FiBL
EXCELLENCE FOR SUSTAINABILITY

Research Institute of Organic Agriculture
Forschungsinstitut für biologischen Landbau
Institut de recherche de l'agriculture biologique






Organic agriculture and biodiversity – a global review of research results

Urs Niggli

Seminar organized by

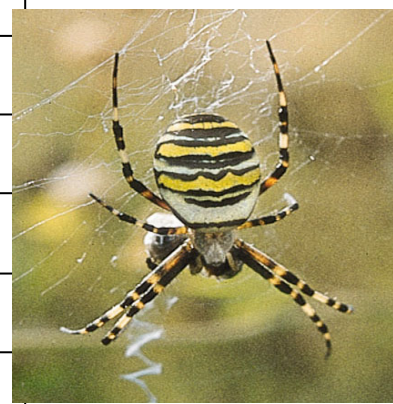
ICROFS
International Centre for Research in Organic Food Systems

FiBL, involved in organic food and farming system research since 1974

135 staff in Switzerland
20 staff in Austria
20 staff in Germany

Biodiversity on organic farms* (global literature review of comparison studies)

Taxon	Positive	Negative	No difference
Birds	7		2
Mammals	2		
Butterflies	1		1
Spiders	7		3
Earthworms	7	2	4
Beetles	13	5	3
Other arthropods	7	1	2
Plants	13		2
Soil microbes	9		8
Total	**66**	**8**	**25**



FiBL www.fibl.org

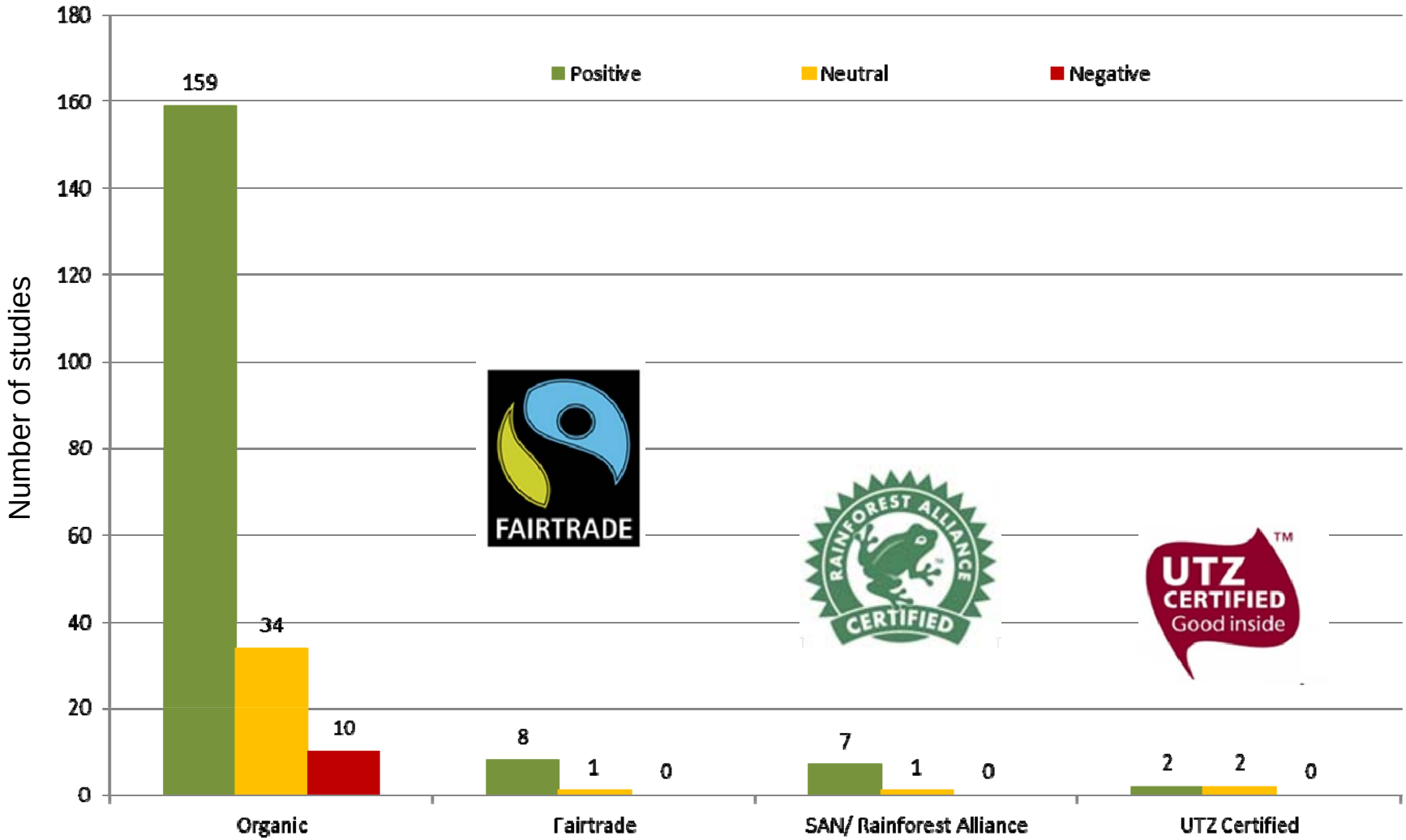
* Scales: Plots, fields, farms, landscape

Hole *et al.,* 2005. Biological Conservation 122, 113-130

Spread of studies in literature

- Literature meta-analysis of Hole et al., 2005:
  - 162 papers from Europe.
  - 54 papers from USA.
  - 4 papers from New Zealand.
  - 2 papers from developing countries.

Number of studies indicating positive, negative or varying/ inconclusive environmental impacts



Jawtusch & Niggli, 2011

Actual impact of certified labels: number of scientific papers available

	Organic	Fairtrade	SAN/ RA	UTZ	RSPO	RTRS
Environmental impacts	213	9	6	4	0	0
Social impacts	21	23	5	3	0	0
Economic impacts	27	51	9	6	0	0

Jawtusch & Niggli, 2011

Summary of positive effects of organic farming on biodiversity

- 30 % higher species diversity and a 50 % greater abundance of arthropods (insects, beetles etc.) in organic fields, especially predators and parasitoids.
- Organic farming benefits pollinators: domestic honeybees, wild bees, butterflies, bumblebees, other insects and bats.
- Soils: Earthworms, soil dwelling arthropods and soil bacteria, fungi and Mycorrhiza considerably increased.
- Birds: considerably more breeding territories, higher population densities, higher number of offspring reared.
- High diversity of the segetal flora in arable systems.

Niggli, 2010

Several dozens of long-term field trials with OF.

TCS, FiBL (CH), 6 years

DOK, FiBL (CH), 34 years

Scheyern, Munich (D), 14 years

Rodale, FST, (USA), 25 years

SADP, Maryland, (USA), 8 years

Economics of biodiversity

- The economic value of pollination of crops worldwide for instance was estimated to be € 153 billion (Helmholtz Association of German Research Centres, 2008)
- The replacement of pesticide applications by biological control mechanisms was estimated to range within US$ 3 and 119 billion (€ 3 and 121 billion) (de Groot et al., 2002) per year on global arable and permanent crops.

See also www.teebweb.org

Factors for higher biodiversity on organic farms

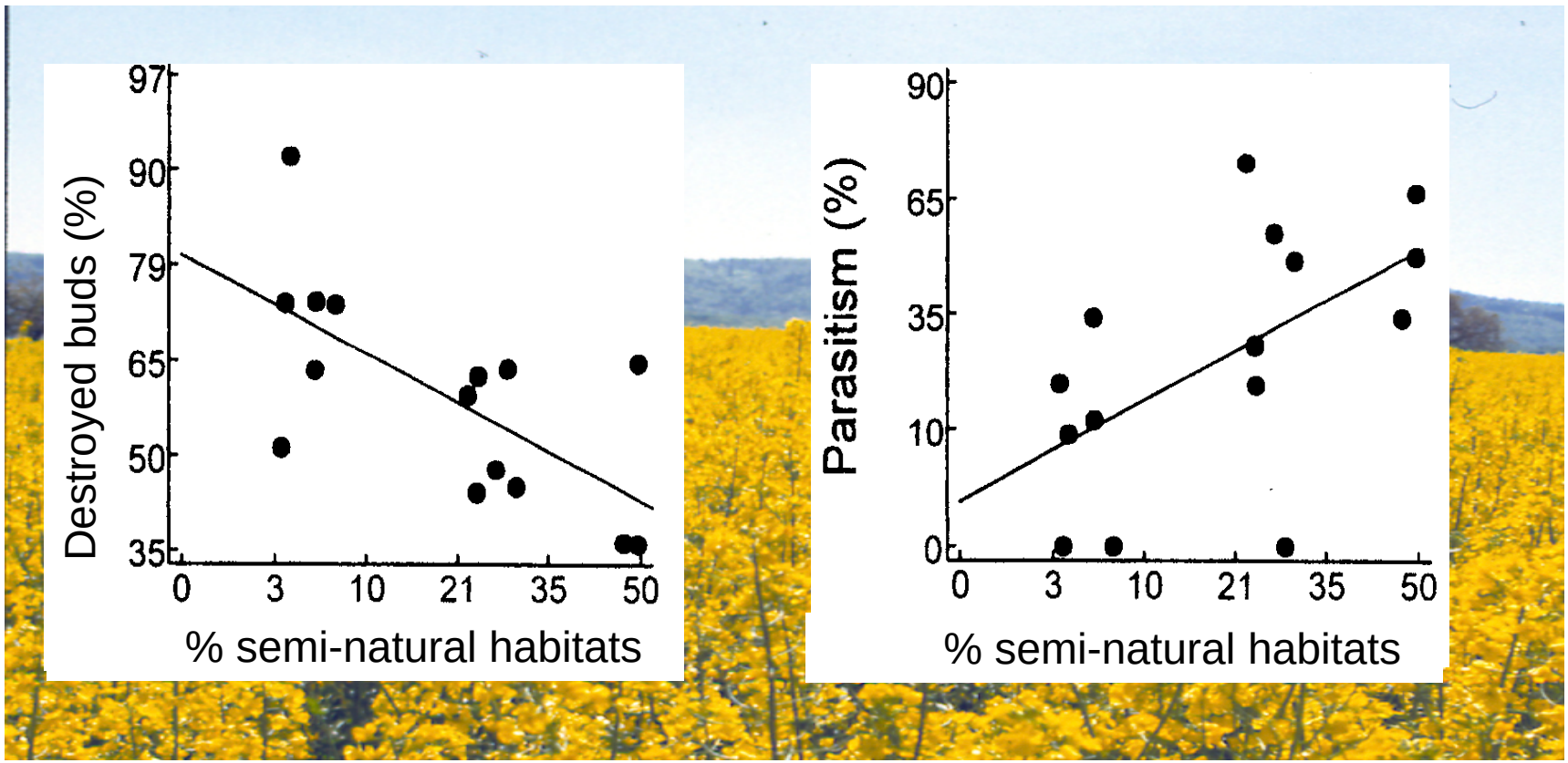
- Ban on herbicides and artificial pesticides.
- Ban on fast release mineral fertilisers.
- More diverse crop rotations.
- Undercropping and undersowing (catch and cover crops).
- Organic fertilisation.
- Less input of nitrogen.
- Careful or reduced tillage.
- More semi-natural habitats on farms.
- Smaller field size.

Multi-level biodiversity

Risk management
of organic/low-input farms

Diversity of landscapes and pest control

The regulation of the rape pollen beetle by parasitoids correlates with percentage of natural habitat.



Thies & Tscharntke 1999, Science

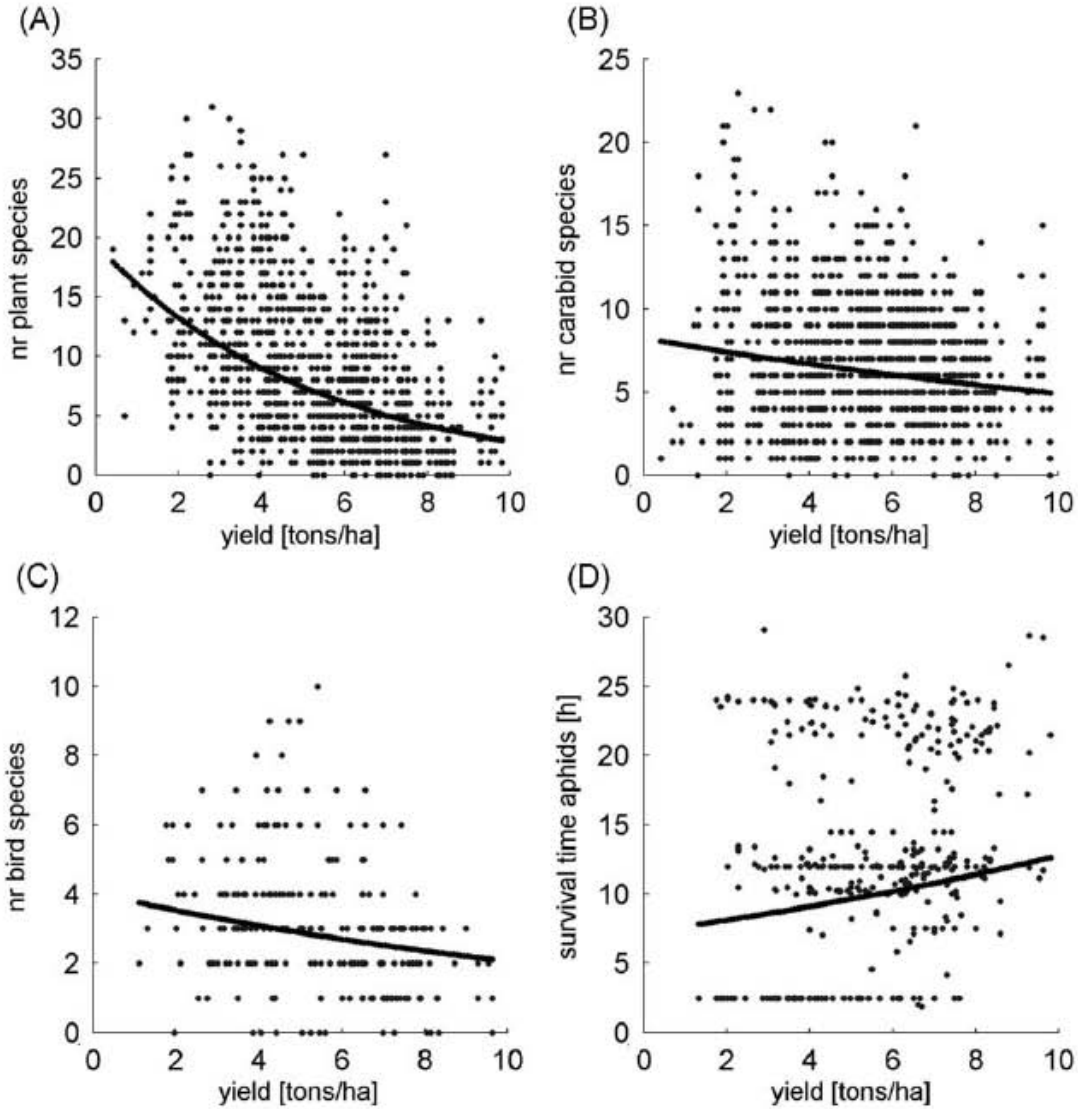
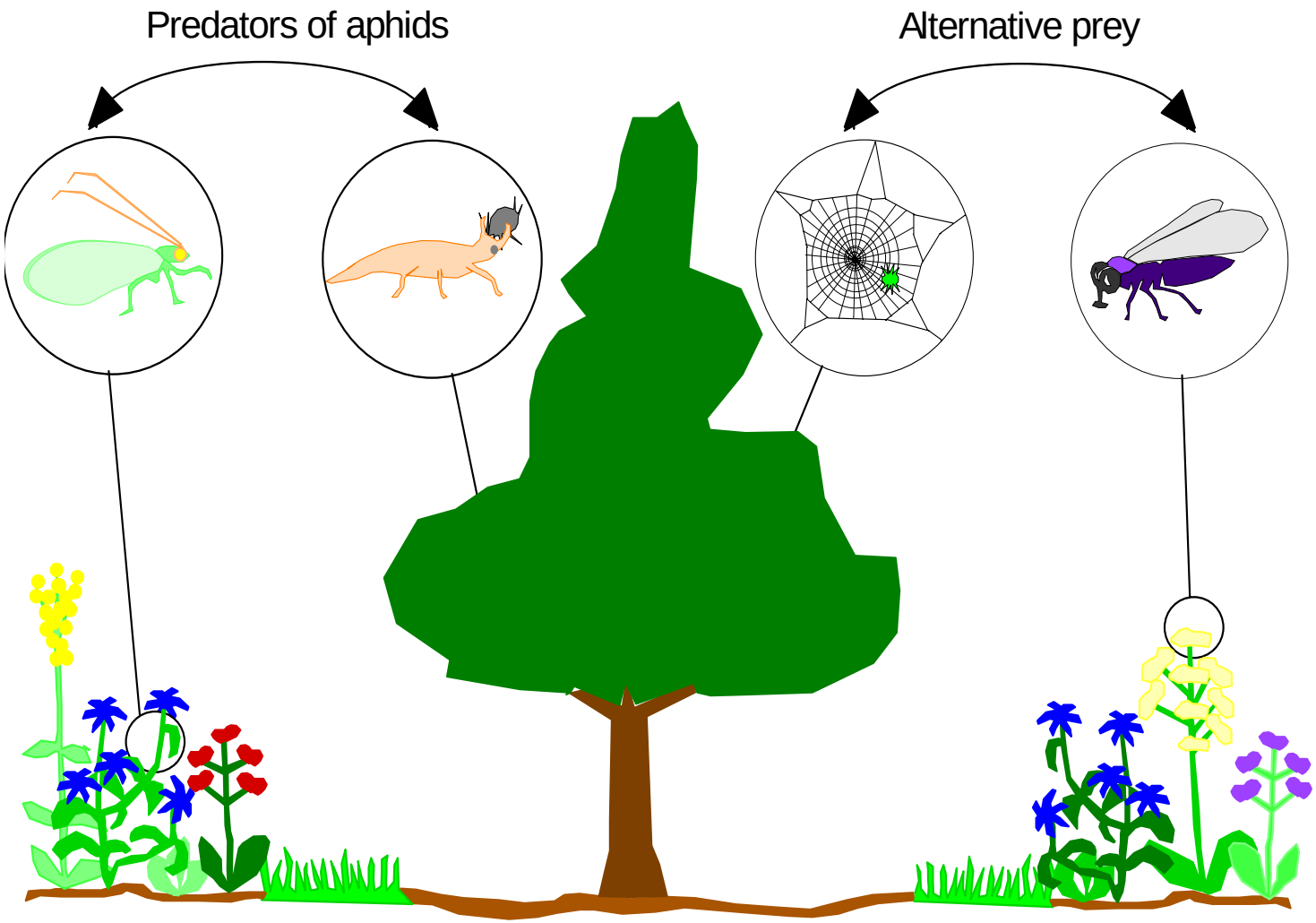


Fig. 1. Effects of cereal yield (ton/ha) on: (A) the number of wild plant species per sampling point (in 3 plots of $4m^2$), (B) the number of carabid species per sampling point (per trap during 2 sampling periods), (C) the number of ground-nesting bird species per farm (one survey plot of $500 \times 500m^2$), and (D) the median survival time of aphids (h). Trend lines were calculated using GLMM including the two surrounding landscape variables as covariates and field, farm and study area as nested random effects.

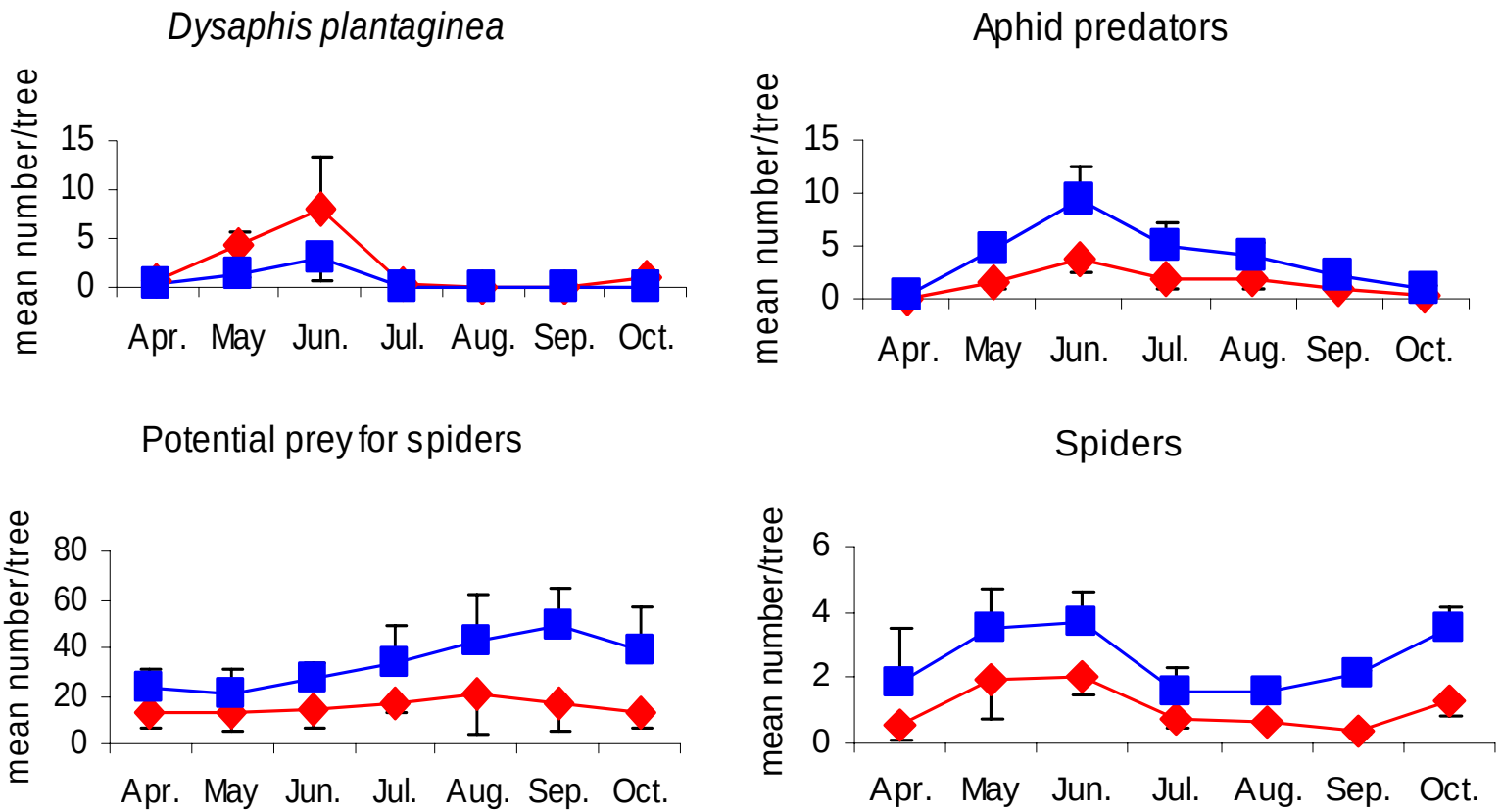
Thies et al., 2010)

Habitat management in apple orchards



Wyss, FiBL, 1995

Less aphids and more beneficials



Development of rosy apple aphid, potential prey, spiders, and predators in strip-managed part or control part of an apple orchard

Wyss, FiBL, 1995

Functional diversity?

Companion plants increase life span, fecundity and mobility of parasitoids

Iberis amara

Centaurea cyanus

Diadegma semiclausum

Companion plants to enhance beneficials in the field

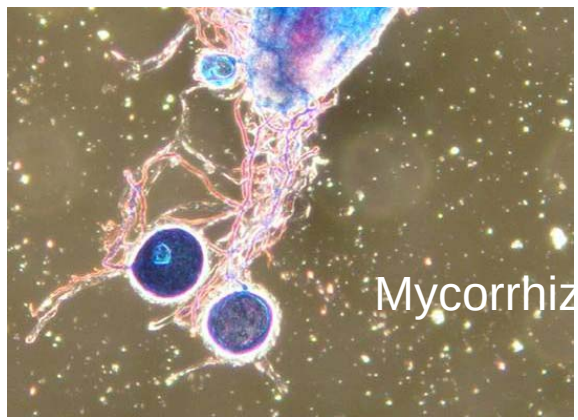


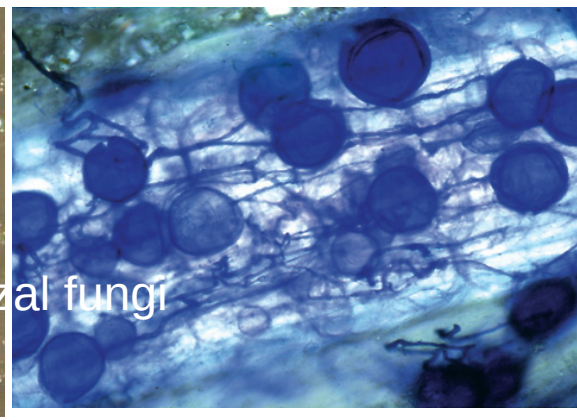




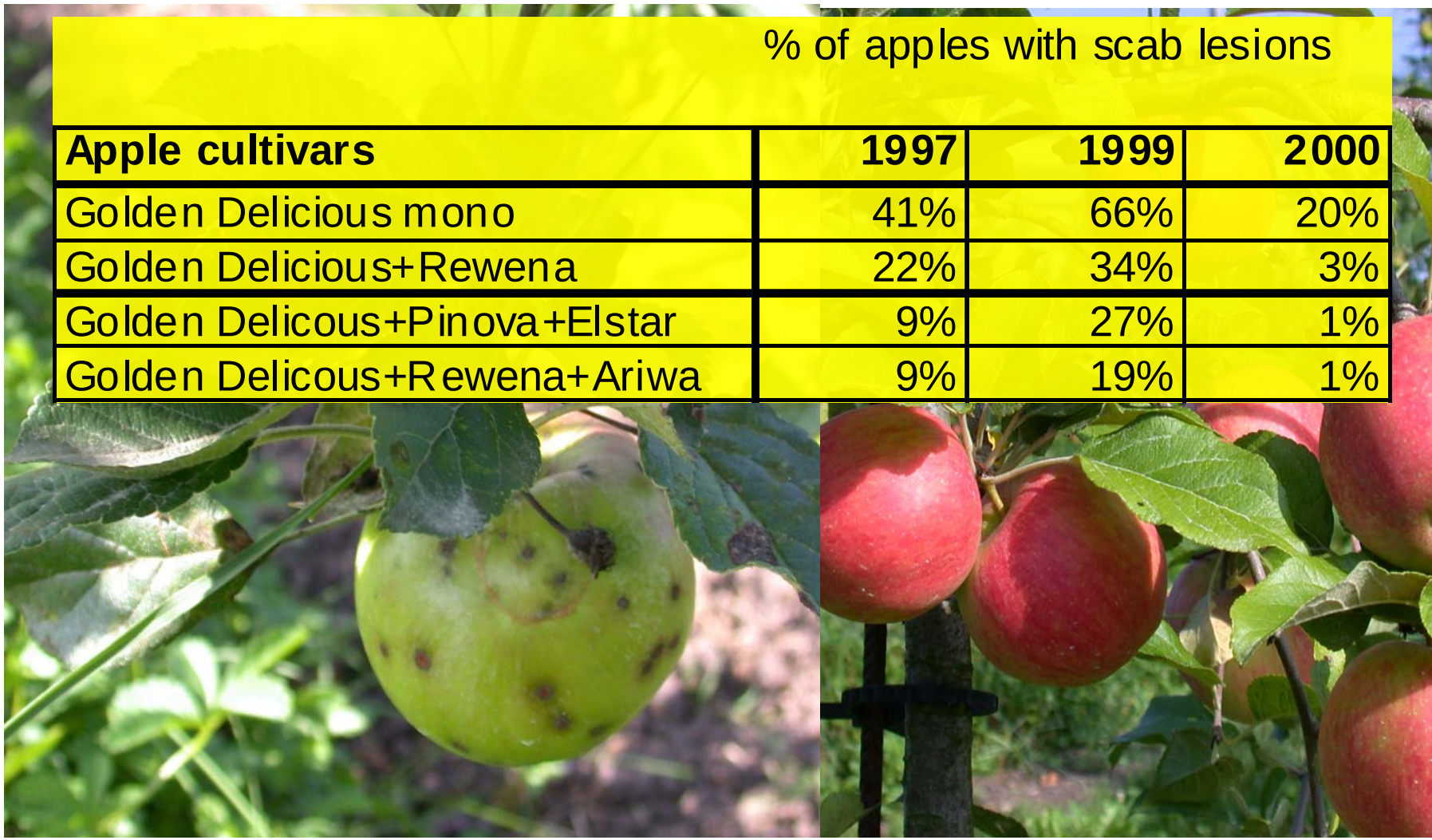

FiBL is actually testing different plant species to enhance parasitoids of cabbage pests

Utilize ecosystem services for long-term sustainable productivity





Cultivar mixtures and plant health



Apple cultivars	% of apples with scab lesions 1997	1999	2000
Golden Delicious mono	41%	66%	20%
Golden Delicious+Rewena	22%	34%	3%
Golden Delicous+Pinova+Elstar	9%	27%	1%
Golden Delicous+Rewena+Ariwa	9%	19%	1%

Gessler, *et al*., 2003

Trade-offs between food production and other ecosystem services

Soil erosion

Climate change

Water waste and pollution

Losses of biodiversity

Food security

Strentghening synergies between food production and other ecosystem services.