

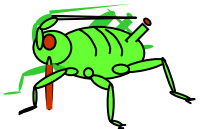
Regulation of Biological Control Agents



Recommendations for a balanced regulatory system
for macrobial (invertebrate) biocontrol agents

REBECA Work Package 5

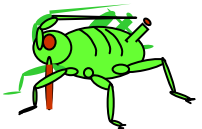
www.rebeca-net.de



Regulation of Biological Control Agents



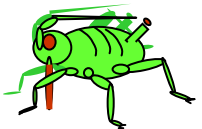
Key Aim: Develop a balanced regulatory system that minimizes the costs imposed on industry without compromising risks to human health or the environment





REBECA: Objectives for IBCAs (WP 5)

- Draft guidelines for a hierarchical regulatory system for invertebrate (macrobial) BCAs (insects, mites, nematodes)
- Describe research methodologies to underpin proposed environmental risk assessment for invertebrate BCAs
- Agree criteria for inclusion of invertebrate BCAs on an updated 'Positive List'
- Evaluate options for implementing a pan-European regulatory system for invertebrate BCAs, including creation and terms of reference for an 'Expert Group' and its relationship to National Competent Authorities

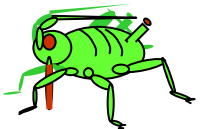




REBECA: Workshops and Conferences

First Workshop, Wageningen, April 2006

- Discussed problems caused by variation in regulation across Europe
- Identified and prioritised risks – real and perceived – concluded that ‘environment’ was main concern
- Adopted concept of a hierarchical environmental risk assessment (ERA) with waivers
- Recognised value of EPPO Positive List and need for updating

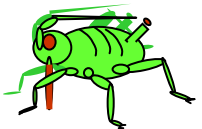




REBECA: Workshops and Conferences

First Conference, Salzau, September 2006

- Achieved endorsement of 'Wageningen ideas' from larger group
- Identified needs and knowledge gaps – delegated specific tasks to working groups
- Considered role of an 'Expert Group' and relationship with National Competent Authorities
- Supported discussions with EPPO on Positive List

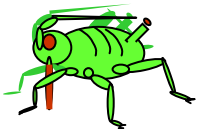




REBECA: Workshops and Conferences

Small Group Meetings

- ERA for nematodes, Kiel, January 2007
- ERA for insects and mites, Rotterdam, March 2007
- Positive List and Expert Group, Delemont, April 2007
- Guidance Document, Wageningen, June 2007

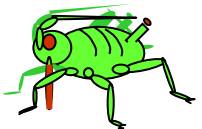


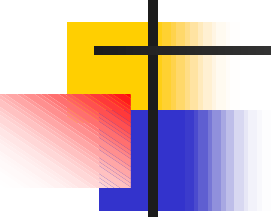


REBECA: Workshops and Conferences

Second Workshop, Frankfurt, July 2007

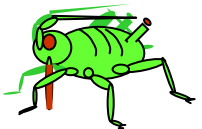
- Reviewed and amended recommendations from small group meetings
- Agreed to create standard 'Application Form' for permits, linked to Guidance Document
- Confirmed use of a flexible ERA with waivers, applicable to insects, mites and nematodes
- Evaluated feasible options for a pan-European regulatory system





Invertebrates, Microbes, Botanicals and Semiochemicals

- Fundamental difference in regulation between groups of agents
- Microbes, Botanicals and Semiochemicals regulated by EU directive 91/414 – consistent across Europe, but can have expensive regulatory costs in some countries
- Invertebrate BCAs – no EU directive, and variable regulatory policy in different countries
- Relative success of invertebrate BCAs attributable to absence of coordinated ‘EU directive-based’ regulation – but ‘country-specific’ legislation causes problems





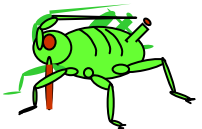
Important problems to solve

Agricultural Industry

- Withdrawal of chemicals
- Few new products
- Pest resistance
- Supermarket pressures
- Problem pests
- New crops – new pests

Biocontrol Industry

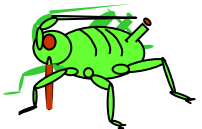
- Small companies
- Limited R&D budgets
- No IPR
- Fragmented regulation in EU
- Increased regulatory costs
- Few new products





Types of biological control

- **Classical:** Control of alien species using small scale releases leading to *permanent establishment* of co-evolved natural enemies from origin of pest
- **Inundative:** Mass release of laboratory-reared populations (indigenous or non-native) to control open field or glasshouse pests - *do not persist*
- **Conservation:** Sustainable use of indigenous IBCAs against native or non-native pests



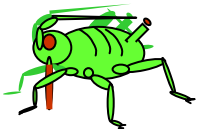


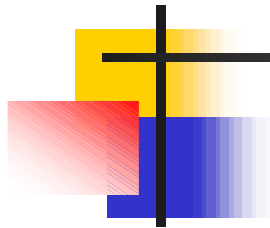
Comparison of chemical and biocontrol

	Chemical	Biological
Number of ingredients tested	>1 million	3,000
Success ratio	1:200,000	1:10
Developmental costs	\$200+ million	\$2 million
Developmental time	10 years	up to 10 years*

*From first discovery of species

Bale *et al.*, (2007) *Phil. Trans. Roy. Soc.* (in press)

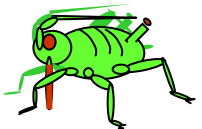




Comparison of chemical and biocontrol

	Chemical	Biological
Benefit:cost ratio	2-5:1	30:1
Risks of resistance	large	small
Specificity	low	high
Harmful side-effects	many	nil/few

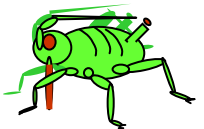
Bale *et al.*, (2007) *Phil. Trans. Roy. Soc.* (in press)





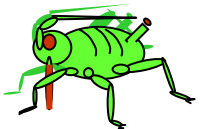
What are the risks of biological control?

- Human health: very few – allergies in production
- Crops and plants: very few – some plant feeding
- Environment: main potential problem
- Reputation: negative if any environmental problems



What are the risks of biological control?

- **Environment**
- Non-native species may establish in new countries

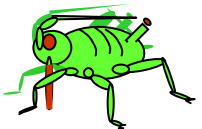




What are the risks of biological control?

Environmental risks of non-native establishment:

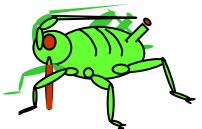
- May attack non-target species
- May displace native insects important in natural control and other 'exotics' used in biological control
- May carry hyperparasites or pathogens
- May disrupt ecosystem functions – pollination
- May interbreed with native species



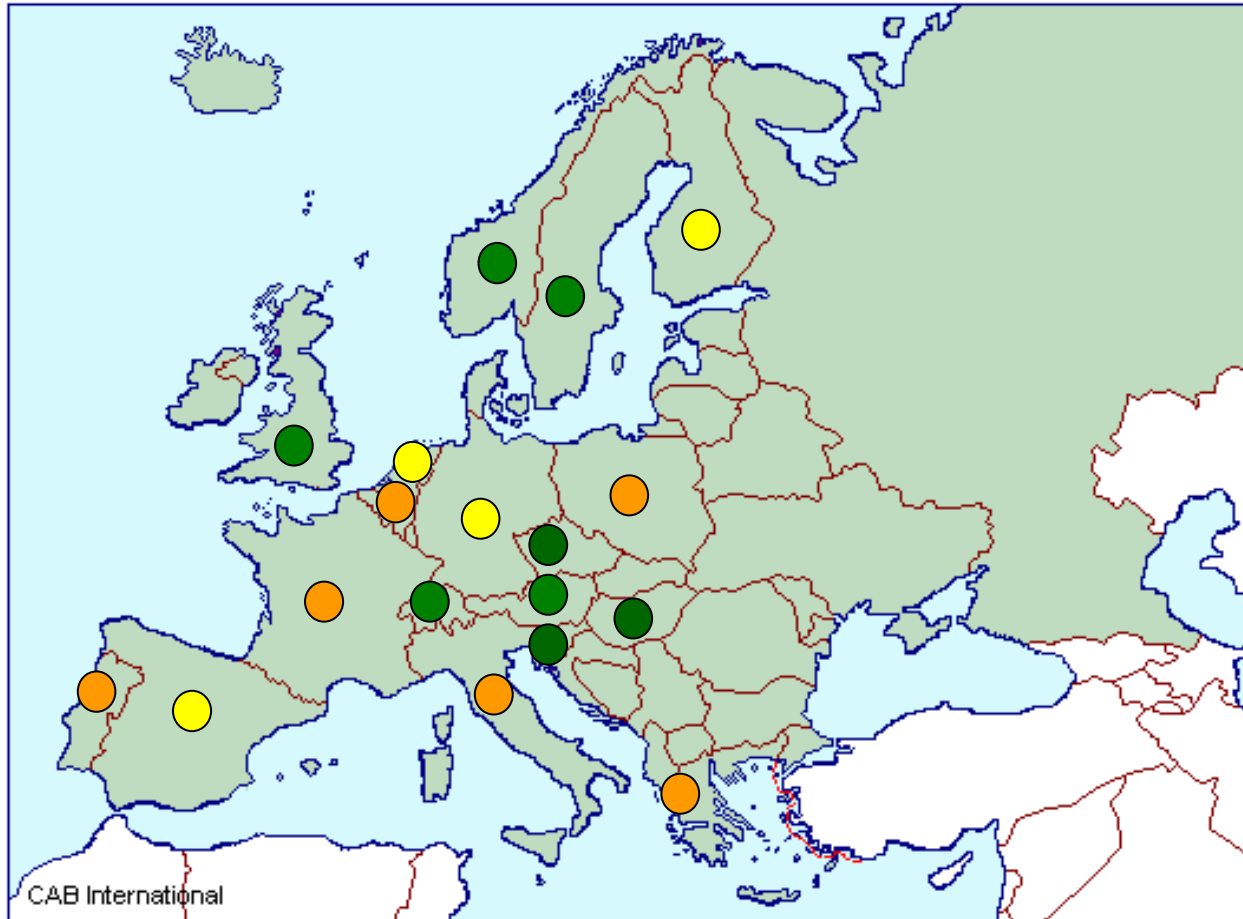


Invertebrate BCAs – is regulation needed?

- Is it realistic to propose that invertebrate BCAs need no regulation? **No – individual countries have different ‘policies’**
- Regulation in some EU countries is the responsibility of the ‘Ministry of the Environment’ – strong ‘environmental’ agenda
- Regulation in some countries involves routine consultation with NGOs – responsible for ‘environmental protection’
- In some countries, establishment of non-native species *even without any adverse effects* is considered highly undesirable



Regulation of Invertebrate BCAs in Europe



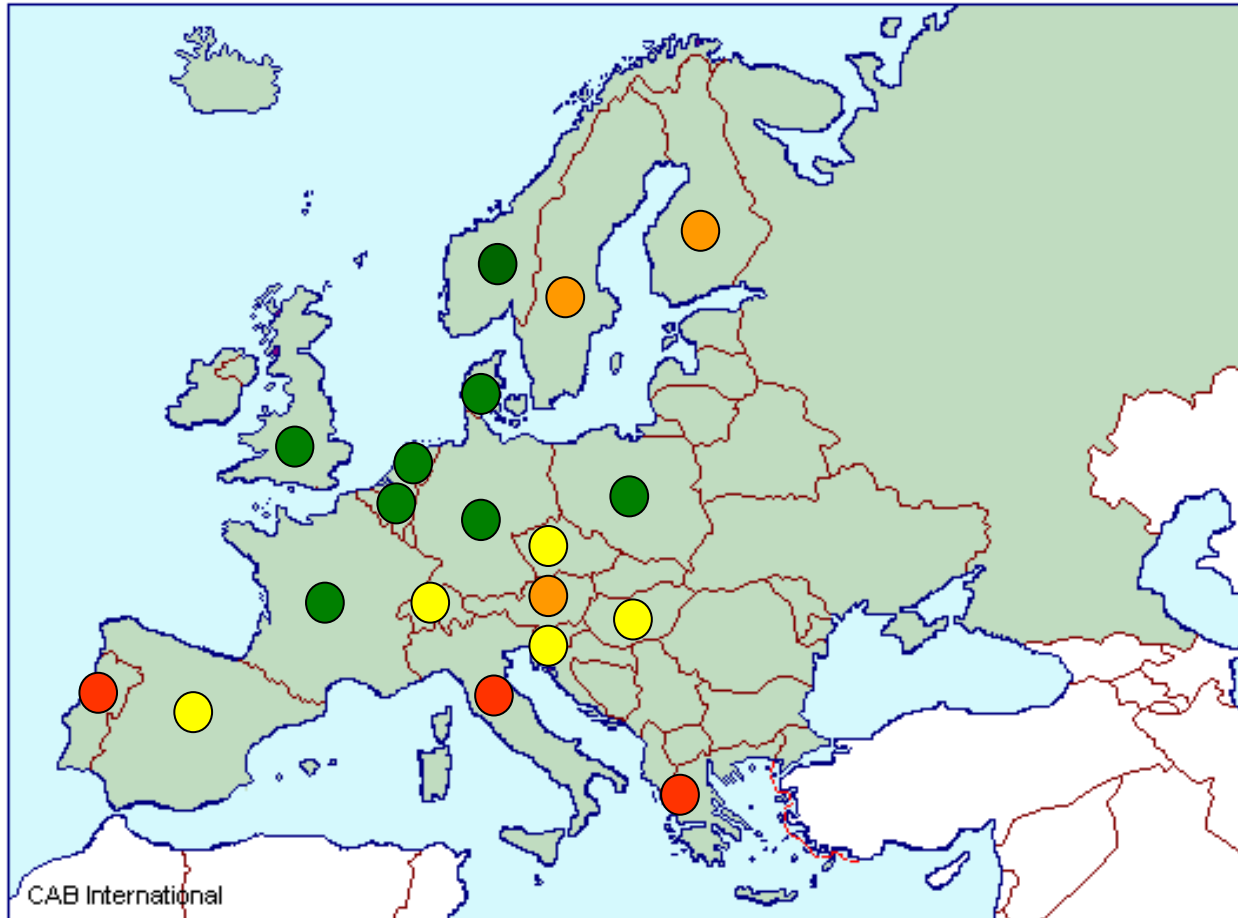
● Implemented (9)

● In preparation (4)

● No regulation (6)



Legal basis for legislation in different EU countries



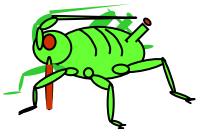
- Substances (3)
(pesticides)
- Plant Health (5)
(phytosanitary)
- Nature Conservation (8)
(environment)
- Unknown/none (3)



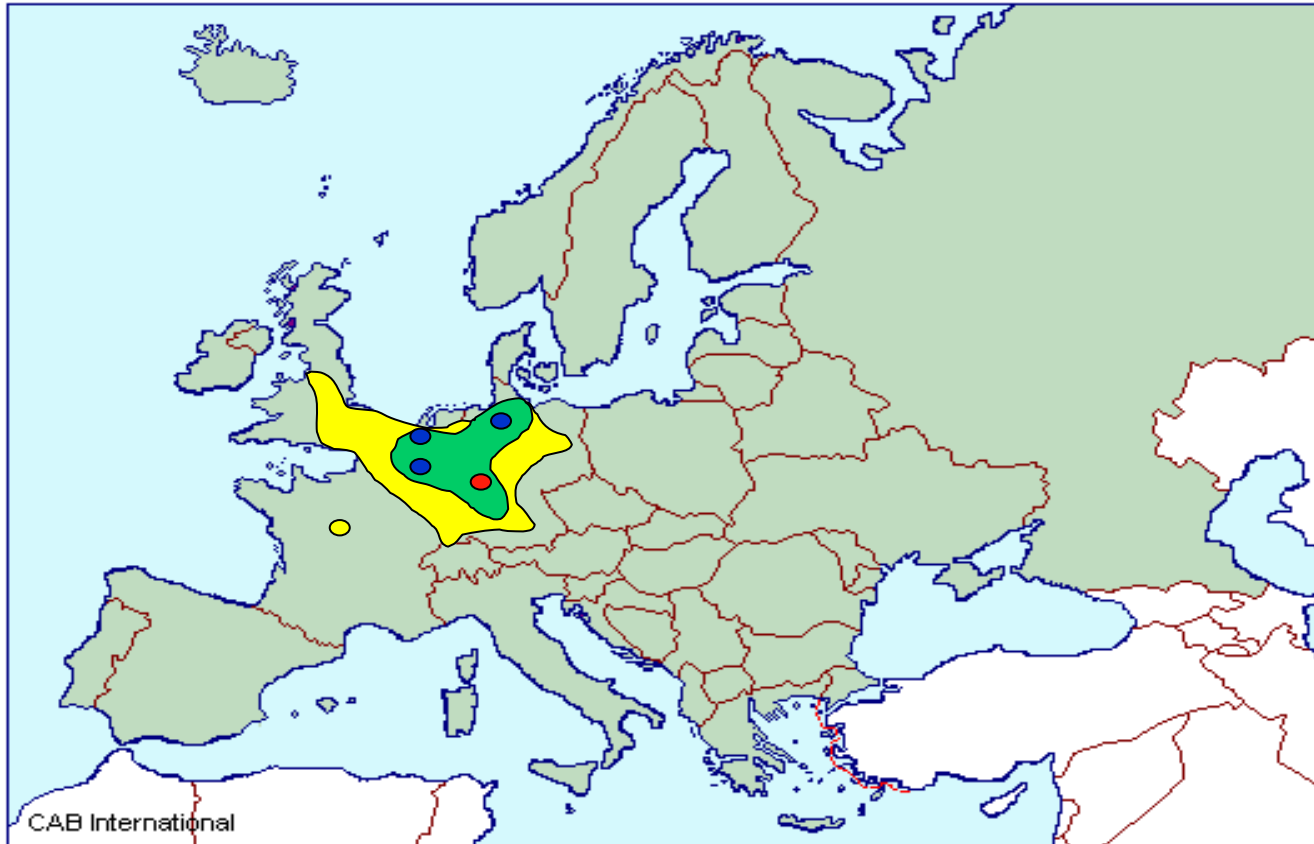


Regulation of Invertebrate BCAs in Europe

- In countries *with* regulation, no consistency in information required for risk assessment
- Reliance on published literature – key information often unavailable
- Assumptions made on basis of ‘climate matching’ as a proxy for direct assessment of thermal tolerance – tropical species will not establish in temperate and colder climates
- Approach has allowed release and establishment of non-native insects and mites – consequences unknown

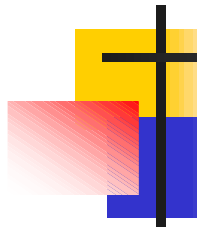


Spread of *Harmonia axyridis* in Europe



- 2000
- 2002
- 2003
- 2004

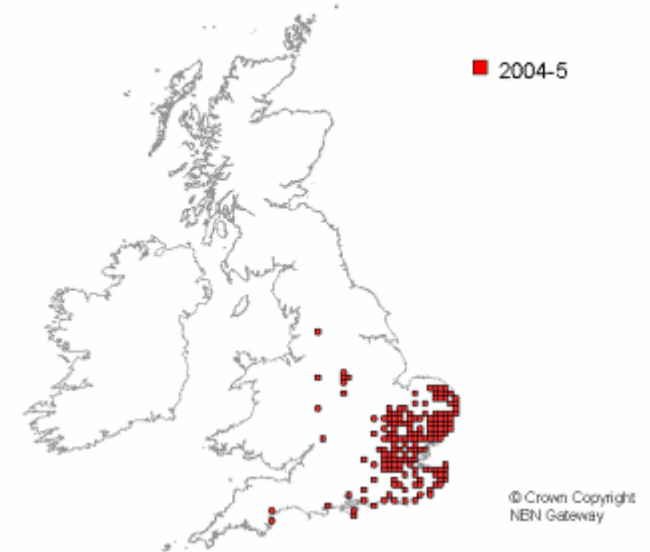




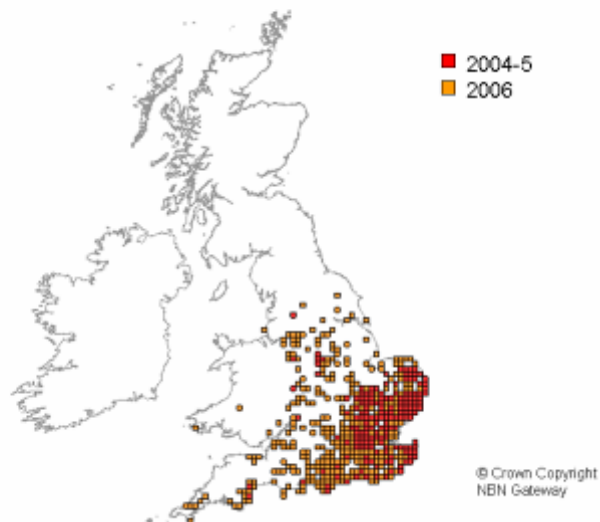
Harmonia axyridis 2004



Harmonia axyridis 2005



Harmonia axyridis 2006



Total number of UK 10 km squares per year with verified records of *H. axyridis*

Year	No. 10 km squares
2004	49
2005	145
2006	428



Harmonia predation of 7- spot ladybird larva

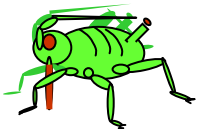




ERA for invertebrate BCAs

Environmental Risk Assessment should be:

- **Quantifiable** - environmental effects of different biological control agents can be compared and choices made, including wider comparison with pesticides
- **Hierarchical** - a tiered or step-wise procedure
- **Provide quick identification of safe or hazardous agents with minimum costs**



IOBC-WPRS initiative - CHIBCA

Biocontrol News and Information 26(4), 115N – 123N
pestscience.com
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Review Article

Guidelines on information requirements for import and release of invertebrate biological control agents in European countries¹

F. Bigler^{a*}, J. S. Bale^b, M. J. W. Cock^c, H. Dreyer^d, R. Greatrex^e, U. Kuhlmann^f, A. J. M. Loomans^g and J. C. van Lenteren^h

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Keywords: authorization; biocontrol safety; nontarget effects; regulation; risk assessment

Abstract

Several international documents have been published in recent years with the objective of providing guidance to industry, biocontrol practitioners and competent national regulatory authorities on the regulatory framework for the import and release of invertebrate biological control agents (IBCA). As the scope and the level of detail given in these documents were diverse in many respects, it has been difficult for all stakeholders to apply such guidelines, and to integrate them in a harmonized way into national regulatory documents. At the request of several stakeholders, the International Organization for Biological Control of Noxious Animals and Plants/West Palearctic Regional Section (IOBC/WPRS) organized an initiative with the objective of merging all relevant international documents into one document, to provide more specific guidance, and to harmonize the regulation of IBAs in European countries and in other countries of the IOBC/WPRS. This document consists of five sections which together form comprehensive guidelines specifying the information required for regulating import and release of IBAs.

- Commission on harmonisation of invertebrate biocontrol agents (CHIBCA)
- Merged previous documents of FAO, EPPO and OECD
- Guidelines produced by representatives of industry, regulatory bodies and science

See Bigler *et al.*, *Biocontrol News and Information* **26**, 2005



ERA for invertebrate BCAs

Annu. Rev. Entomol. 2006. 51:609–34
doi: 10.1146/annurev.ento.51.110104.151129
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First published online as a Review in Advance on September 7, 2005

ASSESSING RISKS OF RELEASING EXOTIC BIOLOGICAL CONTROL AGENTS OF ARTHROPOD PESTS

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Key Words environmental risk assessment, host range, establishment, dispersal,
nontarget effects

■ **Abstract** More than 5000 introductions of about 2000 species of exotic arthropod agents for control of arthropod pests in 196 countries or islands during the past 120 years rarely have resulted in negative environmental effects. Yet, risks of environmental effects caused by releases of exotics are of growing concern. Twenty countries have implemented regulations for release of biological control agents. Soon, the International Standard for Phytosanitary Measures (ISPM3) will become the standard for all biological control introductions worldwide, but this standard does not provide methods by which to assess environmental risks. This review summarizes documented nontarget effects and discusses the development and application of comprehensive and quick-scan environmental risk assessment methods.

- Recent article in *Annual Review of Entomology* **51**, (2006) covers many issues relevant to ERA of invertebrate agents
- Key recommendation is need for a step-wise (hierarchical) testing system

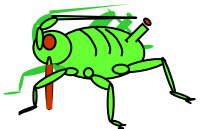
See Van Lenteren *et al.*, *Ann. Rev. Ent.* **51**, 2006





REBECA: Activities, Achievements and Recommendations

- Compared EU regulatory systems with USA, Canada, Australia and New Zealand
- Produced a standardised 'Permit Application' form
- Written an accompanying 'Guidance Document'
- Devised hierarchical ERA with details of methods
- Made recommendations for update of EPPO Positive List
- Set out options for implementing a balanced regulatory system in Europe

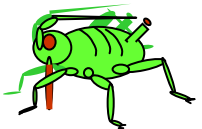




REBECA: Activities, Achievements and Recommendations

Licence (Permit) Application form

- Single form to be used in all EU countries, and for all applications: native and non-native, research only or commercial release
- Clearly structured depending on purpose of application
- Describes exemptions where appropriate
- Explicitly linked to accompanying Guidance Document

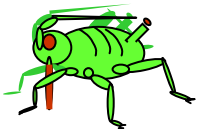




REBECA: Activities, Achievements and Recommendations

Licence (Permit) Application Guidance Document

- Directly cross-referenced to Application form
- Divided into same sections (native, non-native)
- Explains what information is required and why
- Incorporates exemptions and waivers





REBECA: Activities, Achievements and Recommendations

Licence Application form and Guidance Document

- Structured in 5 parts

Part 1: Information on applicant

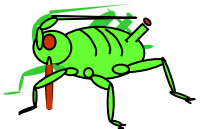
Part 2: Information on IBCA

Part 3: Information on release of non-native IBCA (ERA)

Part 4: Submission details for NCA

Part 5: Appendix of cited literature

- Parts 1,2, 4 and 5 for all applications; Part 3 only for commercial release of non-native IBCA

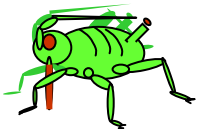




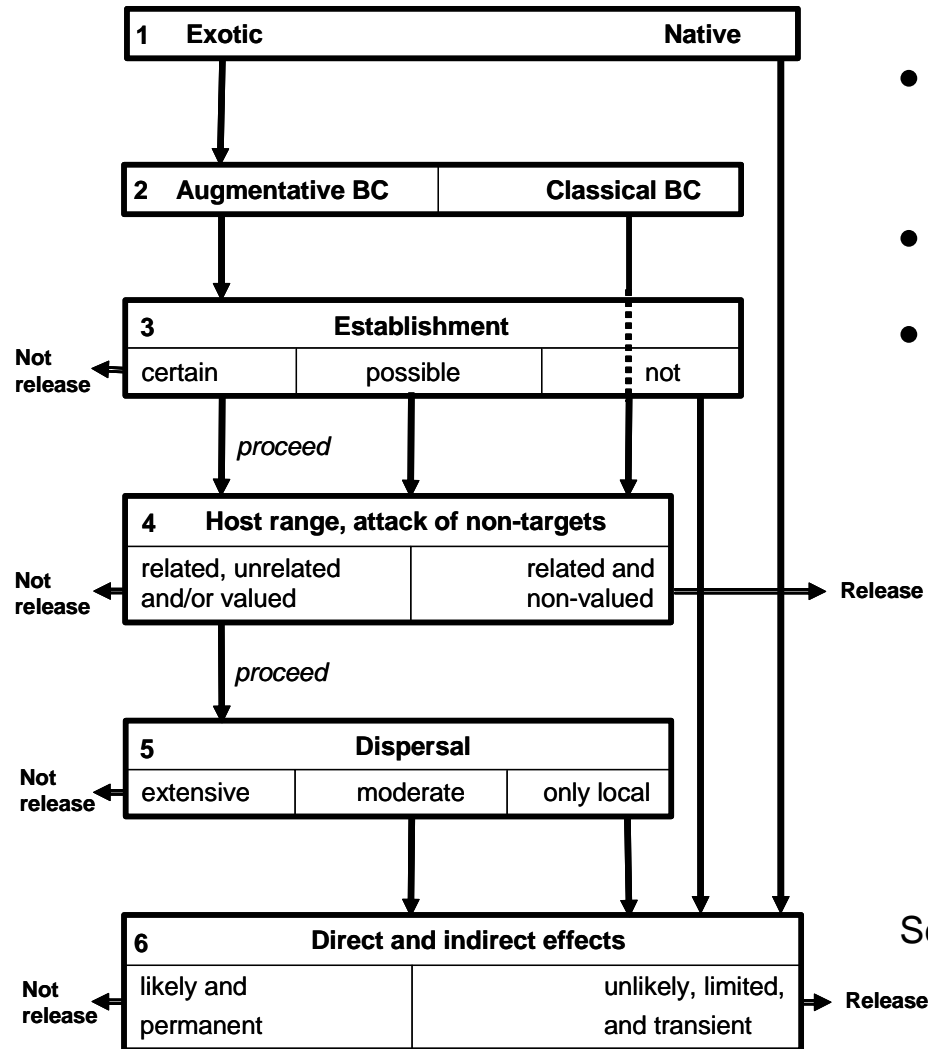
REBECA: Activities, Achievements and Recommendations

Generic hierarchical Environmental Risk Assessment (ERA)

- Used in combination with Application form and Guidance Document
- Focus on Inundative control, but relevant to Classical control and use of native species
- Step-wise testing procedure with exemptions
- Evidence-based with references to case studies



Generic hierarchical ERA



- Distinguishes between Exotic/Native, and Augmentative/Classical control
- Has 'Full' and 'Quick' Scan options
- Identifies key features of ERA:

Establishment

Host range

Dispersal

Direct effects

Indirect effects

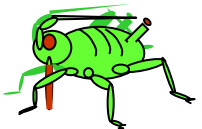
See Van Lenteren *et al.*, *Biocontrol* **48**, 2003





Current issues in Europe

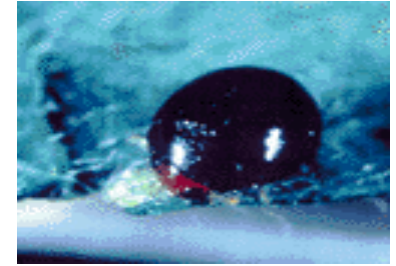
- In northern Europe, biological control mainly in glasshouses (inundation) - risk assessment should focus initially on establishment – without establishment, other effects unlikely to be major
- In southern Europe, also inundation, but climate allows year round survival and reproduction – establishment more likely – focus on host range – also the dominant issue with classical control



ERA methodologies: Establishment



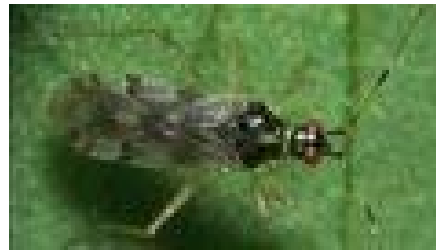
Macrolophus caliginosus



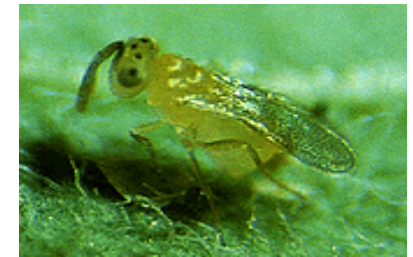
Delphastus catalinae



Typhlodromips montdorensis



Dicyphus hesperus



Eretmocerus eremicus

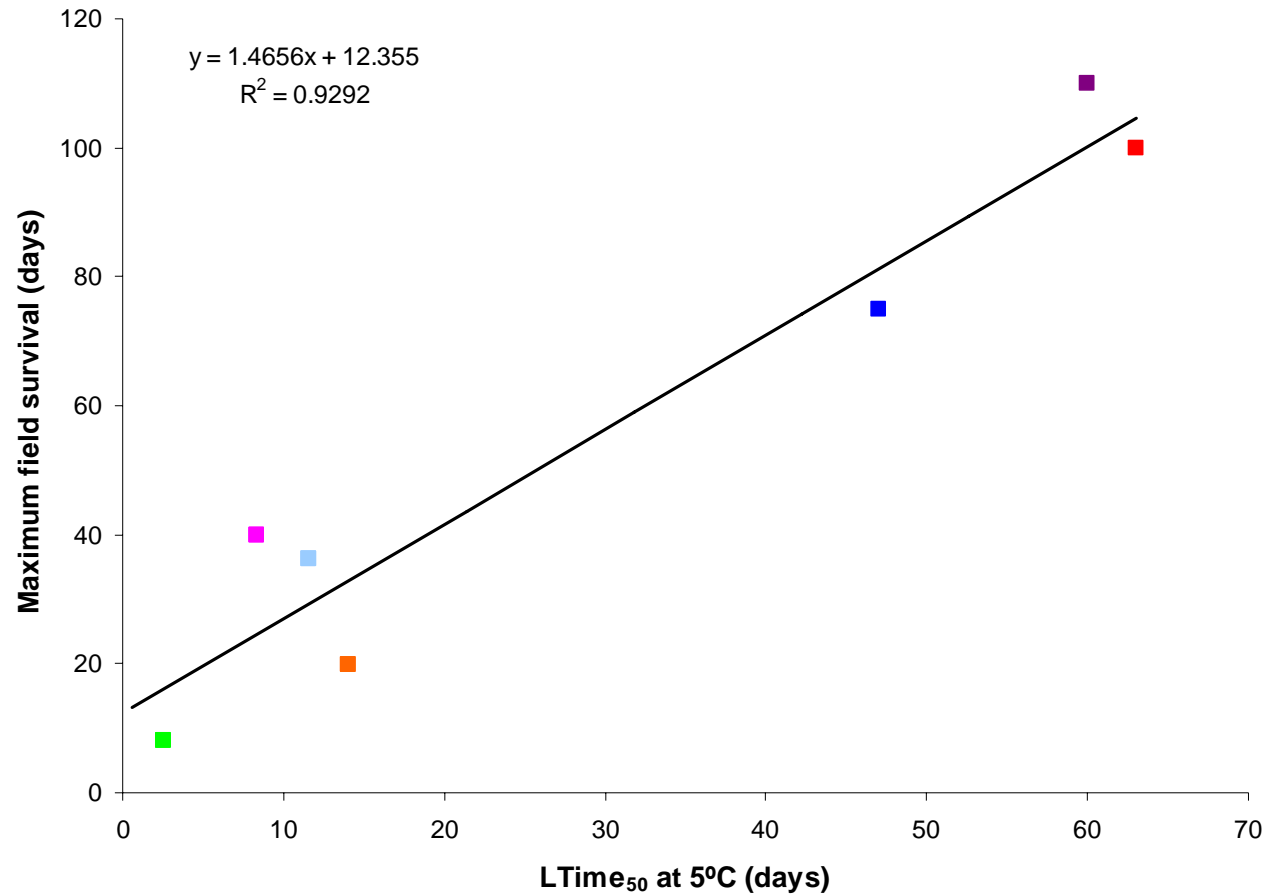


Neoseiulus californicus

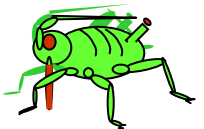


Amblyseius swirskii

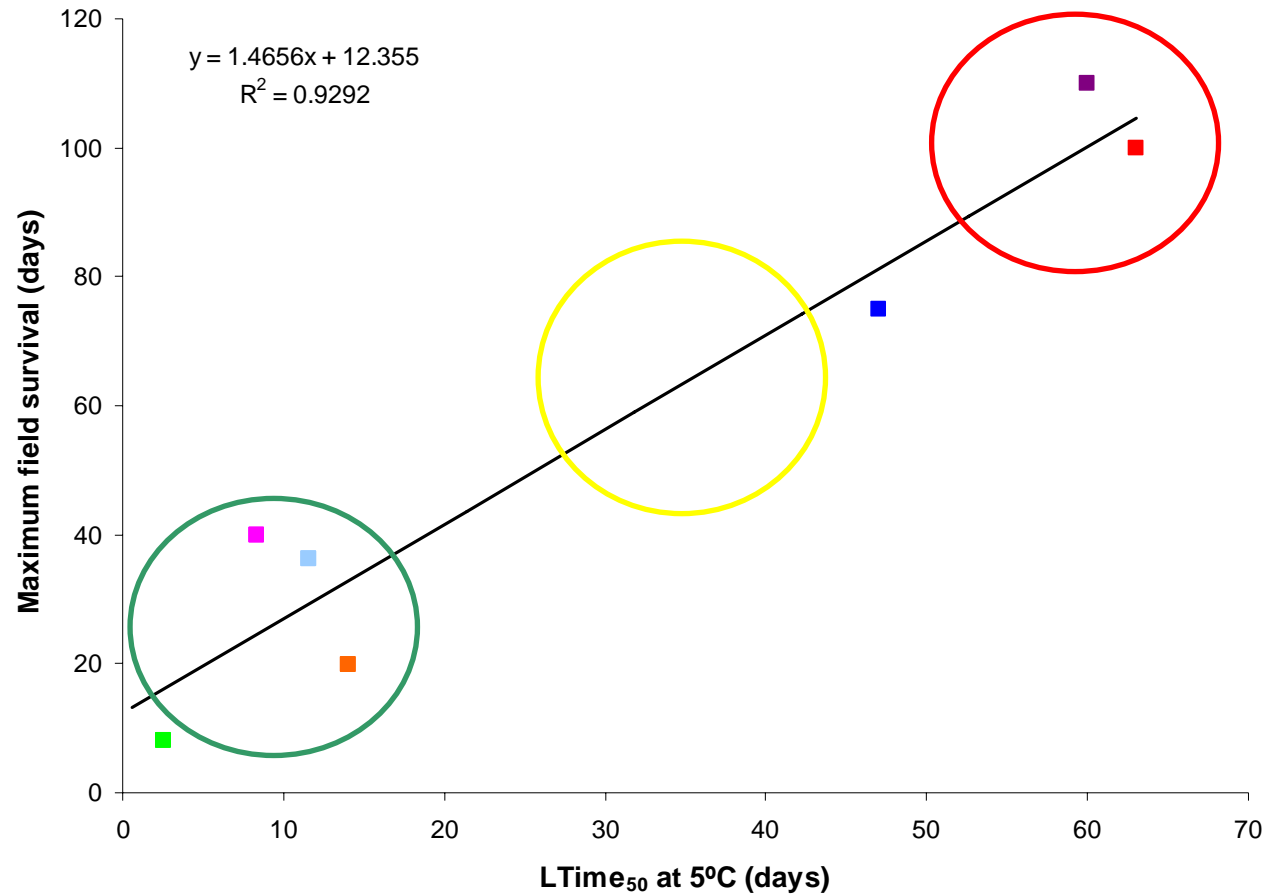
Relationship between LTime₅₀ at 5°C (laboratory) and winter field survival of seven non-native glasshouse biocontrol agents



- M. caliginosus ■ N. californicus ■ D. catalinae ■ E. eremicus
■ T. montdorensis ■ D. hesperus ■ A. swirskii



Relationship between LTime₅₀ at 5°C (laboratory) and winter field survival of seven non-native glasshouse biocontrol agents



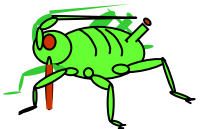
- M. caliginosus
- N. californicus
- D. catalinae
- E. eremicus
- T. montdorensis
- D. hesperus
- A. swirskii





ERA methods: Host range

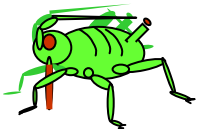
- Most difficult and potentially most expensive part of ERA for biocontrol companies
- Current ideas recommend tests on at least 10 species drawn from three categories: 1. 'Phylogenetically related', 2. 'Share same niche' and 3. 'Unrelated safeguard species'
- Detail of methods important: size of test arena, choice or no choice, attack or development and reproduction





ERA methods: Host range

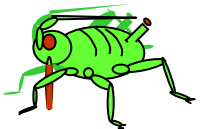
- Idea of a 'two stage' process
- Testing of 10 or more species expensive – useful to have preliminary test – specific or polyphagous
- Stage 1: 3 - 4 species e.g. 1 or 2 species from same or similar taxon, 1 or 2 unrelated, but common and available in winter
- If some specificity - proceed to Stage 2; if accepts all prey/hosts, consider cost effectiveness of further tests





ERA methods: Host range

- *Macrolophus caliginosus* is a polyphagous predator targeted against Glasshouse Whitefly (*Trialeurodes vaporariorum*)
- If its host range was NOT known, could test performance on glasshouse target, a close relative (Cabbage Whitefly *Aleyrodes proletella*) and a common 'unrelated' species e.g. aphid *Myzus persicae*
- Compare development and reproduction



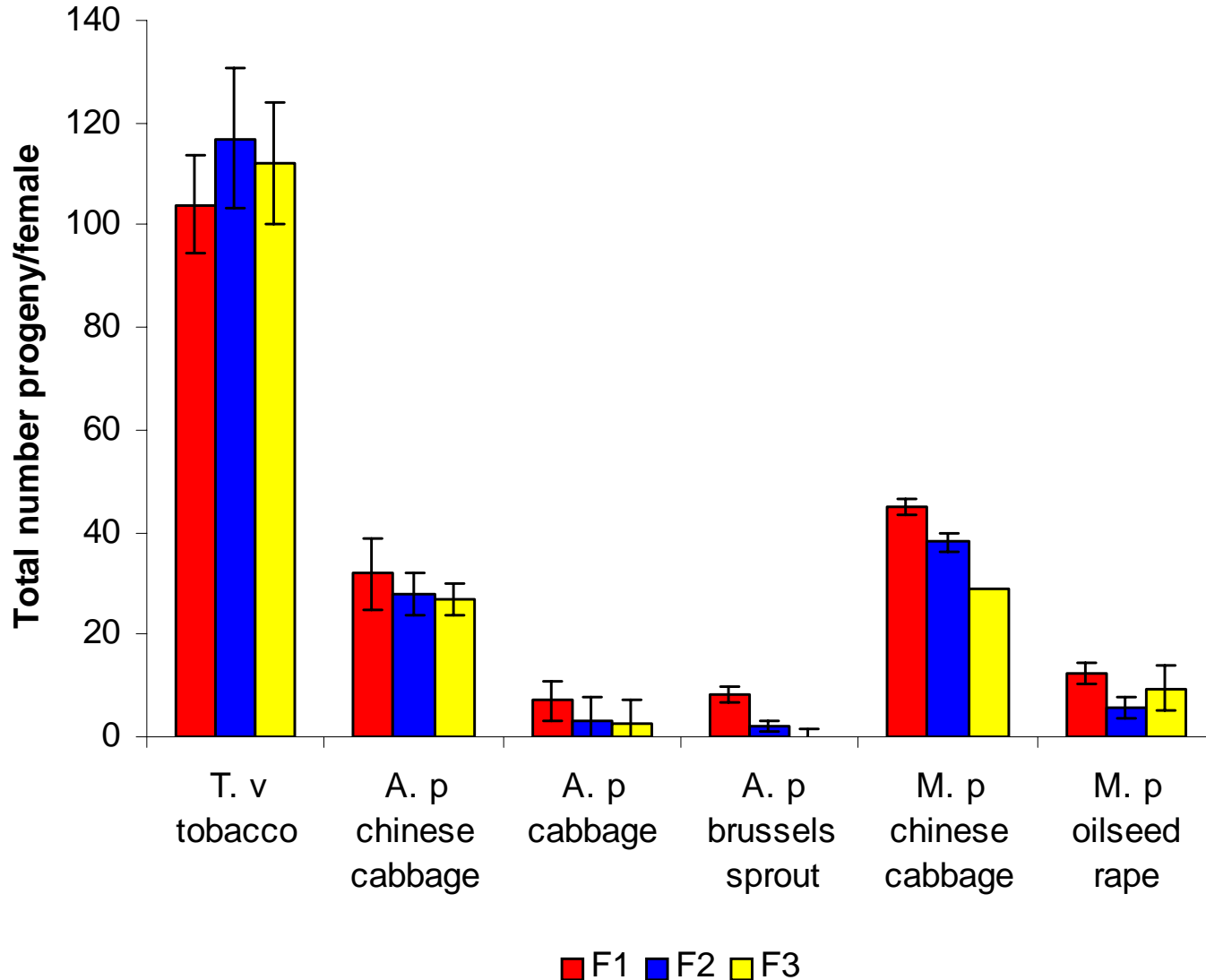


Performance of *Macrolophus caliginosus* on different prey

Prey and host plant	Generation	Developmental time (days \pm SE)	Mortality (%)
<i>Trialeurodes vaporariorum</i> (tobacco)	F1	31.5 \pm 0.27	33
	F2	32.9 \pm 0.14	32
	F3	31.9 \pm 0.15	32
<i>Aleyrodes proletella</i> (cabbage)	F1	35.2 \pm 0.3	66
	F2	34.9 \pm 0.4	86
	F3	37 \pm 0.50	77
<i>Myzus persicae</i> (oil seed rape)	F1	34.0 \pm 0.36	33
	F2	31.7 \pm 0.37	50
	F3	31.9 \pm 0.37	51



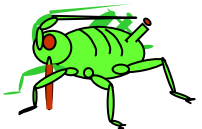
Number of progeny (\pm SE) per *M. caliginosus* reared on different prey and host plants





ERA methods: Dispersal

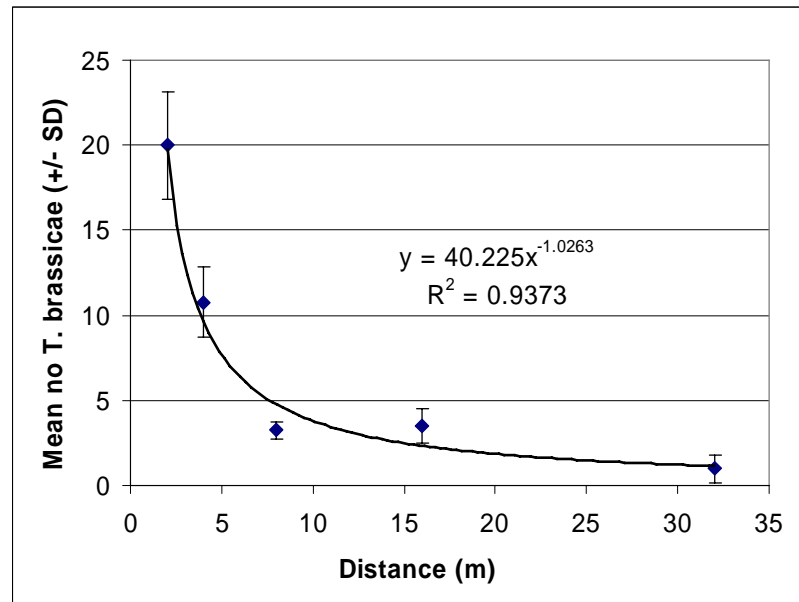
- Will not be necessary for most species – if can establish, dispersal will follow: how soon, how far
- Dispersal assessed only for ‘open field’ releases or structures that do not prevent escape (no reliable methods for long range dispersal – monitoring)
- In longer term, create a database of ‘typical dispersal distances’ for different taxa



Dispersal studies on *Trichogramma brassicae* in the field



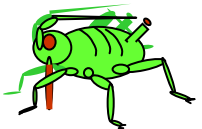
- Do parasitoids leave the field?
- How far do they travel?





ERA methods: Nematodes

- Entomopathogenic nematodes (EPNs) closely associated with specific symbiotic bacteria
- In general, no risks to human health (*Heterorhabditis indica* and *Photorhabdus asymbiotica* are exceptions)
- EPNs have much lower establishment and dispersal than insects and mites and highly host specific
- EPNs can be included in generic ERA with exemptions and flexible route through process – ERA tests available if required





REBECA: Activities, Achievements and Recommendations

EPPO Positive List

- List of biological control agents widely used in EPPO region, created in 2002
- Informs decisions on import and release of safe IBCAs by National Competent Authorities of EPPO countries
- Invertebrate biological control agents are listed in Appendix I and II



Positive List: Appendix I

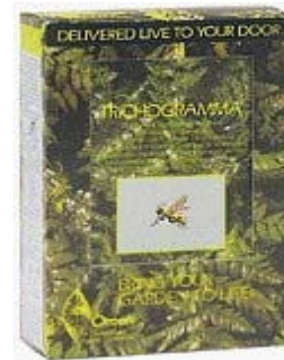
- Commercially available invertebrate BCAs: native and exotic species for inundative/inoculative indoor and outdoor use



Nematodes



Trichogramma



Encarsia formosa



Positive List: Appendix II

- Successfully introduced invertebrate BCAs for classical biocontrol





EPPO Positive List: future plans

- REBECA and IOBC discussed Positive List with EPPO
- Agreement in principle to establish EPPO-IOBC Expert Group
- Urgent need to review existing list – remove any risky species
- Establish criteria for new entries on list – 5 years safe use in 5 countries
- Determine mechanism for information dissemination: web format



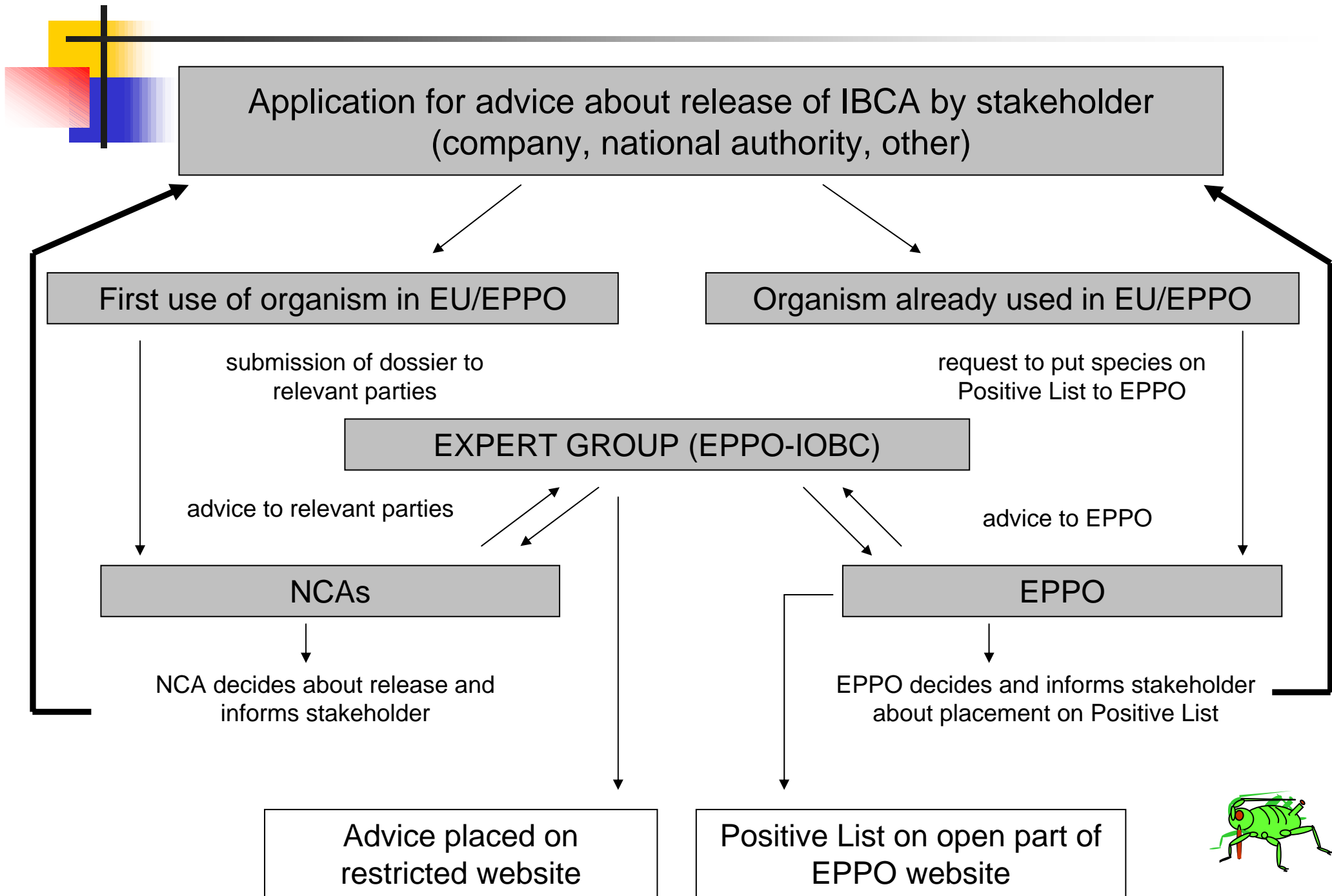


REBECA: Activities, Achievements and Recommendations

Implementation of pan-European regulation of IBCAs

- All EU countries should use same 'Dossier Application form', supported by same 'Guidance Document' and same 'ERA system' – all produced by the REBECA project
- But even in countries with regulation, expertise in biocontrol and ERA often lacking
- Clear role for an Expert Group to provide advice







REBECA: Summary of Activities, Achievements and Recommendations

- Reviewed regulatory systems in USA, Canada, Australia and New Zealand – distilled into best framework for Europe
- Produced a standardised ‘Permit Application’ form
- Written an accompanying ‘Guidance Document’
- Devised hierarchical ERA with methods
- Made recommendations for update of EPPO Positive List
- Set out options for implementing a balanced regulatory system in Europe

