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Insecticide Resistance Action Committee

Are there any transferable lessons for Insecticide Resistance Management between Agriculture and Vector Control?





IRAC?

- Insecticide Resistance Action Committee (IRAC)
  - Specialist technical group of the agrochemical industry association CropLife International
  - Formed in 1984
  - Provides a coordinated industry response to the development of resistance in insect and mite pests

"Resistance Management for Sustainable Agriculture and Improved Public Health"

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1984


GLOBAL COLLABORATION
SHARING INFORMATION AND STRATEGIES FOR RESISTANCE
MANAGEMENT AROUND THE WORLD
2013

Insecticide Resistance

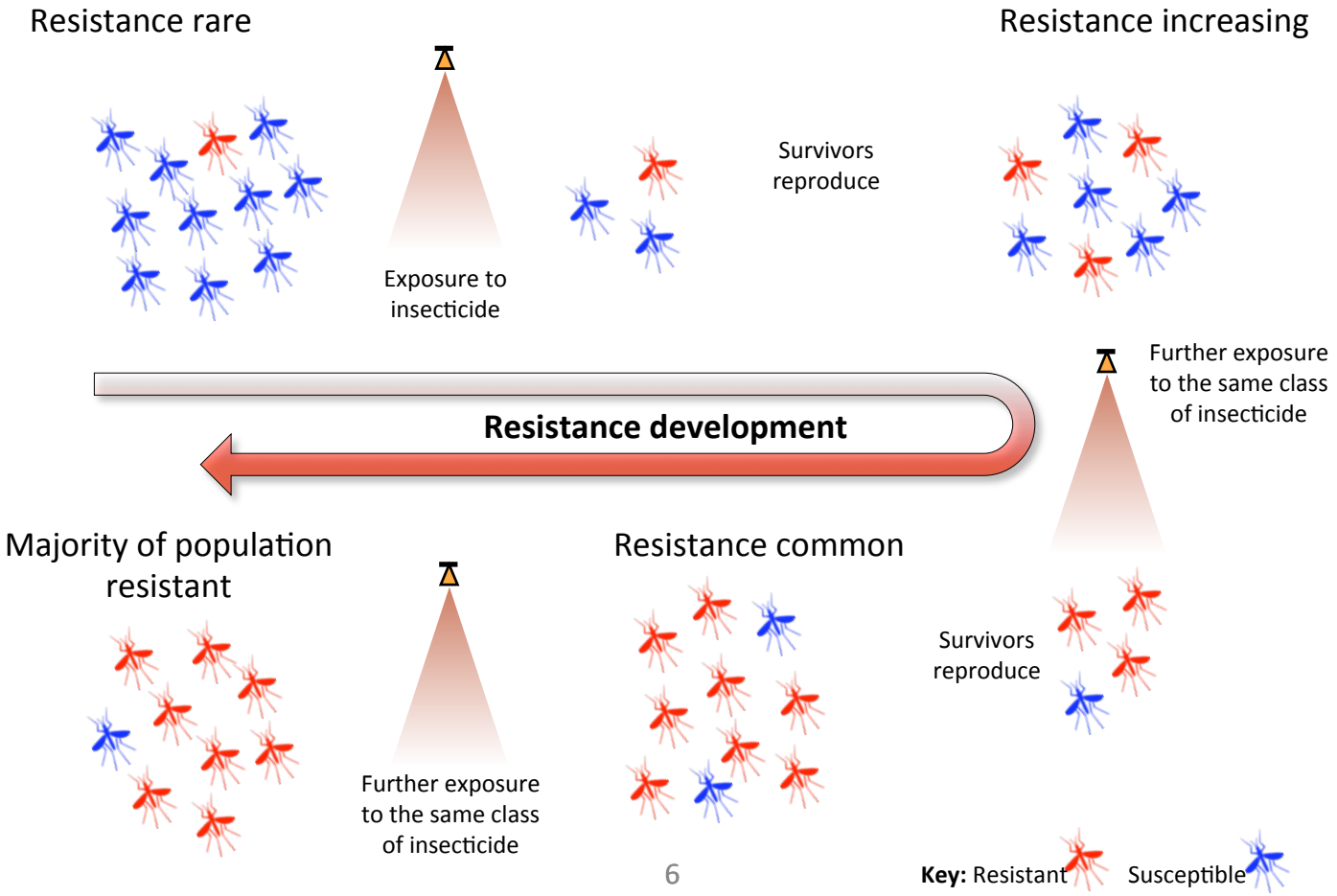
1887	• Scale insects “resistant” to kerosene
1914	• Insects resistant to sulphur sprays
1948	• House flies resistant to DDT
2012	• 574 species of “resistant” insects • 338 insecticides

Crop Protection vs Vector Control Similarities…

The main aim is to stop the insect pests from feeding

Crop Protection vs Vector Control Similarities…

The mechanism of selection is fundamentally the same



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Insecticide Resistance Management

- Similarities:
  - Primary aim is to remove, or reduce, the selection pressure for the genes that result in “resistant” phenotypes.
- Differences:
  - insect control requirements
  - available insecticidal tools
  - decision making processes used to decide upon the intervention

Insect control requirements

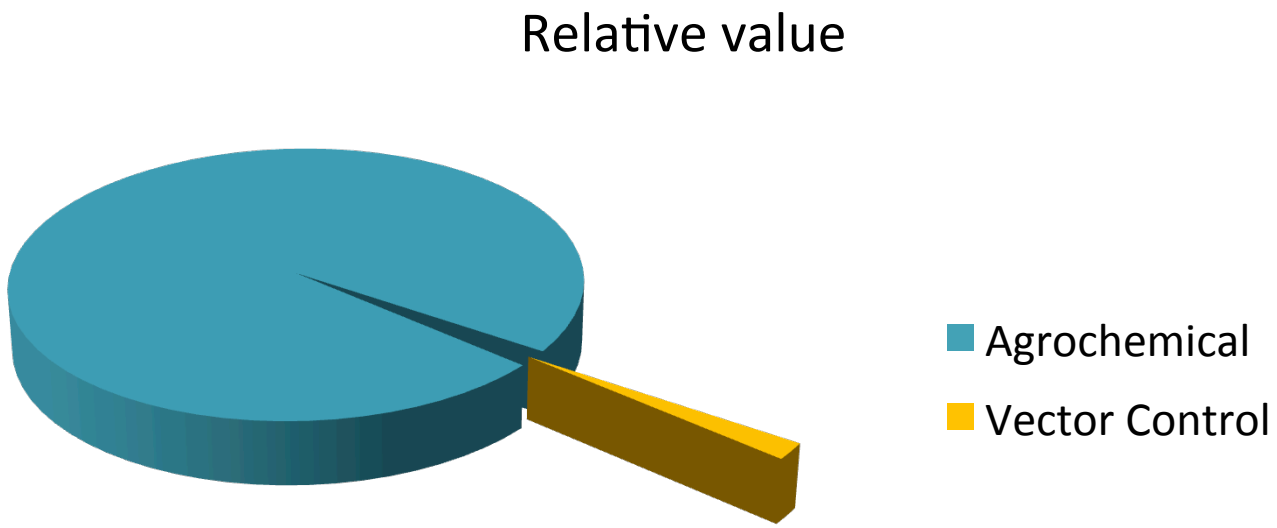
- Agriculture
  - Yield and quality key
  - Potentially many pest spp. in a crop
  - Different pests during crop cycle
  - Multiple/rapid insecticide applications possible
  - Crop rotation

Insect control requirements

- Vector Control
  - Reduction in malaria burden is key
  - Limited species targeted
  - Insecticide application logistically challenging
  - Multiple generations exposed to same insecticide

Available insecticidal tools

- Agrochemical plus non-crop market ca. $54 Billion
- Vector Control market <$1 Billion



Source: Phillips McDougall report 2013.

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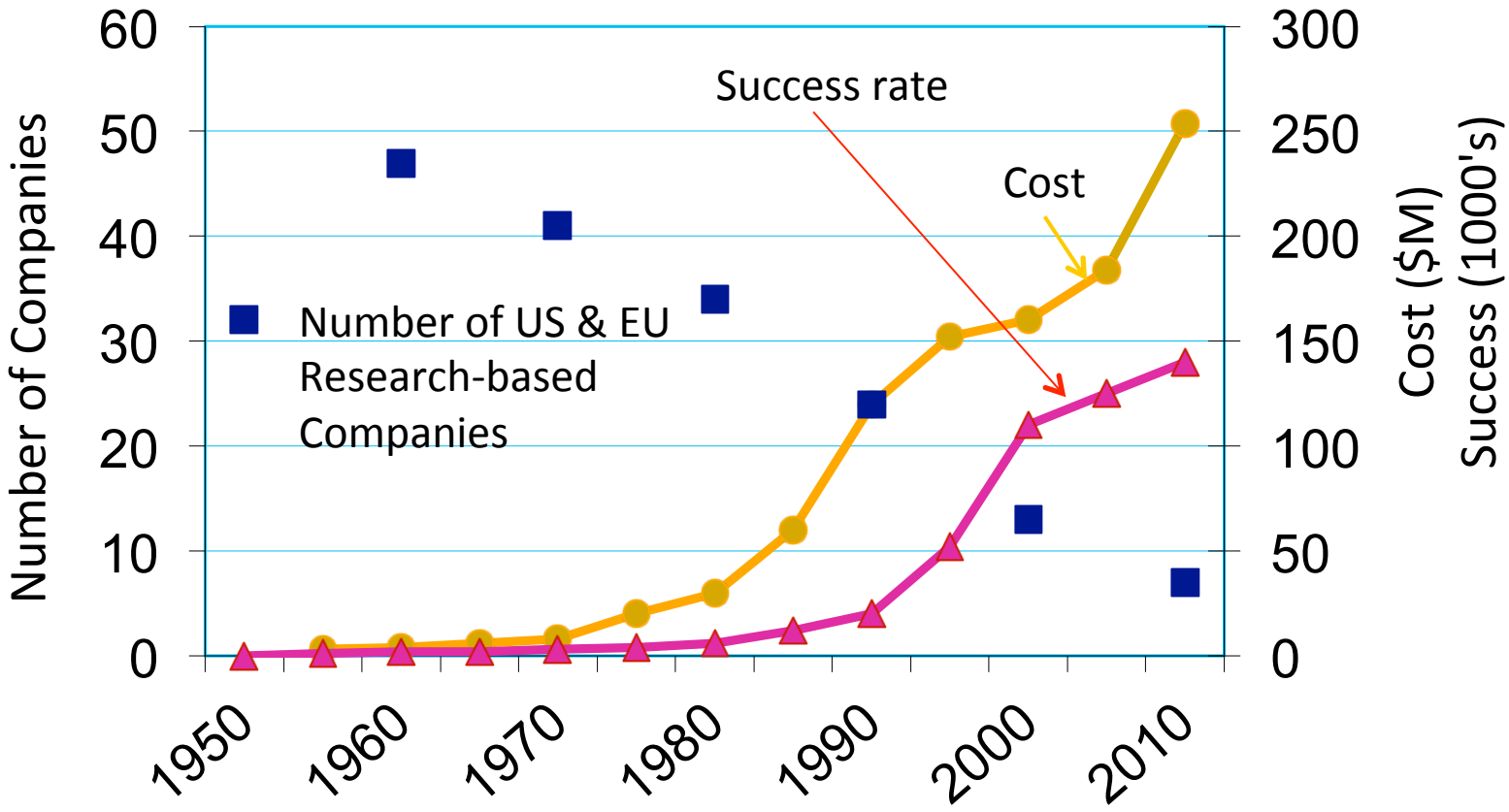
Available insecticidal tools

- Relatively small size of Vector Control market has made investment in novel insecticide development historically unattractive
- Regulatory pressure on broad spectrum and persistent insecticides limits opportunity for insecticides with both agricultural and vector control utility
  - No novel commercialised MoA for vector control since pyrethroids

Available insecticidal tools



Success rate = number of cpds that need to be screened for each product found

Data from GT Brooks 1974, RL Metcalf 1980, W. Klassen 1995 Philips McDougal, 2003, CropLife 2011

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Decision making processes

Crop Protection:

- Insecticide purchase based on cost benefit analysis, return on investment
- Many growers, each including a variety of factors in their analysis
  - Making room for many different products

  → Competitive market

- Incentivises innovation and product development

Decision making processes

Crop Protection:

- Decision to implement IRM also a cost benefit analysis
  - Looking at the financial implications of insecticide resistance development on future crops

Decision making processes

Vector Control:

- Insecticide product choice based on analysis of impact, and how much money is available, not how much can be made
- influenced by third parties, donors, etc.
- Often tender based, smaller number of vendors and purchasers
  - Encourages similarity in products

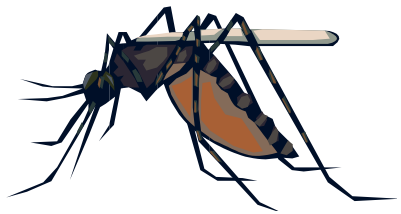
  → Leads to less than perfect market

- Disincentives innovation and product development

Decision making processes

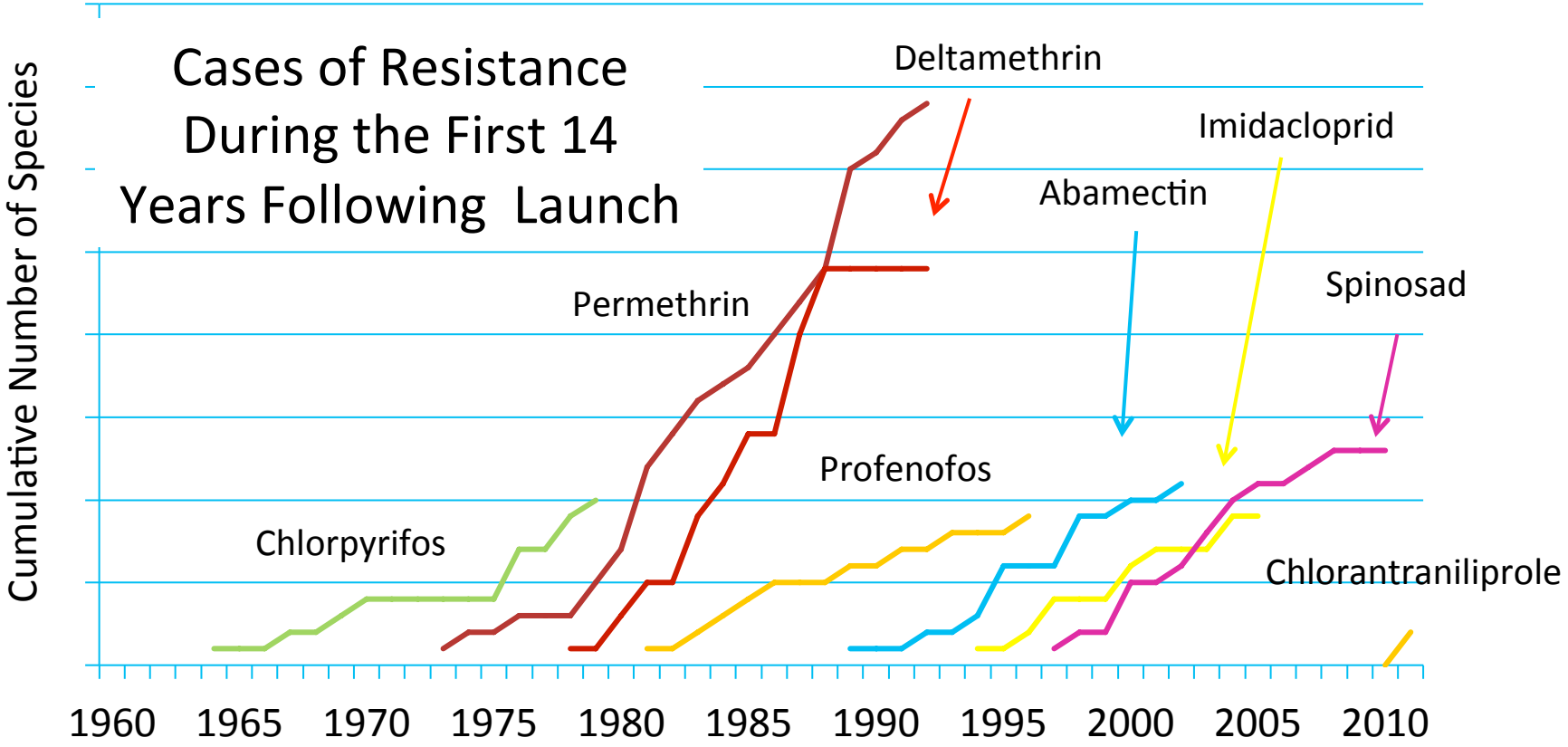
Vector Control:

- Decisions to implement IRM are complicated by the need to protect the greatest proportion of the human population from vector borne disease
  - This short term imperative is not necessarily compatible with longer term IRM.



Lessons…

- Resistance can, and will, eventually develop to any insecticide



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Lessons…

- There is still an agricultural insecticide market
  - Whilst IRM has had limited success in preventing resistance development, it is successful at managing resistance once it has arisen in a pest population and prolonging the useful life of that insecticide class

Lessons…

- How has the effective use of insecticides been sustained, despite insecticide resistance development in agriculture?
  - Integrated Pest Management (IPM)
  - IRM built into product label
  - rotation of insecticide classes, etc.
  - “spray windows”
  - untreated refugia
  - development and introduction of novel insecticide classes

Lessons…

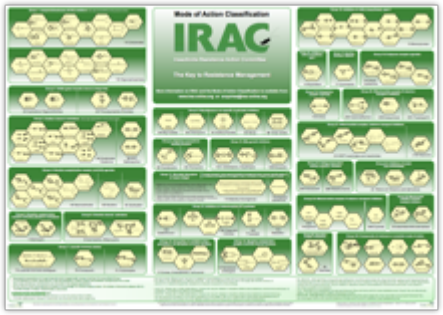
- Crop Protection has no silver bullet for Vector Control
  - But there are lessons that can be learnt from their comparison…

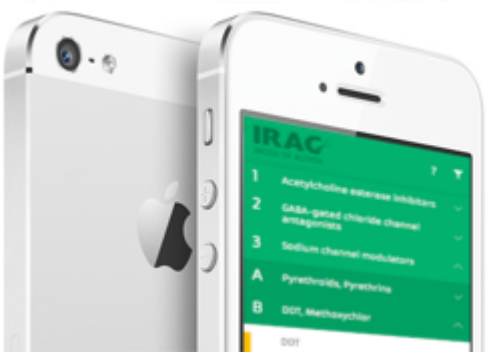
Lessons…

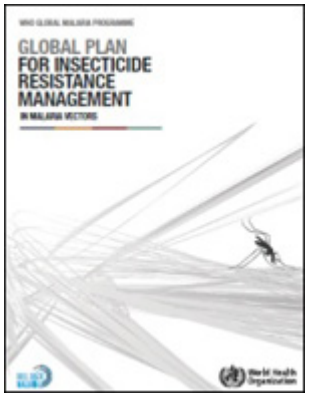
- Integrated approach:
  - Integrated Vector Management (IVM) is key, both to Vector Control, and IRM
    - Any activities that reduce the adult mosquito population, without recourse to adulticides, will help to reduce the selection pressure for insecticide resistance development

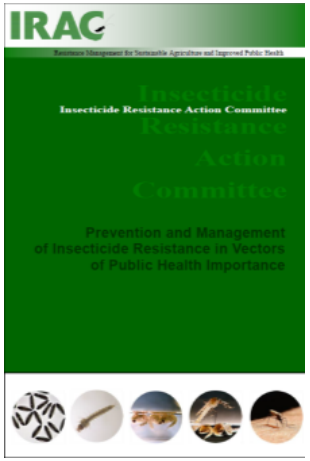
Lessons…

- Several sources of information on best practice IRM in Vector Control
  - Mixtures
  - Rotations
  - Mosaics
  - Etc.
  - Monitoring
  - Source reduction
  - Education and training

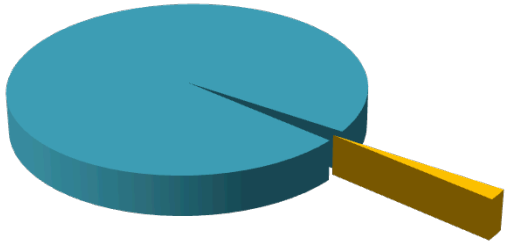








Lessons…



- Unlike Crop Protection, the Vector Control adulticide market is not conducive to product innovation →fewer products for IRM
  - Relatively small size, vs cost of development of novel mosquito adulticide
  - Tender business encourages development of products that “satisfy” not “excel”
  - Entrance to regulated market through “equivalence” destroys motivation to invest in innovation

Lessons…

- An advantage for IRM in Vector Control?
  - A smaller pool of Vector Control programmes and a supra-regulatory quality assurance system
  - A greater appreciation of the value of insecticide susceptibility, through the dearth of novel insecticides
  - → Easier to communicate the value and principles of IRM
    - Encourage a longer term view

Lessons…

- In Crop Protection, it can be challenging to incentivise all insecticide users to follow the principles of IRM
  - Historic pipeline of resistance busting insecticides
  - Cheap old generic products
  - Many small growers
    - Encourages short term view

"Spray and pray"

Lessons…

- Resistance will eventually develop
  - Continual use of insecticides from a mode of action class where susceptibility is declining, is selecting for eventual product failure
  - Monitoring and early implementation of IRM can help to delay resistance development and prolong the useful life of insecticidal modes of action
  - Better still, have an IRM programme in place when a novel insecticide is first launched or used

Lessons…

- Susceptibility a “common good”
  - Susceptibility of a mosquito population to an insecticide is a “common good”; with financial and utilitarian value, freely available to all
  - Every time an insecticide application is made, without consideration of IRM, a tiny part of “susceptibility” is used up. Once its gone, it can’t be retrieved, which reduces the future benefits from Vector Control with that insecticide
  - IRM should therefore be considered when planning all Vector Control programmes, to minimise the amount of lost “susceptibility”

Summary

Integrated Vector Management

Sustainable Malaria Management - Eradication

Vector borne disease free environment

Conclusions

- To deliver more tools for IRM need to incentivise innovation – pull as well as push
- Integrate IRM into all Vector Control programmes (IVM)
- Have an IRM strategy in place before novel insecticides are introduced

Thank you for your attention

With thanks to the IRAC Public Health Team

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