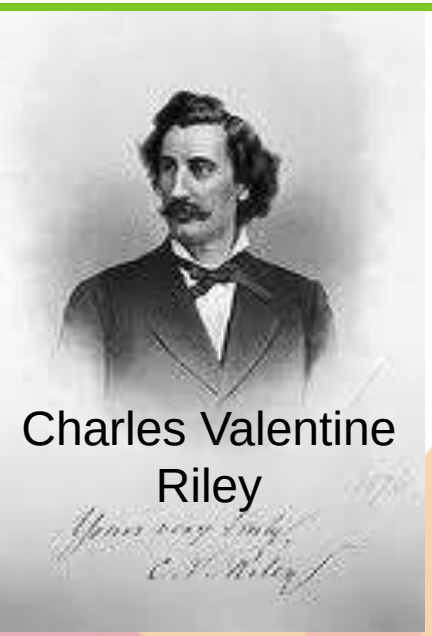
endure®
diversifying crop protection

Overview of IPM

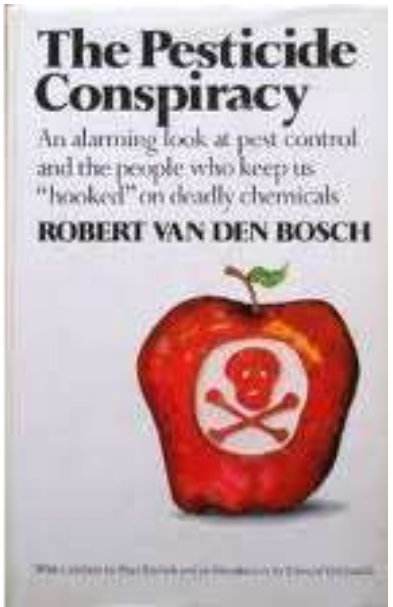
Marco Barzman, ENDURE
Alain Ratnadass, CIRAD
IV ENDURE Summer School
Agroecological engineering for crop protection
Volterra, 9 oct. 2012

Origins of IPM



Charles Valentine Riley

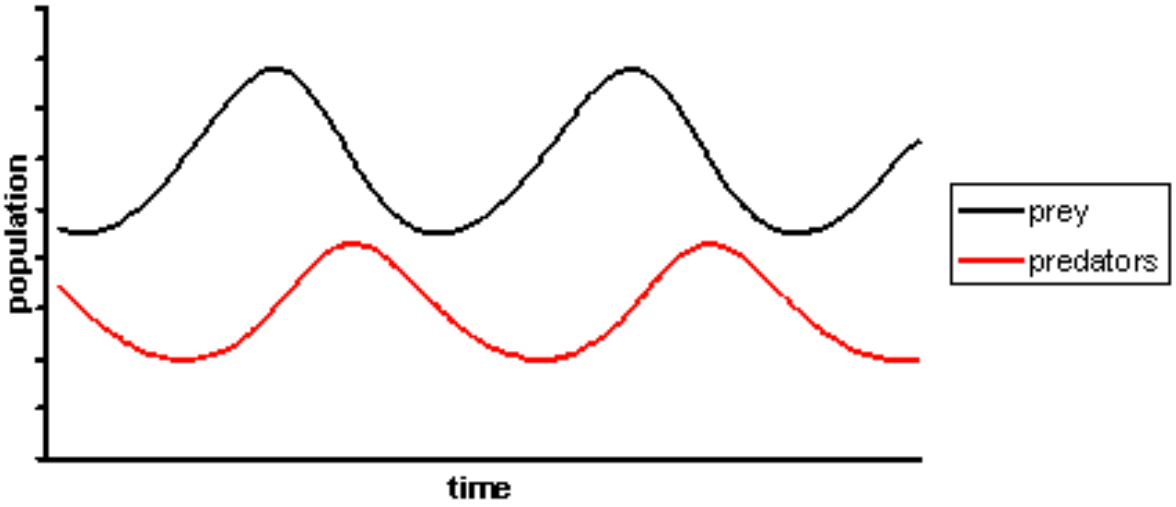
- 1889 “classical” biological control
- Synthetic pesticides
- Impact on non-target organisms – ex: DDT
- Resistance & secondary outbreaks (e.g., cotton)
- Pesticide treadmill → IPM



Insects & mites → pathogens → weeds

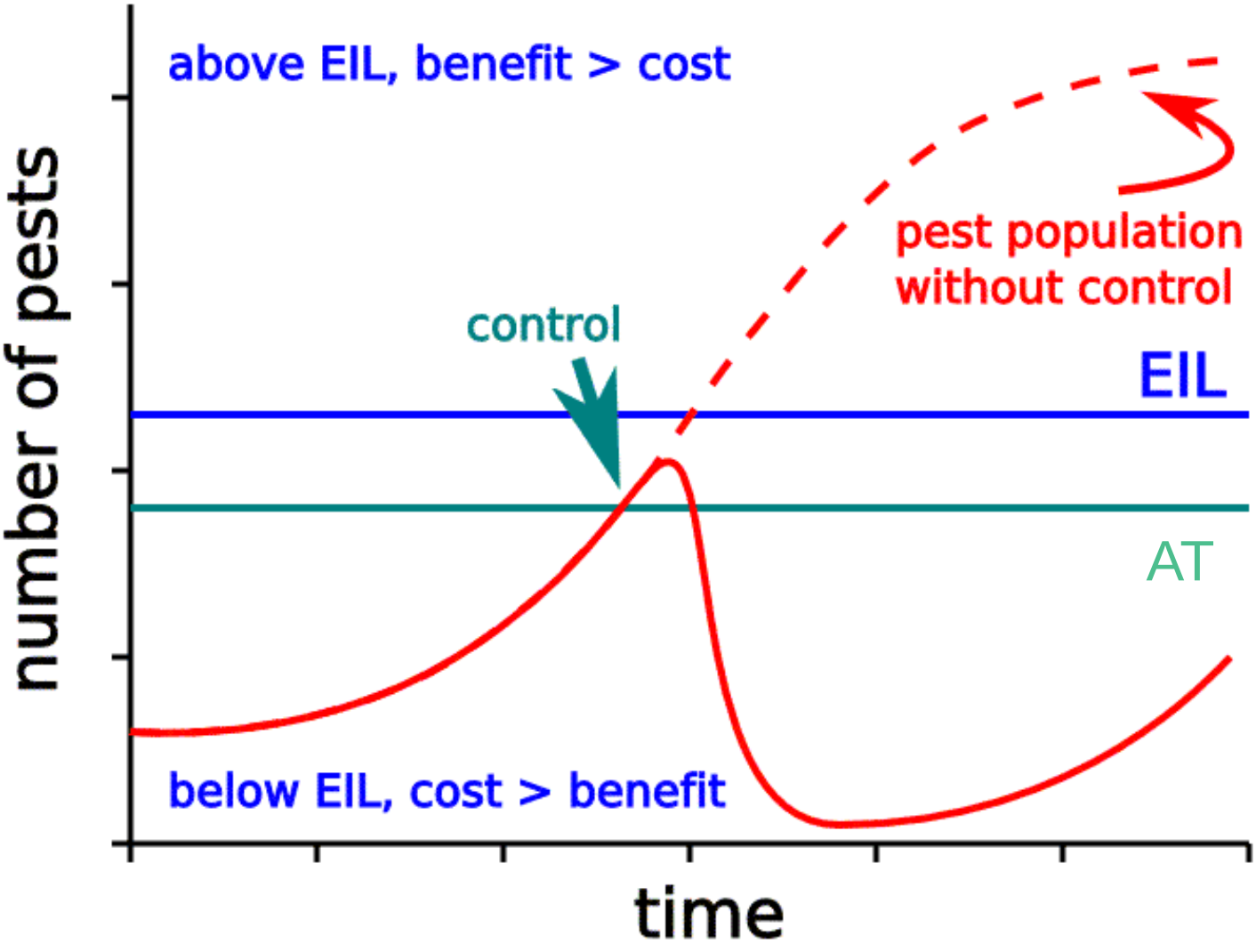
Population dynamics

- **Lotka-Volterra model 1925 & 1926**



Vito Volterra

Thresholds



modified from: Ed Zaborski, University of Illinois

Limitations of EIL

- Stability - universality
- Availability
- Cost
- Relevance (weeds? certain diseases?)
- Practice

IPM in the USA

IPM Voice

UNIVERSITY OF CALIFORNIA AGRICULTURE & NATURAL RESOURCES

UC IPM Online

Statewide Integrated Pest Management Program

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IPM goes South

- 1978 – Indonesia
- FAO - Farmer Field Schools

IPM comes to Europe

Official Journal of the European Union

L 309

English edition

Legislation

Volume 52

24 November 2009

DIRECTIVE 2009/128/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 21 October 2009

establishing a framework for Community action to achieve the sustainable use of pesticides

REGULATION (EC) No 1107/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 21 October 2009

concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC

IPM in Framework Directive

- **FD, Art. 4:**
  - **MS shall adopt National Action Plans to set up their quantitative objectives, targets, measures and timetables to reduce risks and impacts of pesticide use on human health and the environment and to *encourage the development and introduction of IPM and of alternative approaches or techniques in order to reduce dependency on the use of pesticides*. {…}**

Dec. 2012

IPM in EU policy

- **FD, Art. 14:**
  - **1. MS shall take *all necessary measures to promote low pesticide-input pest management* {…}. Low pesticide-input pest management includes *IPM as well as organic farming* {…}.**
  - **4. MS shall describe in their National Action Plans how they ensure that the *general principles of IPM* as set out in Annex III *are implemented by all professional users by 1 January 2014*.**
- **Reg. on the placing of PPPs on the market, art. 55**
  - **Plant protection products shall be used properly**
  - ***Proper use* {…} *shall also comply* {…} *with general principles of IPM*, as referred to in Article 14 of and Annex III to that Directive, which shall apply at the latest by 1 January 2014**

IPM in Framework Directive

IPM means

"careful consideration of all available plant protection methods and subsequent ***integration of appropriate measures that discourage the development of populations of harmful organisms*** and keep the use of plant protection products and other forms of intervention to levels that are economically and ecologically justified and reduce or minimise risks to human health and the environment. 'Integrated pest management' emphasises the growth of a healthy crop ***with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms***"

IPM in Framework Directive

Principle 1 – Achieving prevention and/or suppression of harmful organisms

Principle 2 – Monitoring

Principle 3 – Decision based on monitoring and thresholds

Principle 4 – Non-chemical methods

Principle 5 – Pesticide selection

Principle 6 – Reduced use

Principle 7 – Anti-resistance strategies

Principle 8 – Evaluation

IPM in Framework Directive

Principle 1 – Achieving prevention and / or suppression of harmful organisms

The prevention and/or suppression of harmful organisms should be achieved or supported among other options especially by:

— crop rotation,

— use of adequate cultivation techniques (e.g. stale seedbed technique, sowing dates and densities, under-sowing, conservation tillage, pruning and direct sowing),

— use, where appropriate, of resistant/tolerant cultivars and standard/certified seed and planting material,

— use of balanced fertilisation, liming and irrigation/drainage practices,

— preventing the spreading of harmful organisms by hygiene measures (e.g. by regular cleansing of machinery and equipment),

— protection and enhancement of important beneficial organisms, e.g. by adequate plant protection measures or the utilisation of ecological infrastructures inside and outside production sites.

IPM in Framework Directive

Principle 2 – Monitoring

Harmful organisms must be monitored by adequate methods and tools, where available. Such adequate tools should include observations in the field as well as scientifically sound warning, forecasting and early diagnosis systems, where feasible, as well as the use of advice from professionally qualified advisors.

Principle 3 – Decision based on monitoring and thresholds

Based on the results of the monitoring the professional user has to decide whether and when to apply plant protection measures. Robust and scientifically sound threshold values are essential components for decision making. For harmful organisms threshold levels defined for the region, specific areas, crops and particular climatic conditions must be taken into account before treatments, where feasible.

IPM in Framework Directive

Principle 4 – Non-chemical methods

Sustainable biological, physical and other non-chemical methods must be preferred to chemical methods if they provide satisfactory pest control.

Principle 5 – Pesticide selection

The pesticides applied shall be as specific as possible for the target and shall have the least side effects on human health, non-target organisms and the environment.

IPM in Framework Directive

Principle 6 – Reduced use

The professional user should keep the use of pesticides and other forms of intervention to levels that are necessary, e.g. by reduced doses, reduced application frequency or partial applications, considering that the level of risk in vegetation is acceptable and they do not increase the risk for development of resistance in populations of harmful organisms.

Principle 7 – Anti-resistance strategies

Where the risk of resistance against a plant protection measure is known and where the level of harmful organisms requires repeated application of pesticides to the crops, available anti-resistance strategies should be applied to maintain the effectiveness of the products. This may include the use of multiple pesticides with different modes of action.

Principle 8 – Evaluation

Based on the records on the use of pesticides and on the monitoring of harmful organisms the professional user should check the success of the applied plant protection measures.

ENDURE's angle on IPM

- **A learning process that takes place over time**

ENDURE sees IPM as a continuously improving process in which innovative solutions are integrated and locally adapted as they emerge and contribute to reducing reliance on pesticides in agricultural systems.

No IPM → ***Ultimate IPM***

E-S-R

- Efficiency
- Substitution
- Redesign

E-S-R

- **Efficiency**
  - safe use
  - lower doses
  - precision spraying
  - DSS - monitoring
- **Substitution**
  - least-toxic
  - mechanical weeding
  - BC agents
- **Redesign**
  - ↑ spatial diversity
  - ↑ temporal diversity
  - ↑ genetic diversity
  - BC-friendly env.

IPM vs. Agroecology

Relationship between IPM and Agroecological engineering for crop protection

- Re-design vs substitution?
- Room for chemical pesticides?
- Room for GMOs?

Re-design vs substitution?

- **IPM: not necessarily implies re-design of cropping system**
- **Substitution examples:**
  - Mineral pesticides: e.g. Cu & S authorized in organic viticulture
  - Broad spectrum plant-derived pesticides e.g. rotenone
  - Release of natural enemies/entomopathogenic fungi (augmentative biological control)
- **Agroecological engineering : Sources of natural pesticides as part of the agricultural system**
  - e.g. Jatropha live-hedges; neem wind-breaks (also contributing to « conservation biological control »)

Room for chemical pesticides?

- IPM: rational pesticide use
- Do not thresholds actually promote the use of pesticides?
- Seed treatment is not IPM since it is a systematic treatment
- Can be used in agroecological engineering since it is targeted, and can have a “starter” effect triggering ecological processes (e.g. via biomass production)
- All the same for herbicides (e.g. DMC systems)
- Using targeted chemical pesticide applications in “aided” Push-Pull may delay the build up of resistance to biological insecticides like Bt toxins or spinosad
- Concept of no pesticide use (organic agriculture) vs no pesticide residue (agroecology)

Room for GMOs?

- **In the US, GMOs are a tool for IPM just like any other option**
  - « Transgenic section » in **IPMnet NEWS**
- **Conflicting with the principle of rational pesticide application (on threshold), since it is systematic**
- **Problem of Bt resistance buildup**

Chapter 2

Genetic engineering and ecological engineering: a clash of paradigms or scope for synergy?

Miguel A. Altieri, Geoff M. Gurr and Steve D. Wratten

Room for me?