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Federal Research Centre for Cultivated Plants

IPM and plant protection in organic farming - common features and differences

Hedges and field margins and their meaning for agrobiodiversity

Stabilisation of biological control in greenhouses by predatory flies

Stefan Kühne

Institute for Strategies and Technology Assessment, Stahnsdorfer Damm 81, 14532 Kleinmachnow

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Field of research

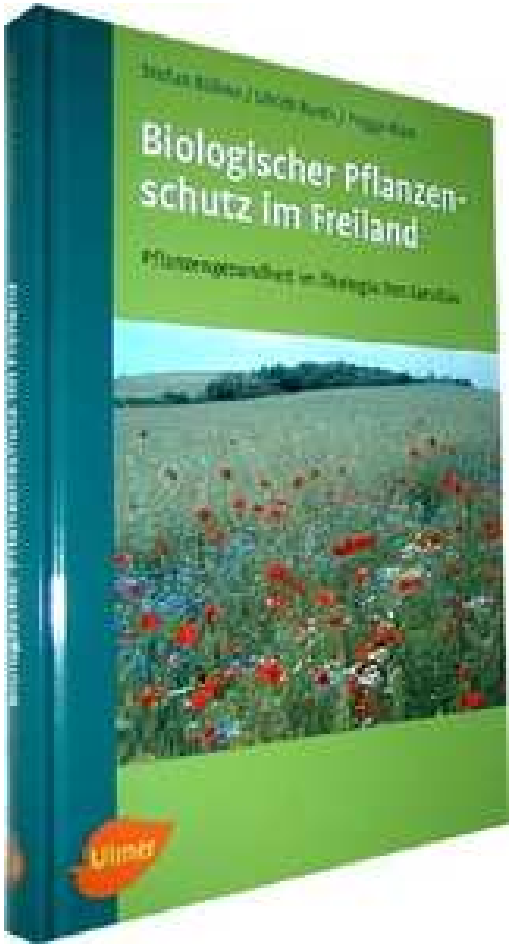
- Entomologist
- Development of plant protetion concepts in organic farming
- beneficial / pest interactions

Honorary Professor at University for Sustainable Development Eberswalde
Assistant Professor at Humboldt-University Berlin, Agricultural Department

Federal Research Centre for Cultivated Plants
Julius Kuehn-Institute (JKI)

- **Institutes:** 15 specialized institutes
- **Budget:**
  Federal budget 62 Mio €, third-party funds 5 Mio €, total 67 Mio €
- **Staff:**
  Permanent posts 831, total staff 1.150, scientists about 250

Plant protection in organic farming



Stefan Kühne, Ulrich Burth, Peggy Marx (eds.)
Biologischer Pflanzenschutz im Freiland - Pflanzengesundheit im Ökologischen Landbau
erschienen Juni 2006
288 Seiten, 256 Farbfotos, Gebunden
Ulmer, Eugen, GmbH & Co. | ISBN: 3800147815

Crop protection strategies

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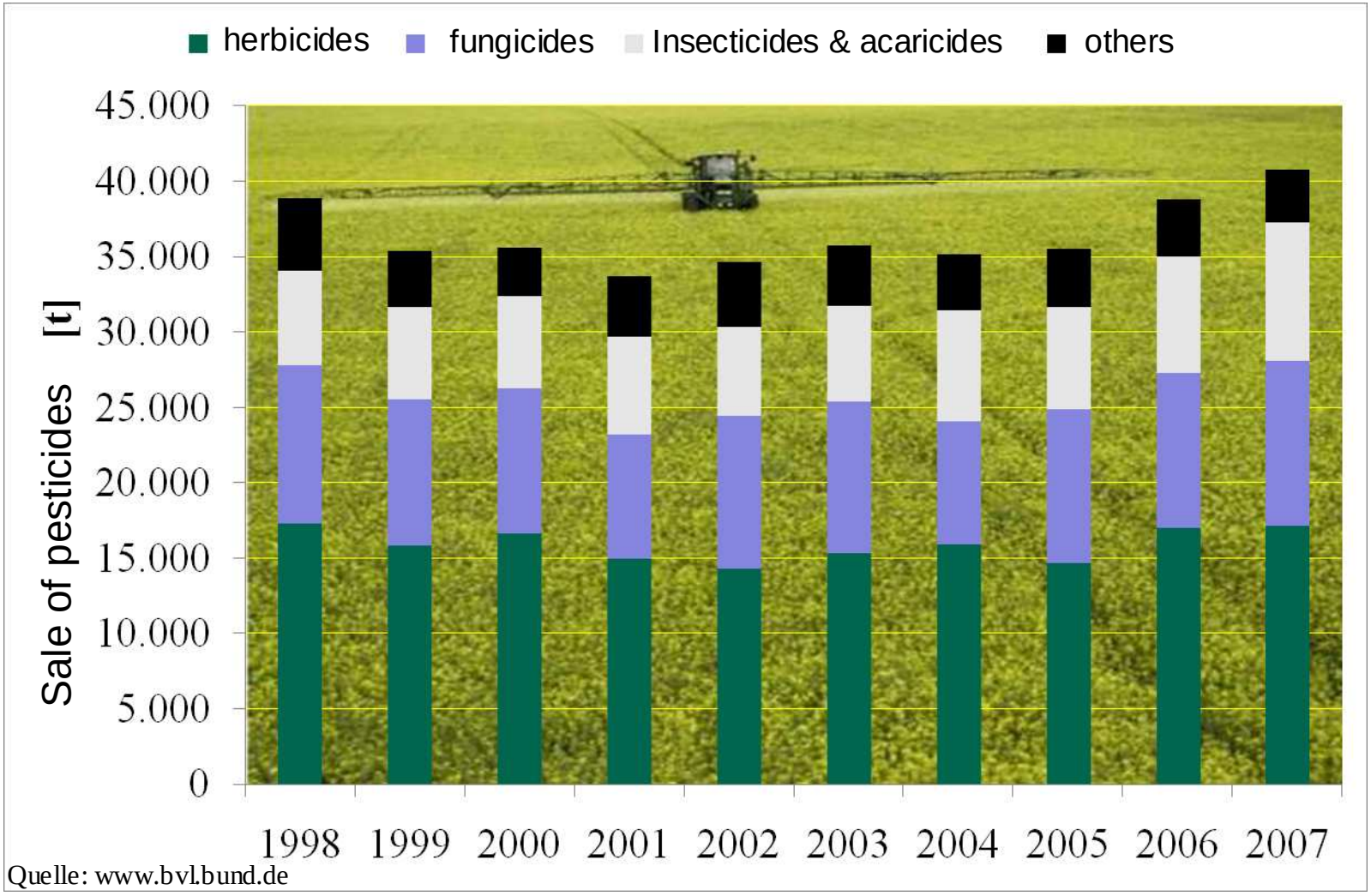
Integrated crop protection

- Use of all possible ways of damage prevention
- Control measures after assessment of infestation and dosage according to the situation
- Use of natural control mechanisms and consideration of ecological demands

Crop protection in organic farming

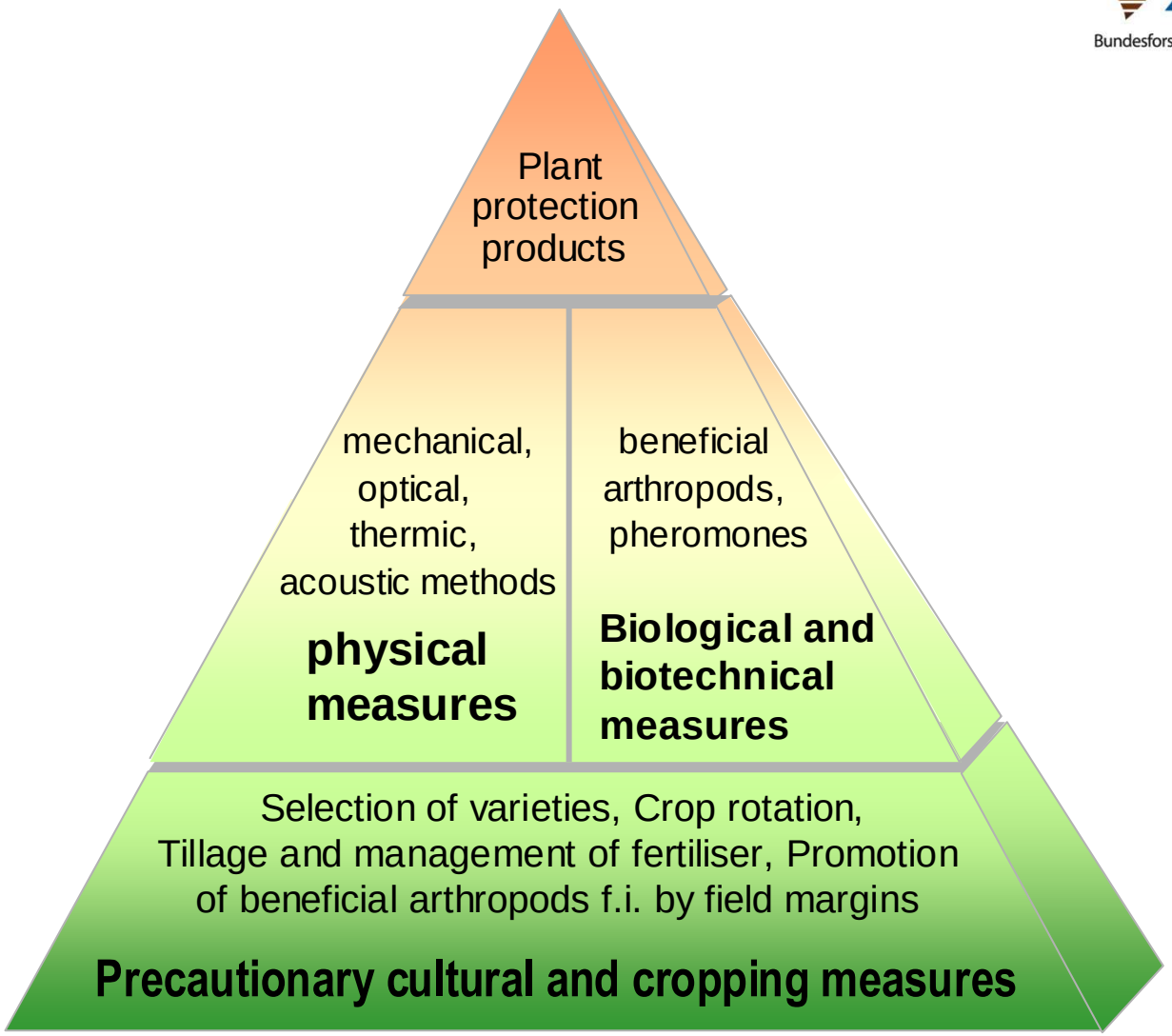
- No synthetic pesticides
  No herbicides
  No GMO
- Use of natural control mechanisms
- Employment of beneficial organisms
- Controlled use of pesticides based on natural substances and Plant strengtheners

Sale of pesticides in Germany



Quelle: www.bvl.bund.de

Framework of plant protection in organic farming



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Experimantal field

= organic farming

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Colorado beetle – *Leptinotarsa decemlineata* Say

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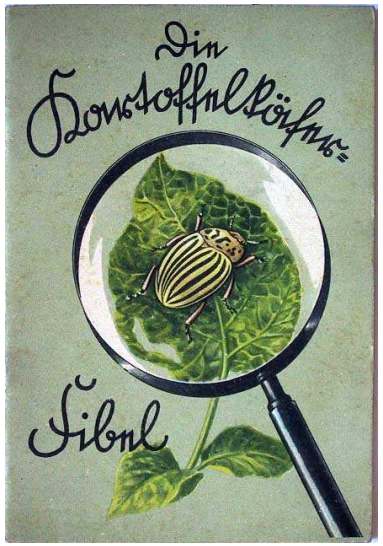
Colorado Potato beetle (*Leptinotarsa decemlineata* Say)

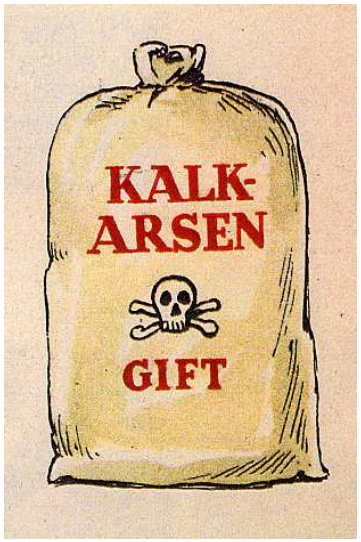
1936

first time in Germany

1937

First law of plant protection in Germany enabled the Organisation and funding of control measurements of Colorado Potato Beetle





Colorado Potato Beetle-decoration

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Decoration for the finder of an new beetle population

Control of Colorado Potato Beetle

ca. 1936 – 1955	lime- and lead arsenic
ca. 1945 – 1980	chlorinated hydrocarbons (DDT, HCH, Lindan u.a.)
seit 1970	phosphoric acid compounds, synthetic pyrethroids
seit 2007	Neonicotinoids

after 10- 12 years of application only one active ingredients resistent population appeared

Colorado beetle to advance

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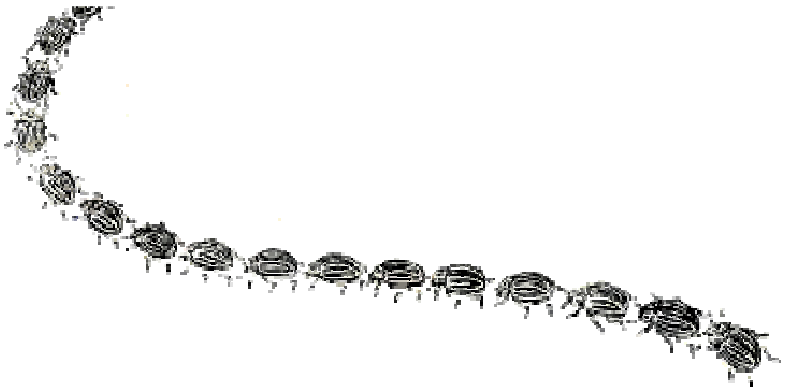
- **Favorable weather conditions in the summer with emerging of a second beetle generation**
- **Concentration of potato production without regulation of Colorado beetle**
- **More often hibernation of potato tuber in the field and growing in following crop as weed**



Experimental site in Dahnsdorf

▭ = organic farming

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Application of active ingridients (a.i.) from 2005 to 2008

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Azadirachtin (Neem)

Extrakt from tropical neem tree *Azadirachta indica*

Pyrethrum

Extract from flowers of Chrysanthemen
Tanacetum cinerariifolium

Bacillus thuringiensis (*B.t.t.*)

insect pathogen Bacteria

Spinosad

Fermentation product derived from
actinomycete bacterium *Saccharopolyspora spinosa*
2008 hold on the EU-Regulation for organic farming

Spraying of Colorado Potato Beetle, Dahnsdorf

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fields on 08.07.2008

untreated
control

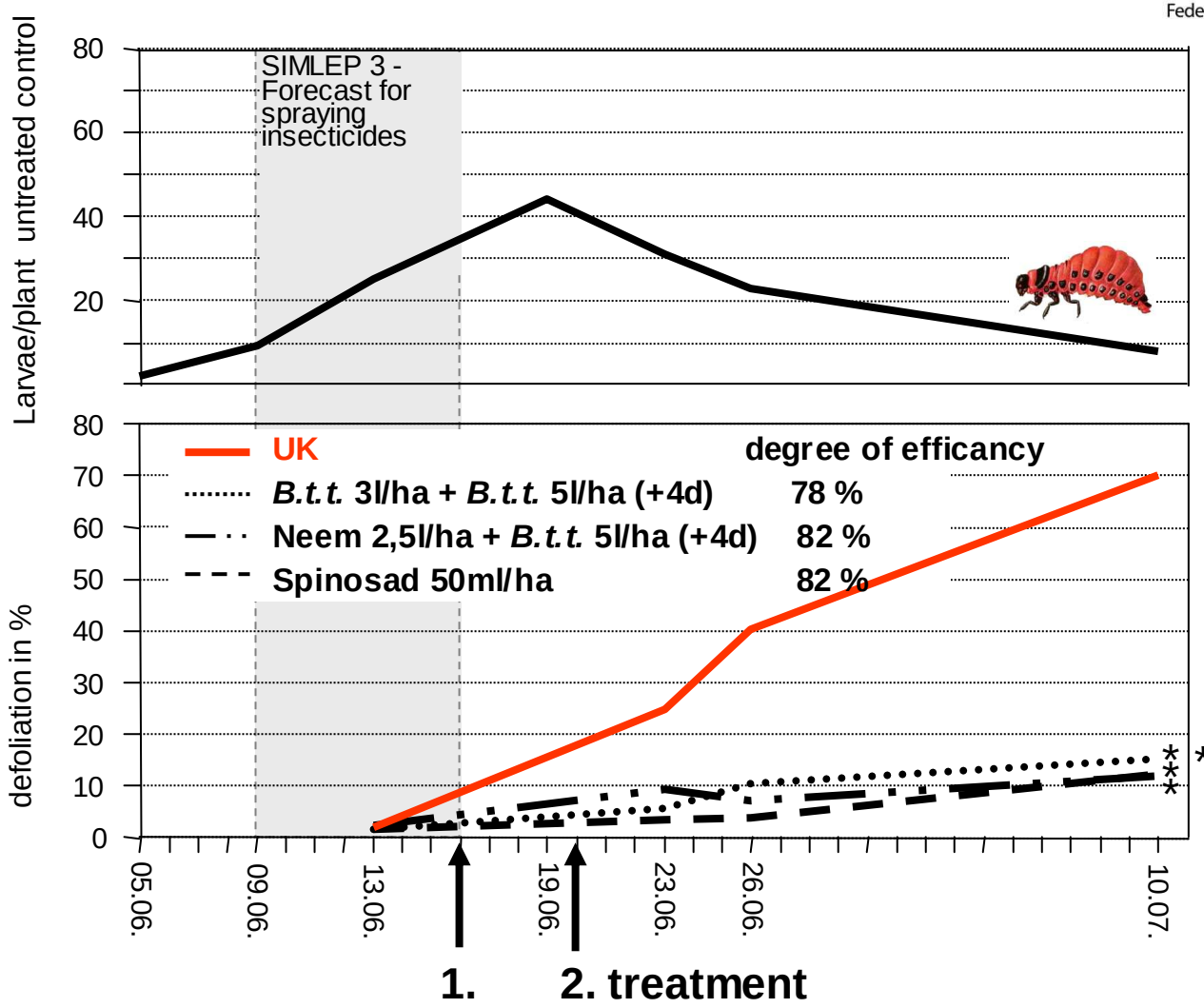
B.t.t 3 l
B.t.t. 5 l
+ 4 d

Neem 2,5 l
B.t.t. 5 l
+ 4 d

Spinosad 0,05 l

22 days after first treatment

Defoliation by Colorado beetle 2008

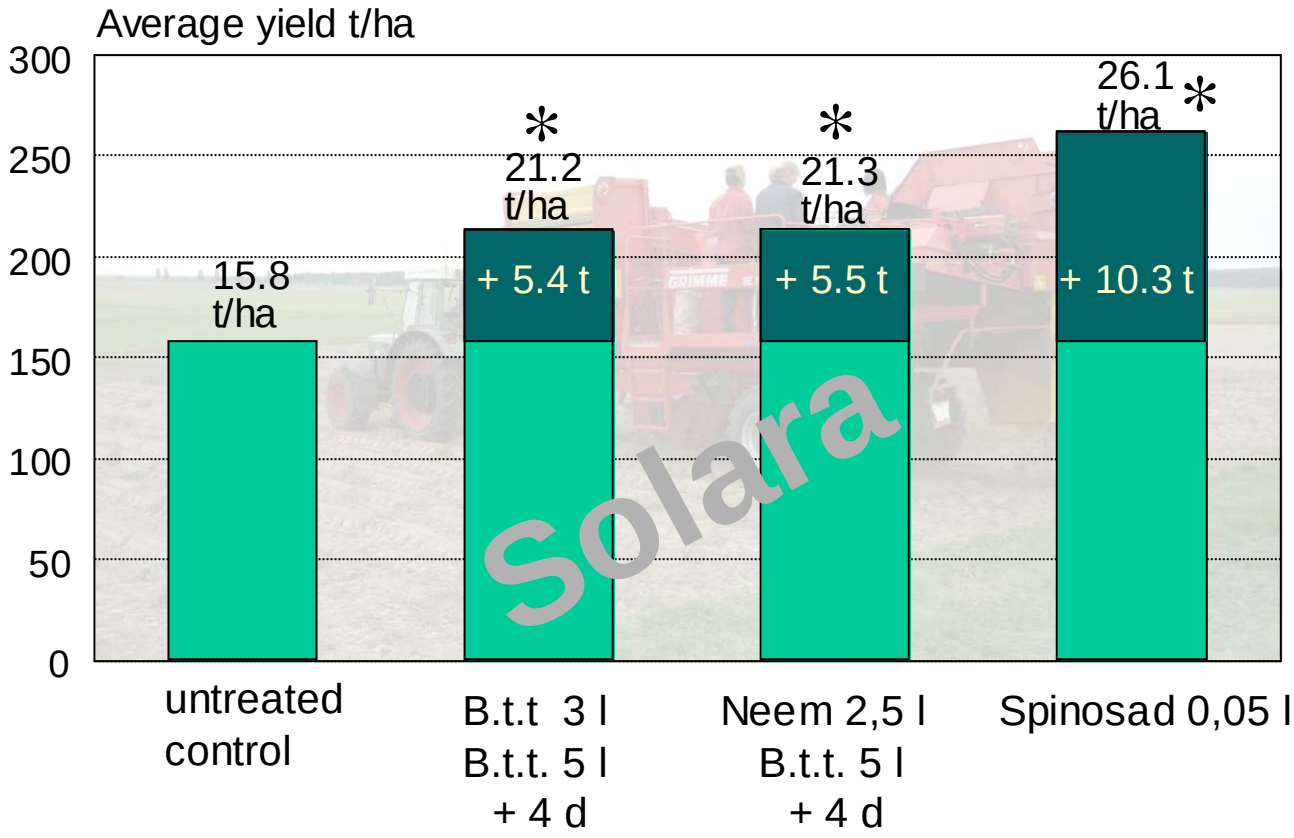


*Significant to untreated control (Tukey-Test P<0,05)

Kosten in Euro pro Hektar

	Behandlungs-Kosten €/ha	Mittelkosten €/ha	Gesamt €/ha
Novodor + Novodor	32	171	203
Neem + Novodor	32	245	277
Spintor	16	20	36

Potato yield und economic return



* signifies to untreated control
(Tukey's test; P<0.05)

Beneficial insects 2008

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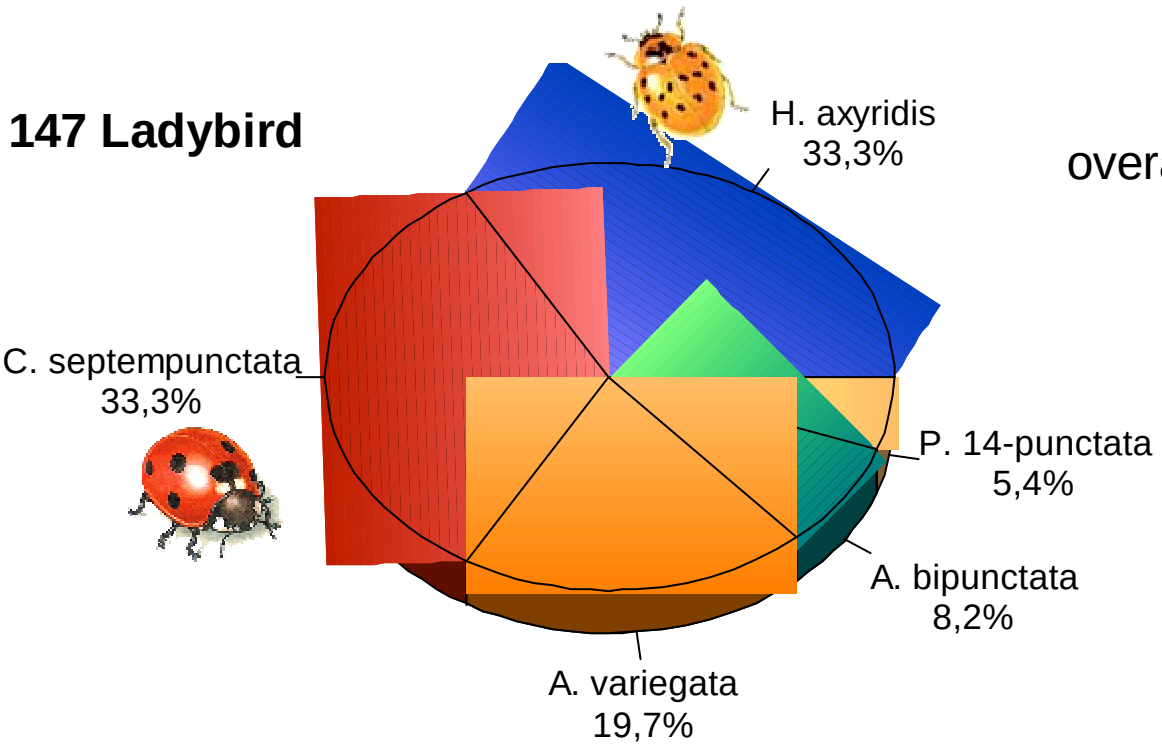
147 Ladybird



overall: 585 beneficial insects

147 ladybird
185 larvae of ladybird
206 pupae of ladybird
40 spider
4 eggs of lacewing
1 Flolacewingrfliege
1 larvae of hover fly
1 pupae of hover fly

Harlequin Ladybird (*Harmonia axyridis*), Dahnsdorf 2007

Predators of Colorado Potato Beetles

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Beneficial insects 2008

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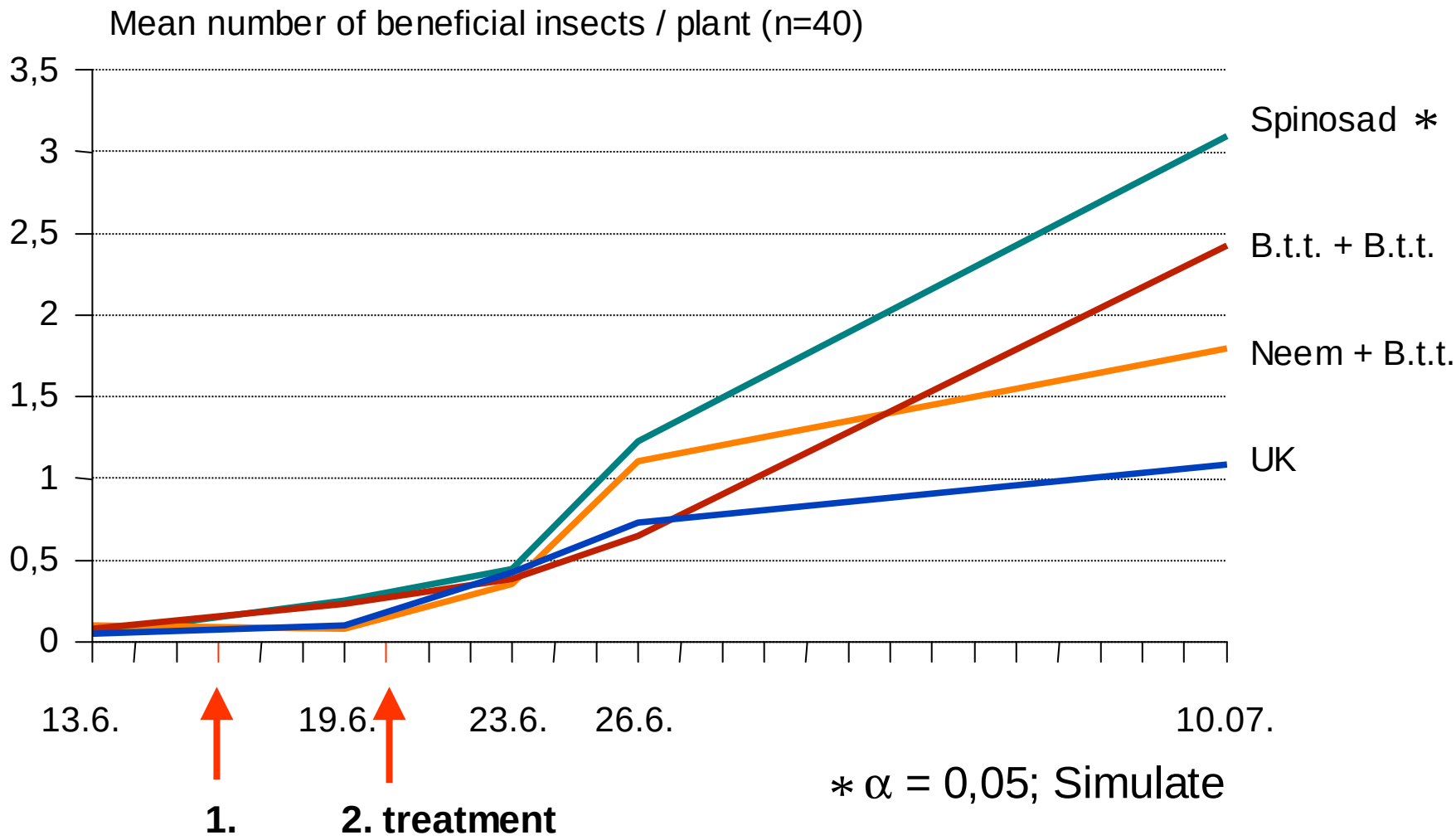

fields on 08.07.2008

untreated
control

B.t.t 3 l
B.t.t. 5 l
+ 4 d

Neem 2,5 l
B.t.t. 5 l
+ 4 d

Spinosad 0,05 l

22 days after first treatment

Summary

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- Natural insecticides are used as a last option for the control of pests in organic farming
- Natural insecticides are generally less stable than synthetic materials and degrade quickly in the environment
- Natural insecticides less potent and have shorter residual periods than their synthetic counterparts
- The treatment should be based on accurate pest control to find out the optimal date of application

Summary

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- Resistance of insects against natural insecticides can be a result of the frequent application of their synthetic counterparts in conventional farming systems
- Natural insecticides conserve beneficial organisms are to prefer
- It can be economic to apply insecticides against the Colorado beetle, because significian additional profit can result
- The combination of different natural insecticides can have an synergetic effect

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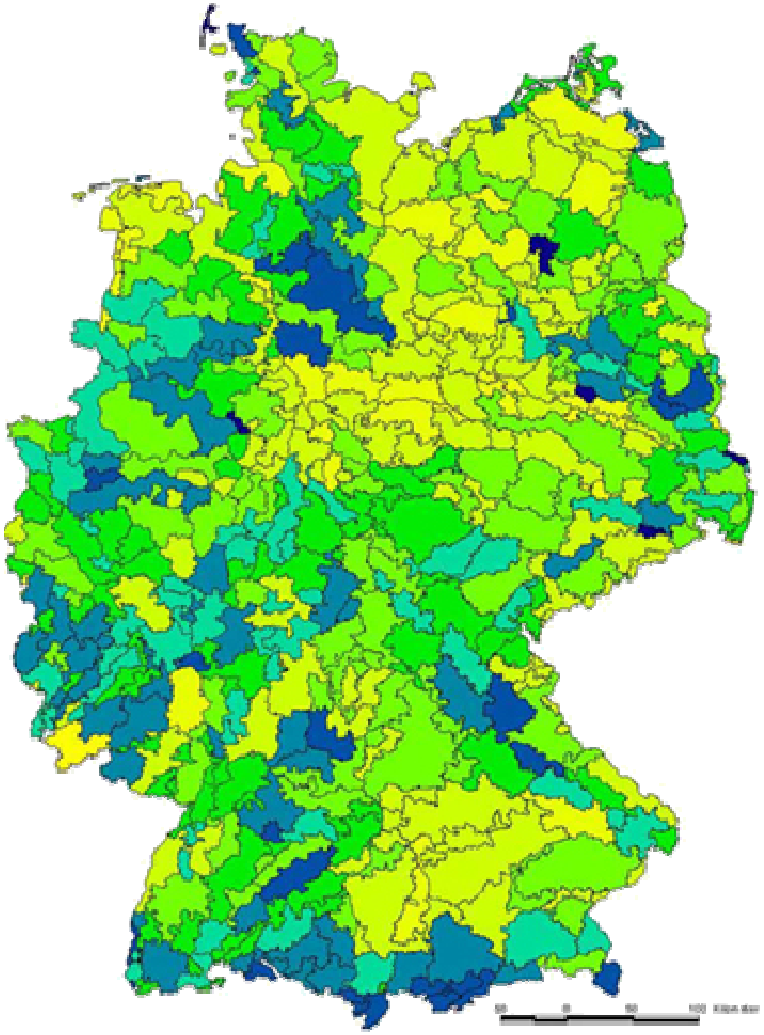
Federal Research Centre for Cultivated Plants

Hedges and field margins and their meaning for agrobiodiversity

Stefan Kühne

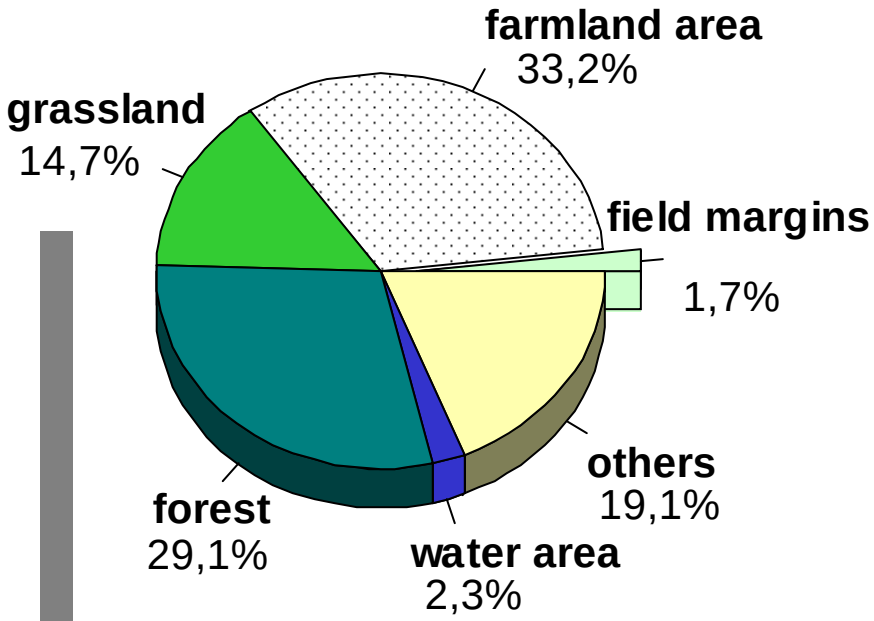
Institute for Strategies and Technology Assessment, Stahnsdorfer Damm 81, 14532 Kleinmachnow

Proportion of field margins in Germany



0 – 2,5
2,5 – 4,5
4,5 – 6
6 – 7
7 – 8
8 – 9
9 – 11
11 – 16
16 – 30

Proportion of field margins in percent



Percentage surface of small and large-scale structures in the total of Germany out of 35 685 395 ha (adopted field margin width of 4 m)
Length: 2,5 Mio km
Surface: 1,7 Mio ha

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Typing of small structures in the vicinity of agricultural land

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- Linear small structures
  = field margins
  - **edges of the forest**
  - **hedges**
  - **field boundary**
  - **roadsides**
  - **bank border**
  - **ditches**
  - **walls of stones**
- plane or punctate
  Small structures
  - **small forest**
  - **field grove**
  - **schrubbary**
  - **pile of stones**
  - **single trees**

Field margins

Hedges

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Mittelhecke

Wallhecke

Schichtholzhecke

Subject of protection – field margin

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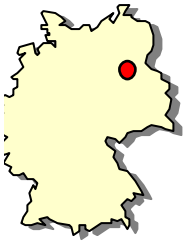
General statements

- high value for agro-biodiversity - pest regulation, biotope for organism special adapted on these living condition
- diverse flora caused diverse fauna
- smal field margins (< 3 m) influenced by land use (z. B. Eutrophierung), wider field margins (> 15 m) are more robust

Year of creation 1993



Hedge - 1998

Hedge - 2000

Hedge - 2004

Hedge - 2004

Trees and shrubs

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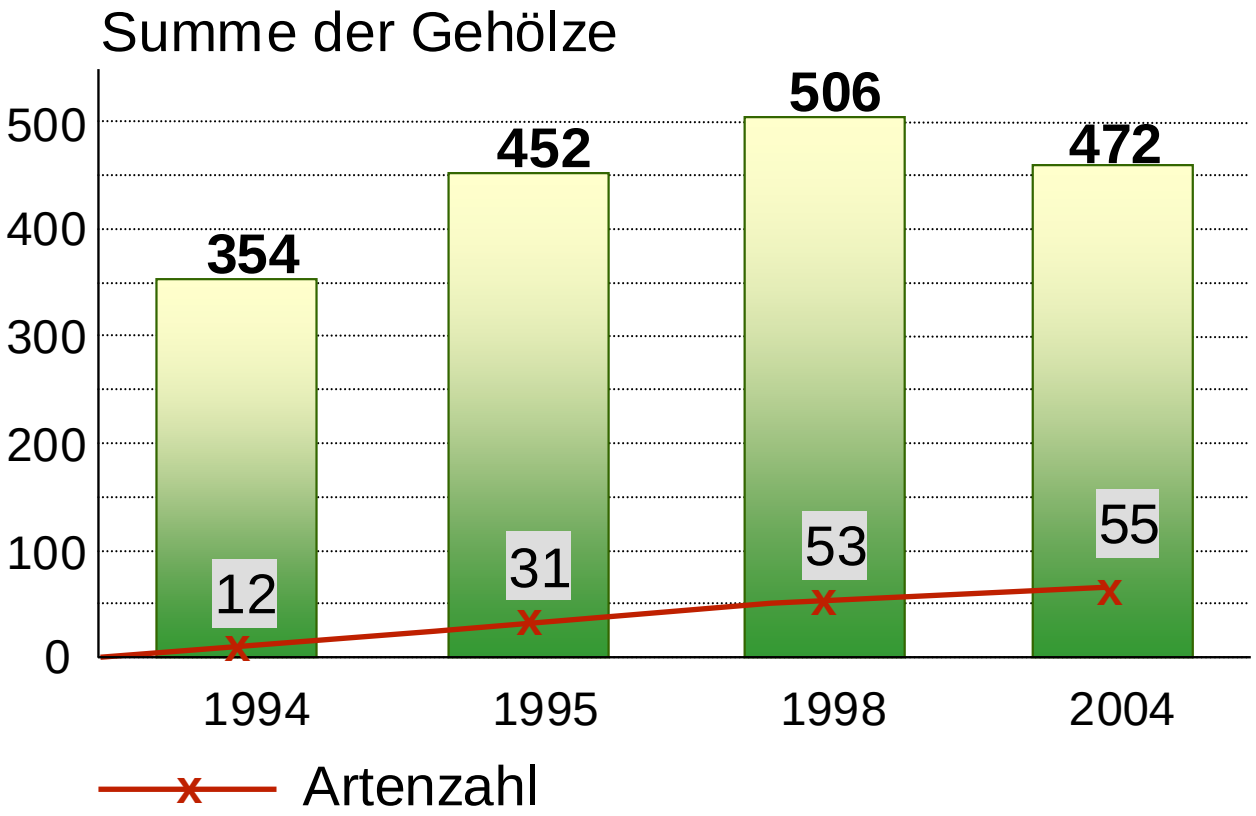
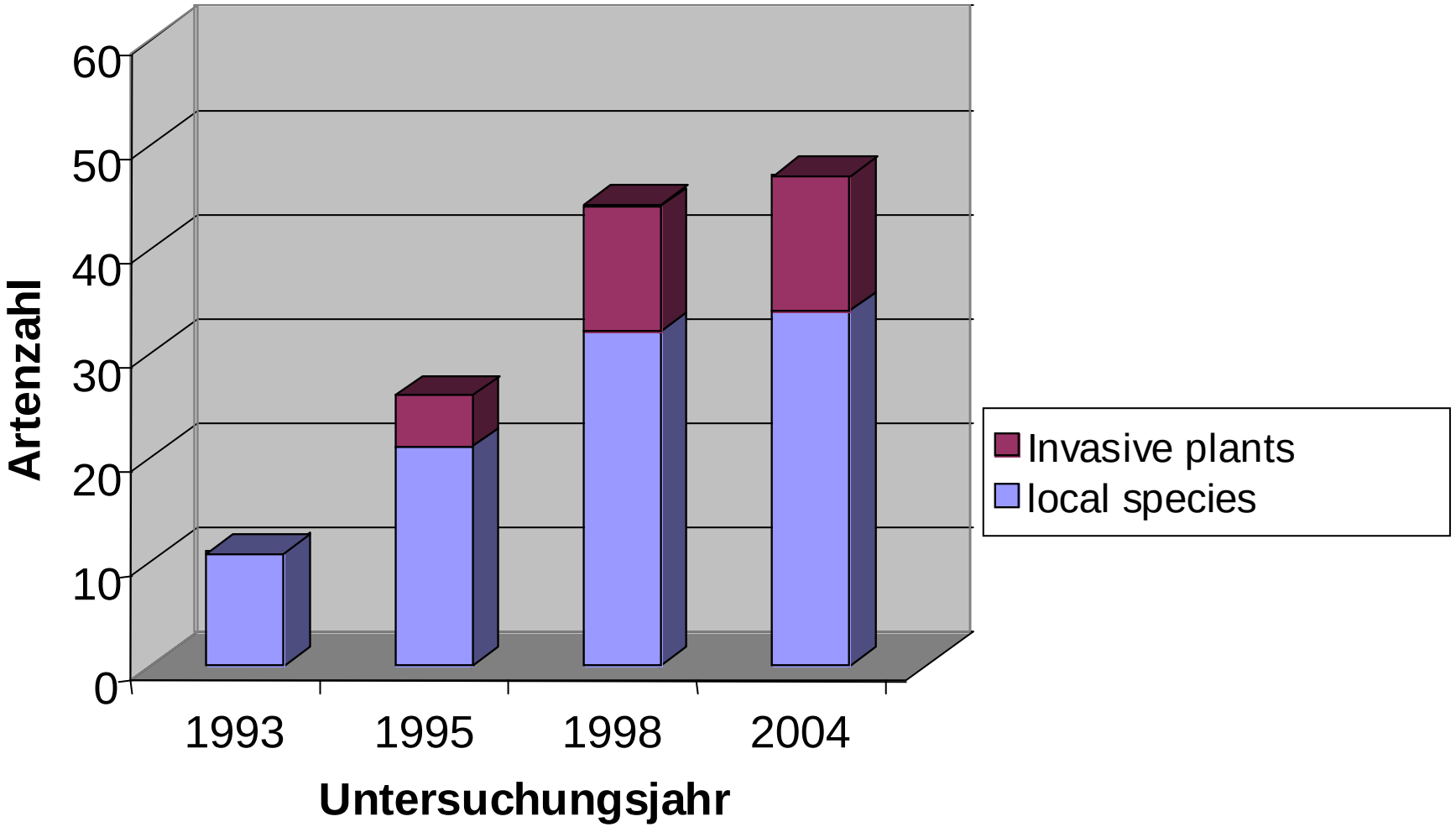
Total number of trees and shrubs



S. Karbe, B. Jüttersonke

Number of invasive plants of the hedge



Conclusion on the botanical development after 10 years

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- number of wild herb species and number of trees and shrubs increasing

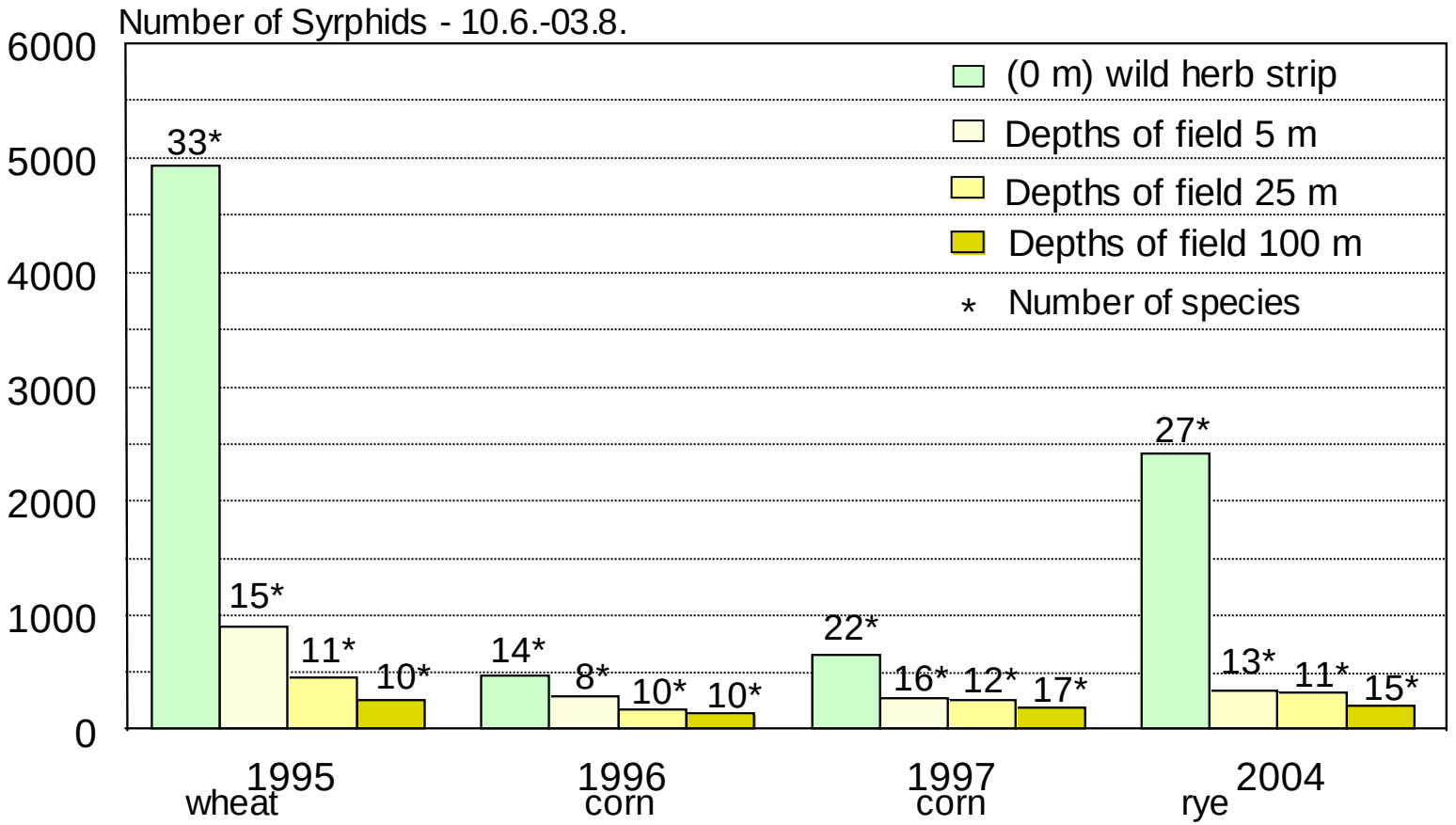
- after 10 years was the species composition of the seedings still visible

- invasive species growing up

- After 10 years cultivation measures are required if the value of the hedge is to be preserved

Blossoms offer

Hover flies in different depths of field (Malaisetraps)



Influence of different field margins on aphids and their predators in the field

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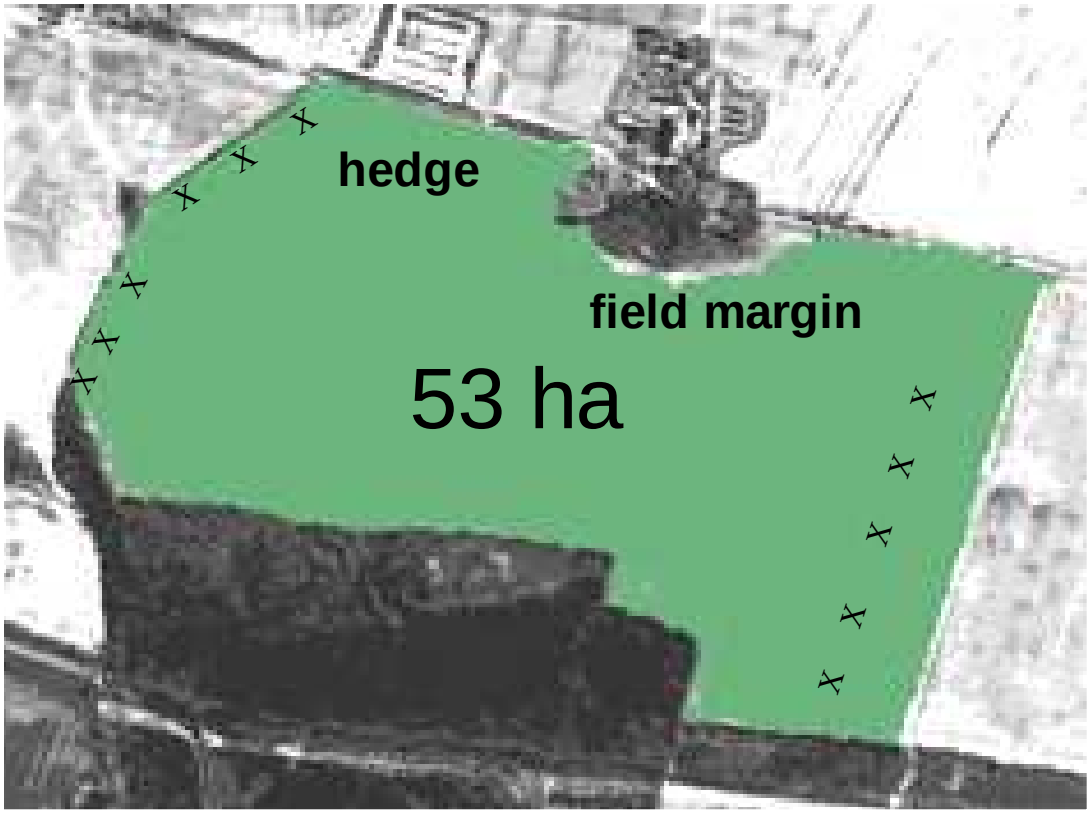

hedge

field margin

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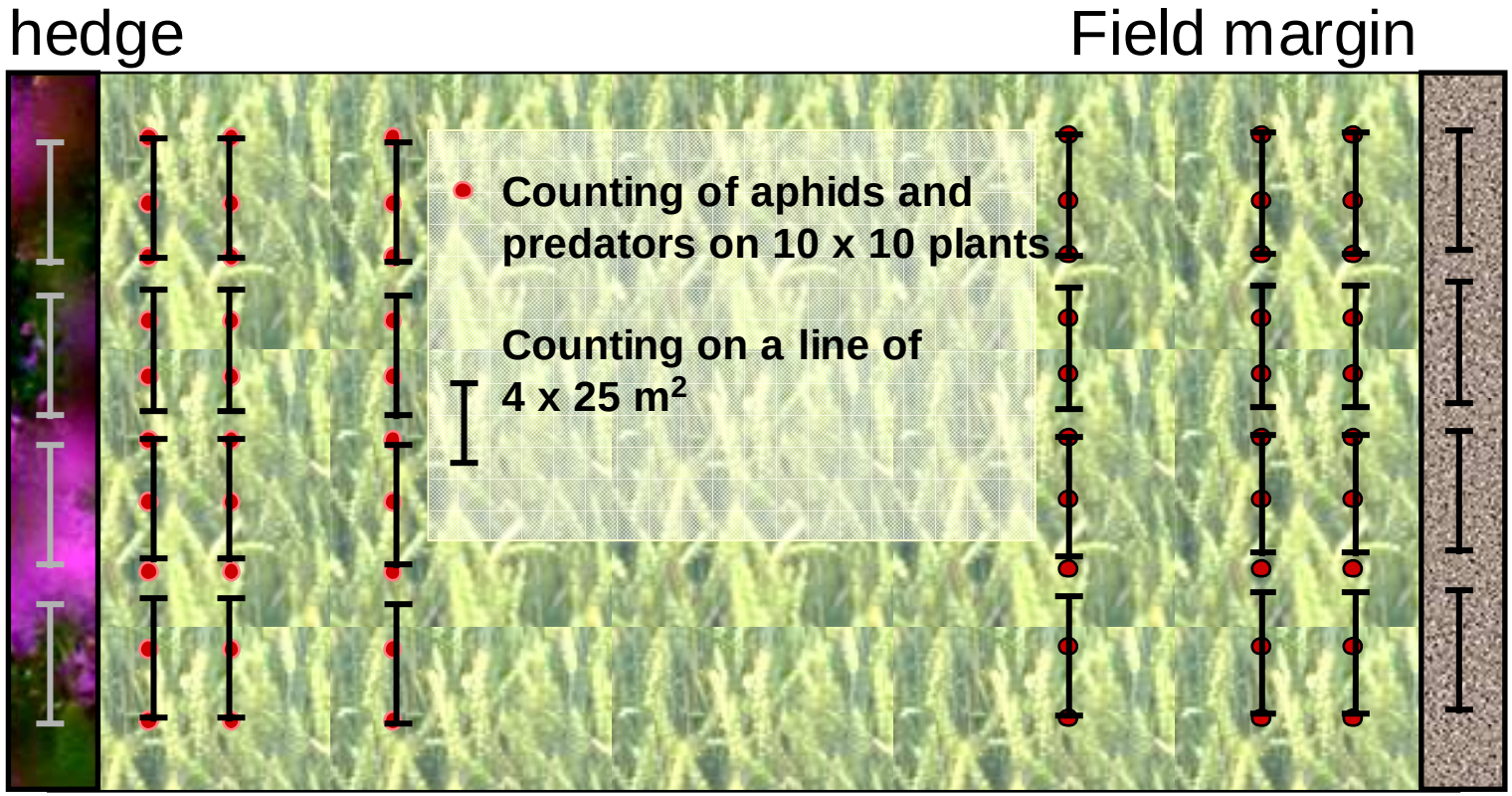
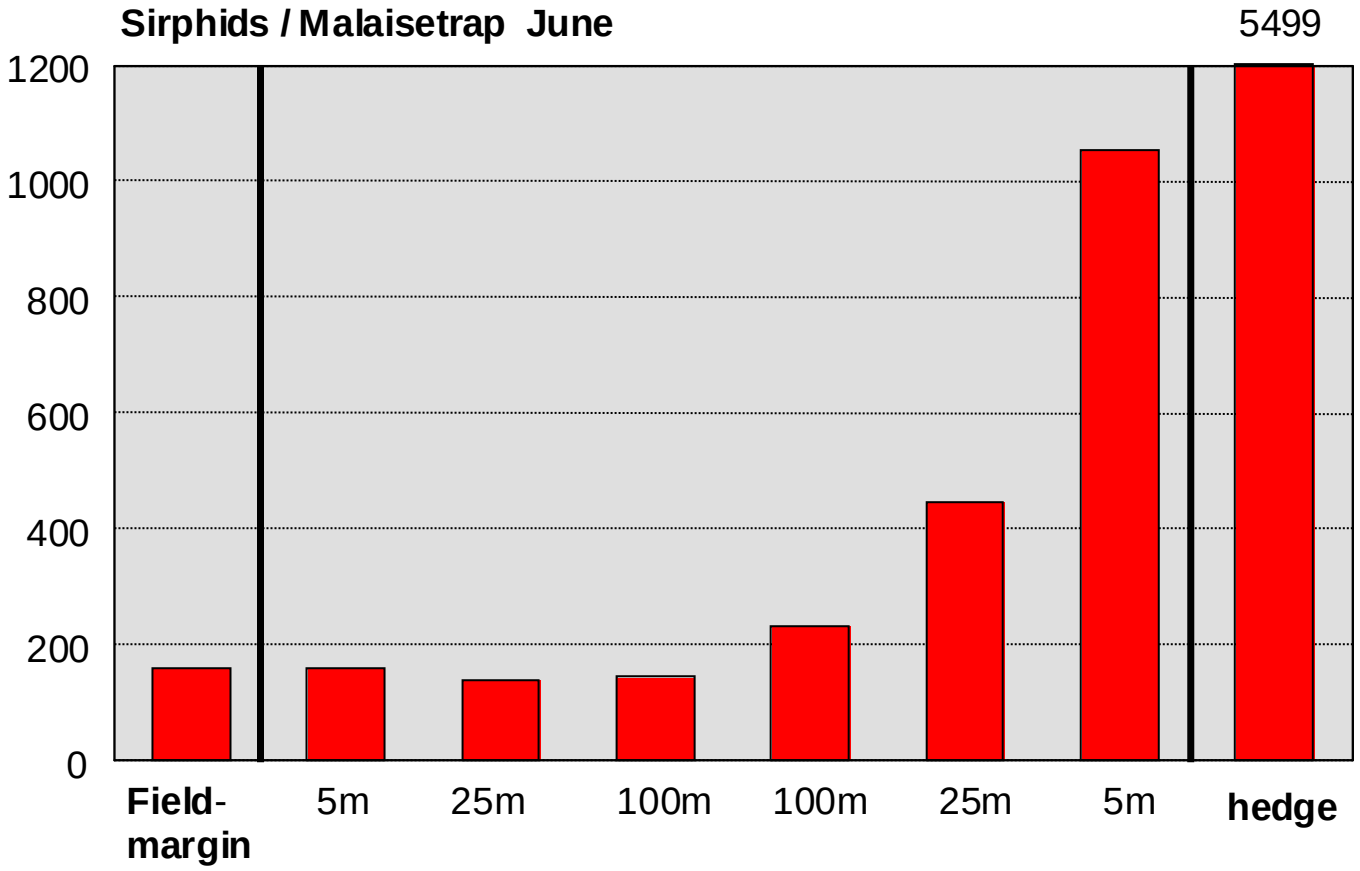
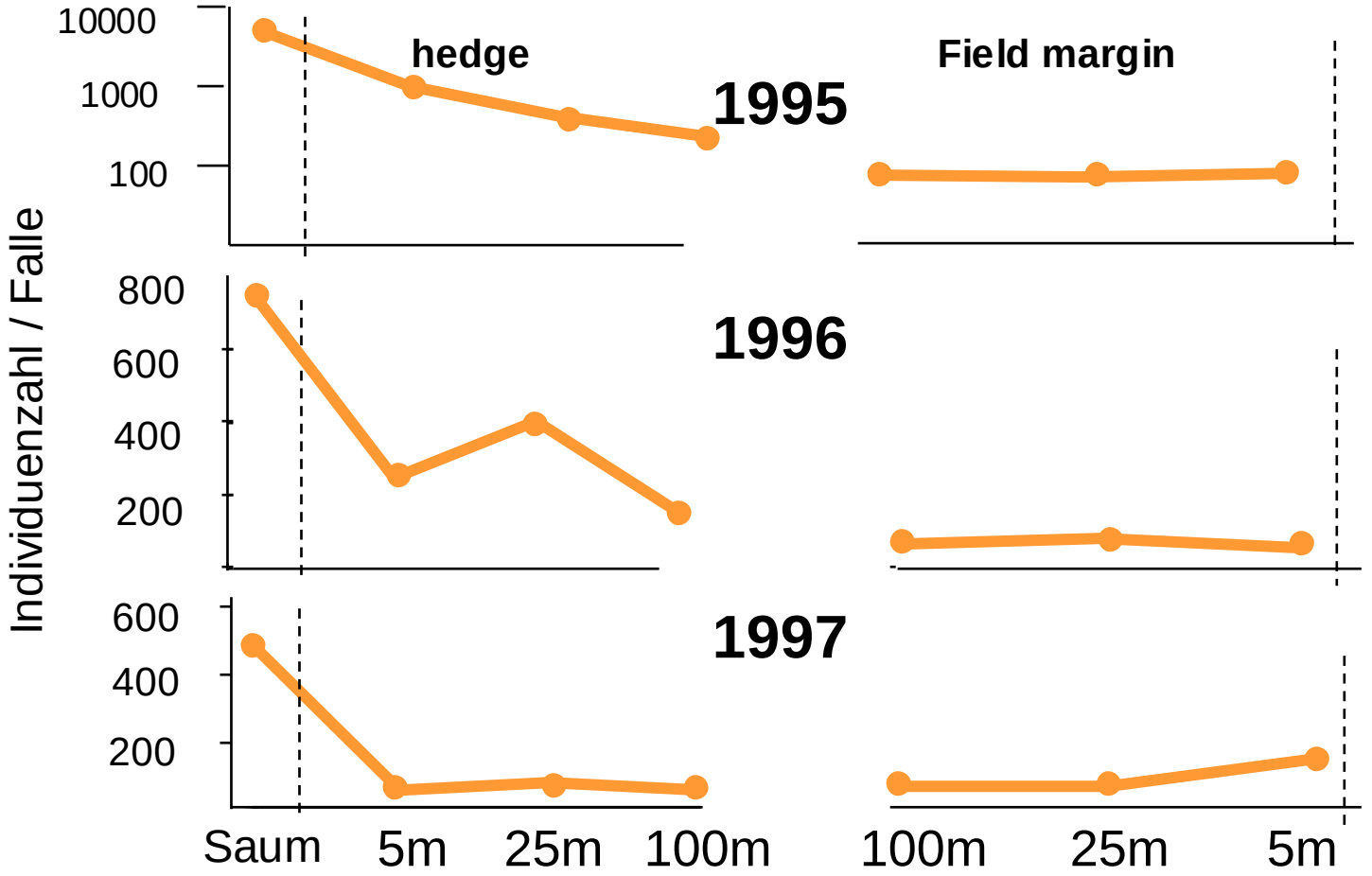
Methods


hedge
Field margin
Counting of aphids and predators on 10 x 10 plants
Counting on a line of 4 x 25 m²
5 25 100
Boniturlinien
100 25 5 Meter
Boniturlinien

Number of *Sphaerophoria scripta* 1995



Number of *Sphaerophoria scripta*



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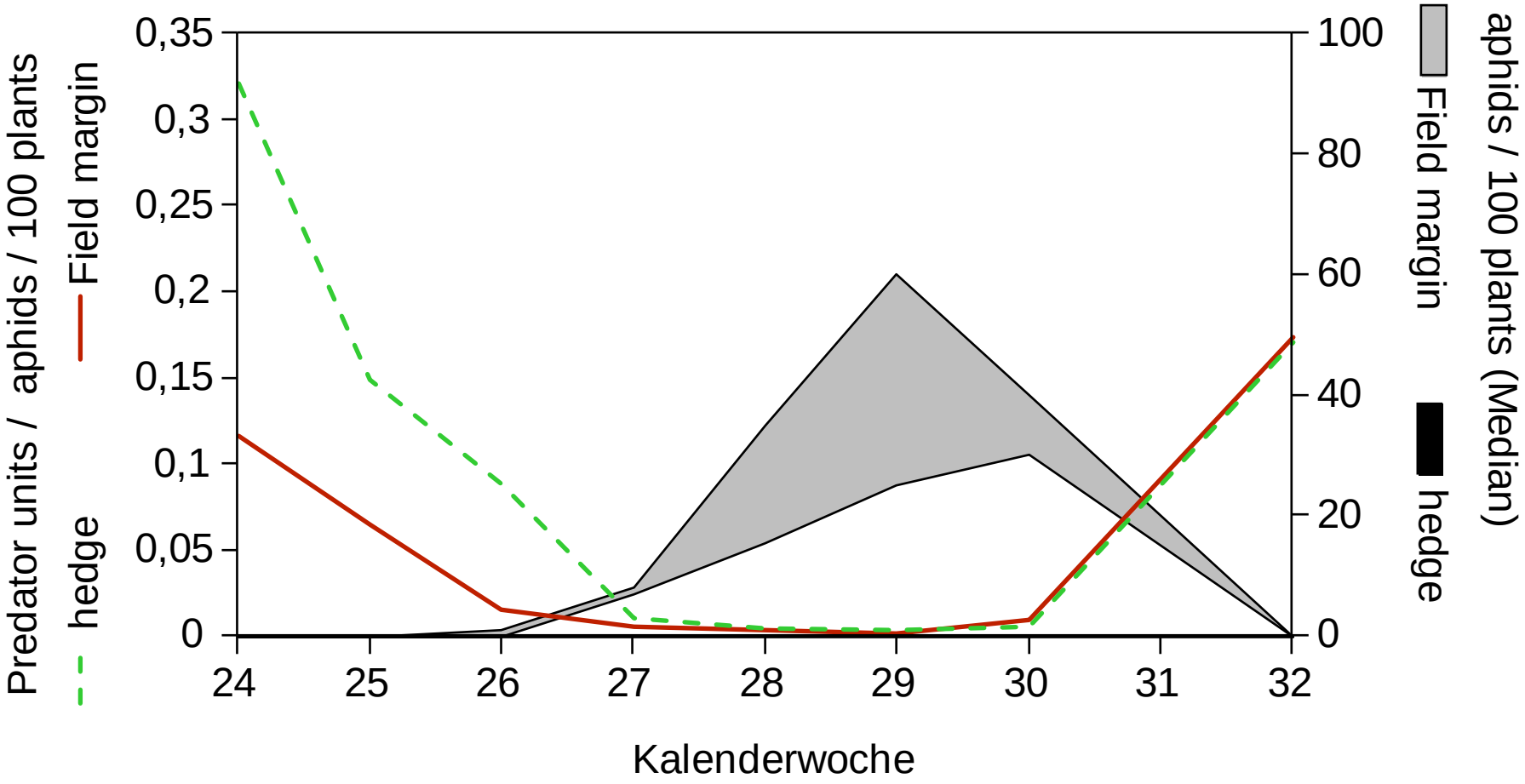
Predator – prey relationship and aphid density, corn, in field depth of 100 m, 1996



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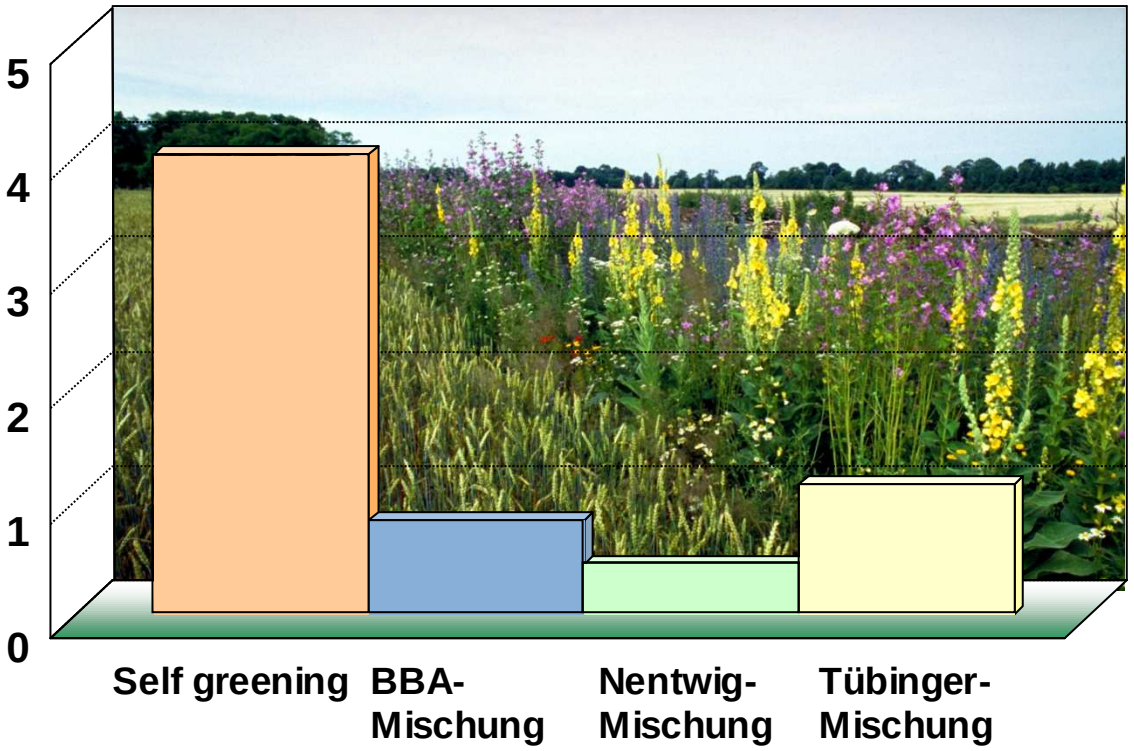
Grasshoppers

Mean number of grasshoppers / m²



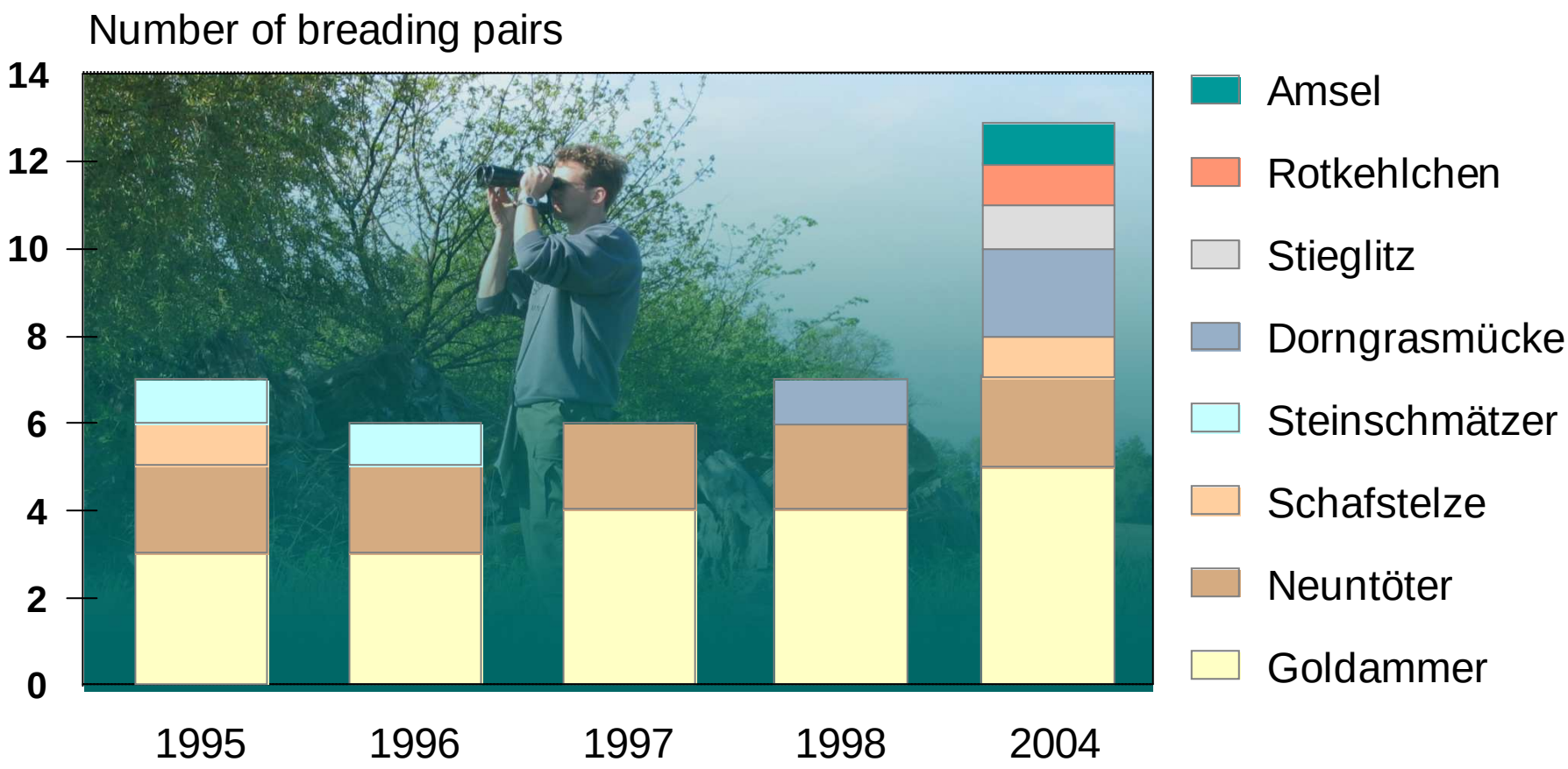
18./19. August 2004

Ch. brunneus 10 % (82=100 %)

Ch. dorsatus 23 %

Ch. apricarius 40 %

Number of nesting birds in the hedge



Problems

Littering and destroying by fire

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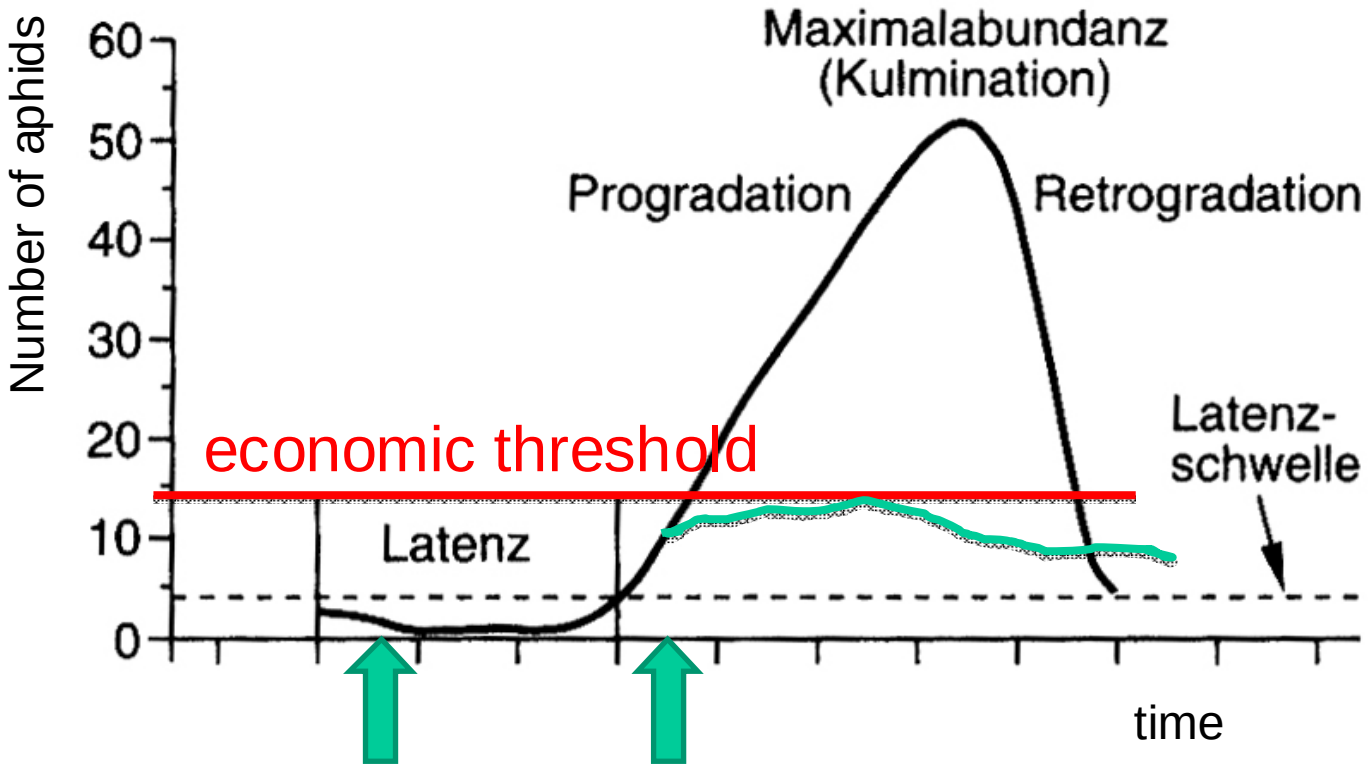
Stabilisation of biological control in greenhouses by predatory flies

Stefan Kühne

Institute for Strategies and Technology Assessment, Stahnsdorfer Damm 81, 14532 Kleinmachnow

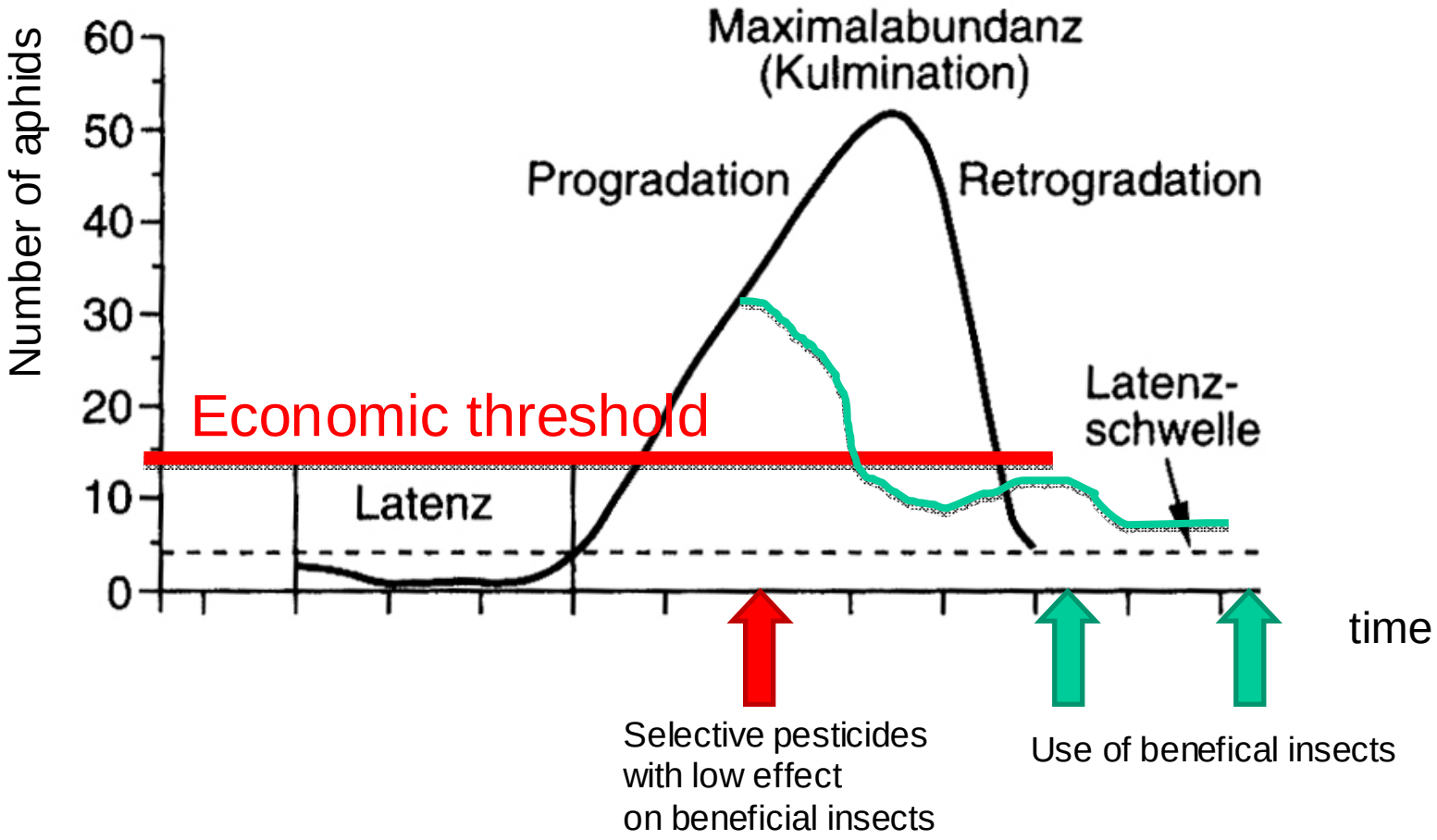
Time of release of beneficials insects I



Parasitic wasps
with high activity to find the pest

Predators like green lacewing
with high feeding potential

Time of release of beneficials insects II



Predatory flies natural occurring in green houses and feeding on black fungus gnats

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Stilpon nubila

Platypalpus pallidicornis

Platypalpus annulatus

Platypalpus pallidiventris

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Coenosia attenuata Stein

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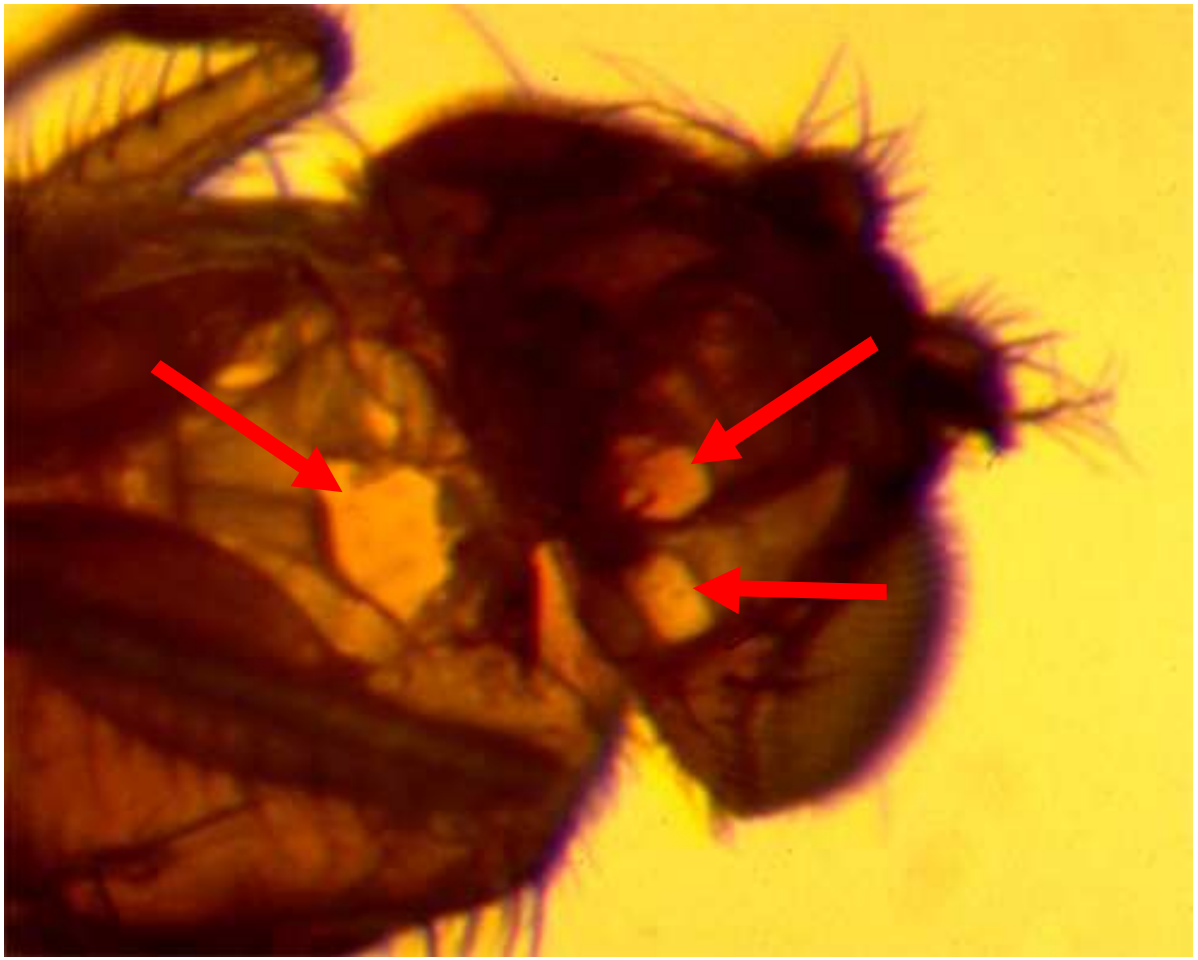
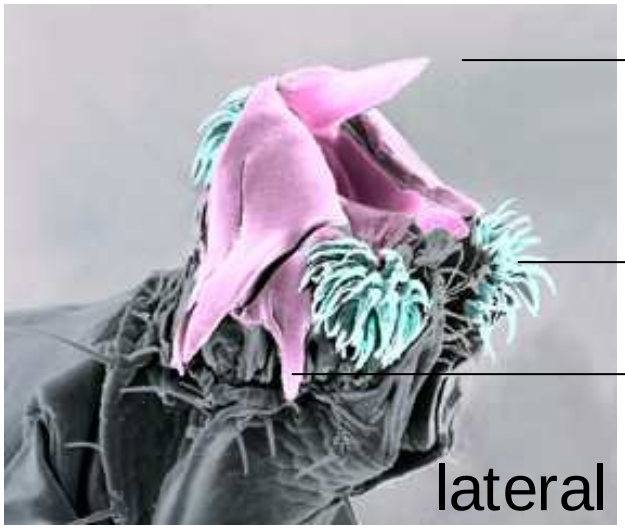
Prey of *Coenosia-Drosophila melanogaster*



Cannibalism

C. attenuata, female feed on male

Mouth disc of *Coenosia*



dagger like tooth

rasp tongue

praestomal teeth

dagger like tooth

rasp tongue

praestomal teeth

Notices about global occurrence of *Coenosia*

Canada, USA, Peru – ornamental plants

Germany – ornamental plants, vegetable crops
Portugal – vegetable crops
Spain – vegetable crops
Italy – ornamental plants
France - soybean
Turkey – cotton fields, pot herbs

Thailand – ornamental plants

1999 - „open rearing“ Thailand

2002 - „the garden of Europe“ – Almeria, Spain

2008 – Orchids „Antura“ in Germany

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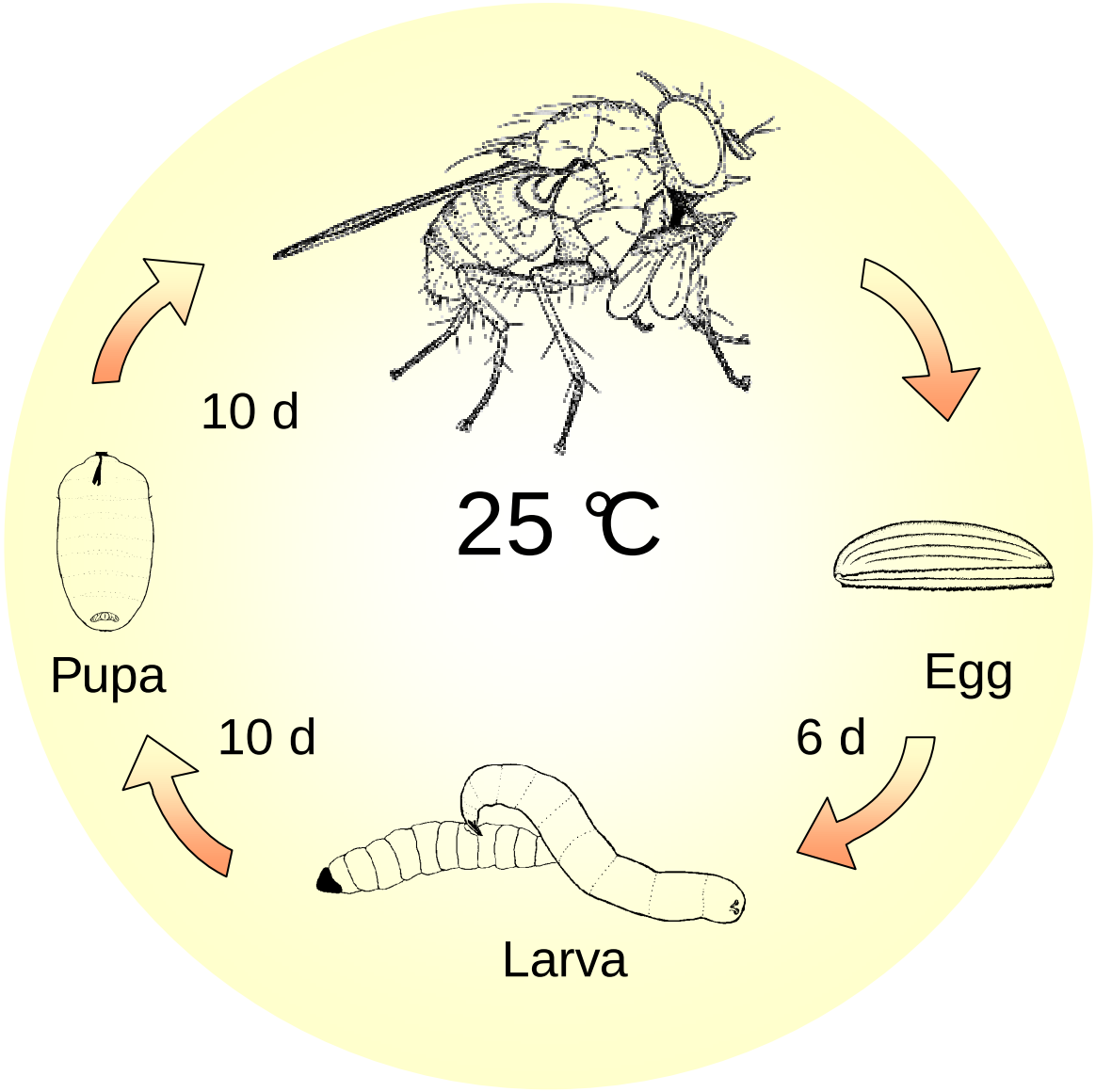
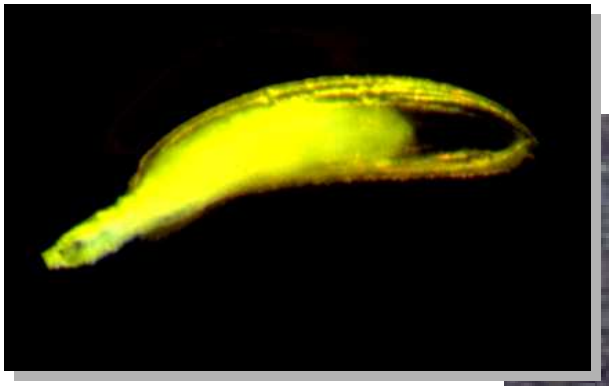
2008 – Orchids „Antura“ in Germany

Development cycle of *C. attenuata*



Larvae of *Coenosia* also predatory!



hatching larva

Coenosia-larva feed on fungus gnat (*Bradysia*)

2009 – potherbs, Antalya, Turkey

2009 – potherbs, Antalya, Turkey

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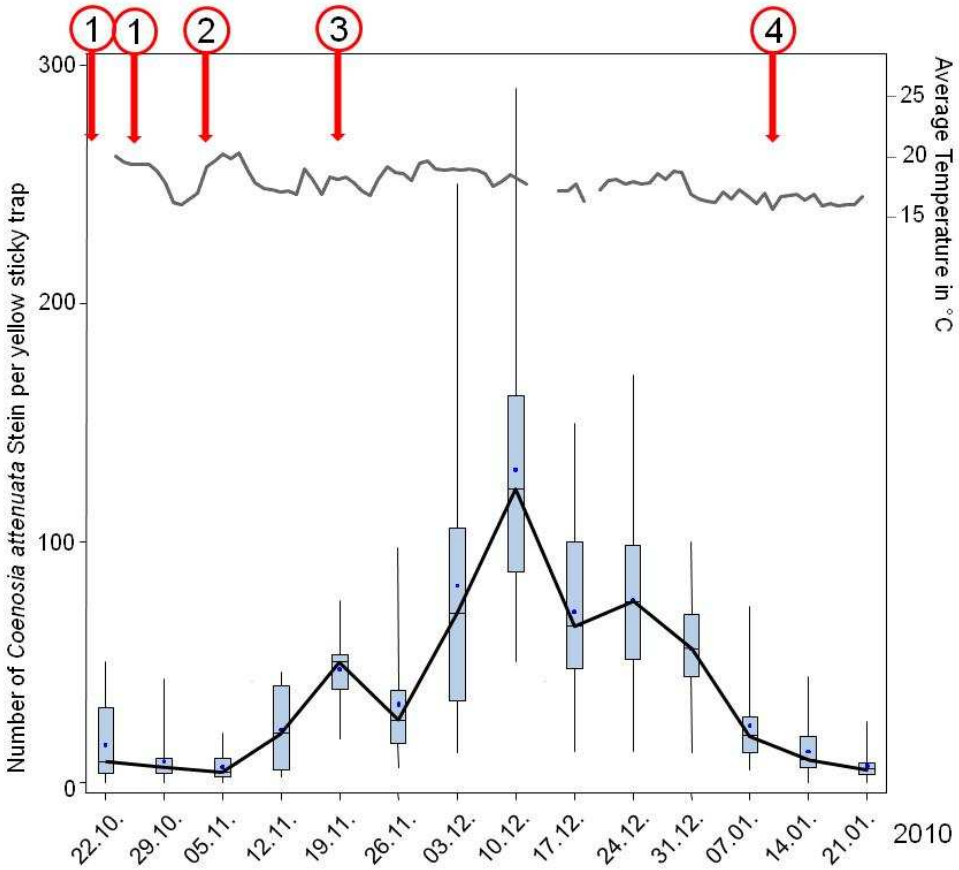
Fluctuation in population of Coenosia attenuata Stein unde greenhouse conditions in herbs with reduced pesticide use



1: Plenum (pymetrozin) 60 gr/100 lt water
2: NeemAzal-T/S (azadirachtin) 300 cc/100 lt water,
3 Laser (spinosad) 35 cc/100 lt water,
4 Spruzit (pyrethrum) 100 cc/100 lt water.

Phytoparasitica
DOI 10.1007/s12600-011-0191-3

Review of *Coenosia attenuata* Stein and its first record as a predator of important greenhouse pests in Turkey

Daniel Pohl · Stefan Kühne · İsmail Karaca · Eckard Moll

Received: 26 April 2011 / Accepted: 3 August 2011

Abstract Greenhouses in Turkey under integrated pest management can be colonized by a high number predatory flies of the species *Coenosia attenuata* Stein, 1903 (Muscidae: *Coenosia* Meigen, 1826). Studies have shown that *Coenosia* predators do not simply colonize greenhouses from the outside for short periods

Keywords Biological control · Black fungus gnat · Muscidae · Whiteflies