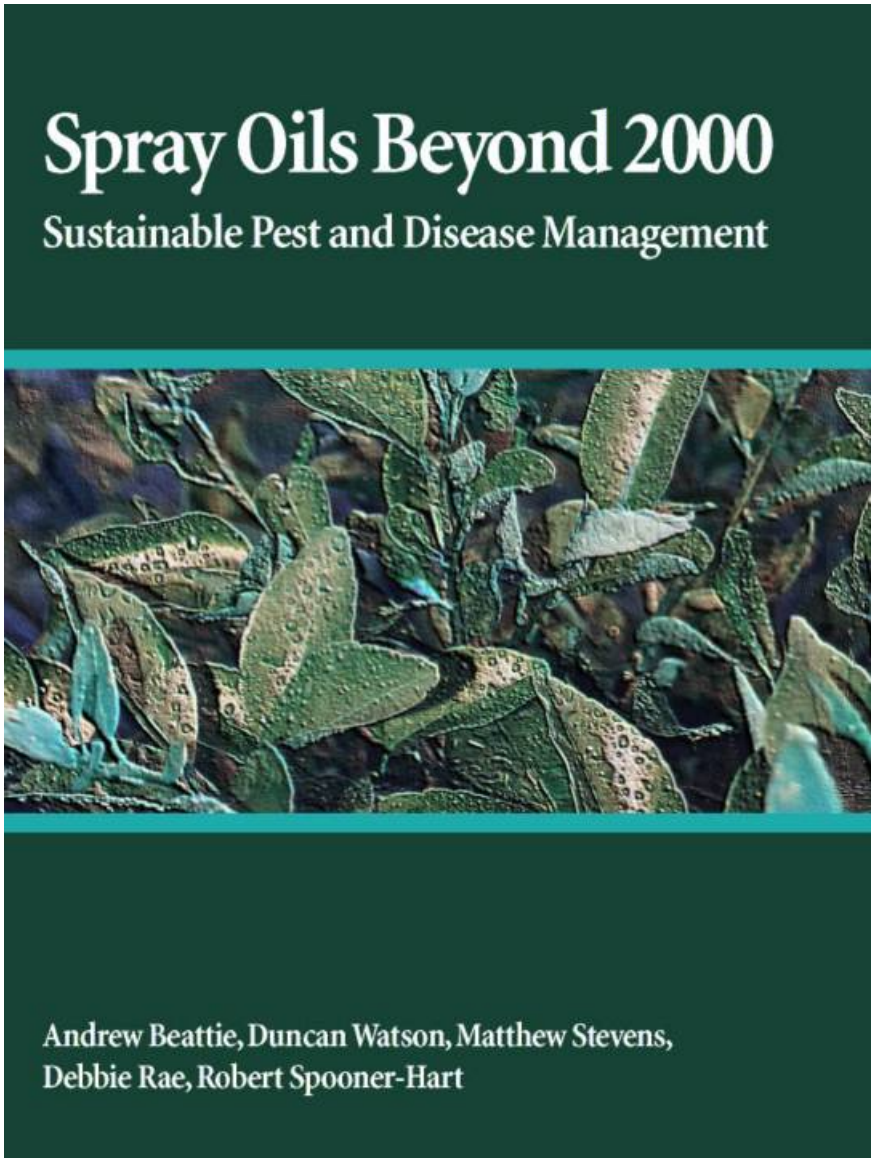


- **Eggs are laid** on **immature leaves < 4 cm long**
- **Control** should be based on **prevention** (prophylatic control) and **focus on flush phenology** — not levels of infestation
- Post-budbreak sprays (as with most chemicals) must be applied every 5-14 days to susceptible flush growth
- **Programs started pre-budbreak are more effective than post-budbreak programs**



Impact of 4 pre-egg peak 0.5% *n*C23 HMO sprays in coastal New South Wales





'Spray Oils Beyond 2000' (Beattie et al. 2002)