Functional agro-biodiversity (FAB)

How to maximize pollination and biocontrol services while preserving nature values

Felix Wäckers

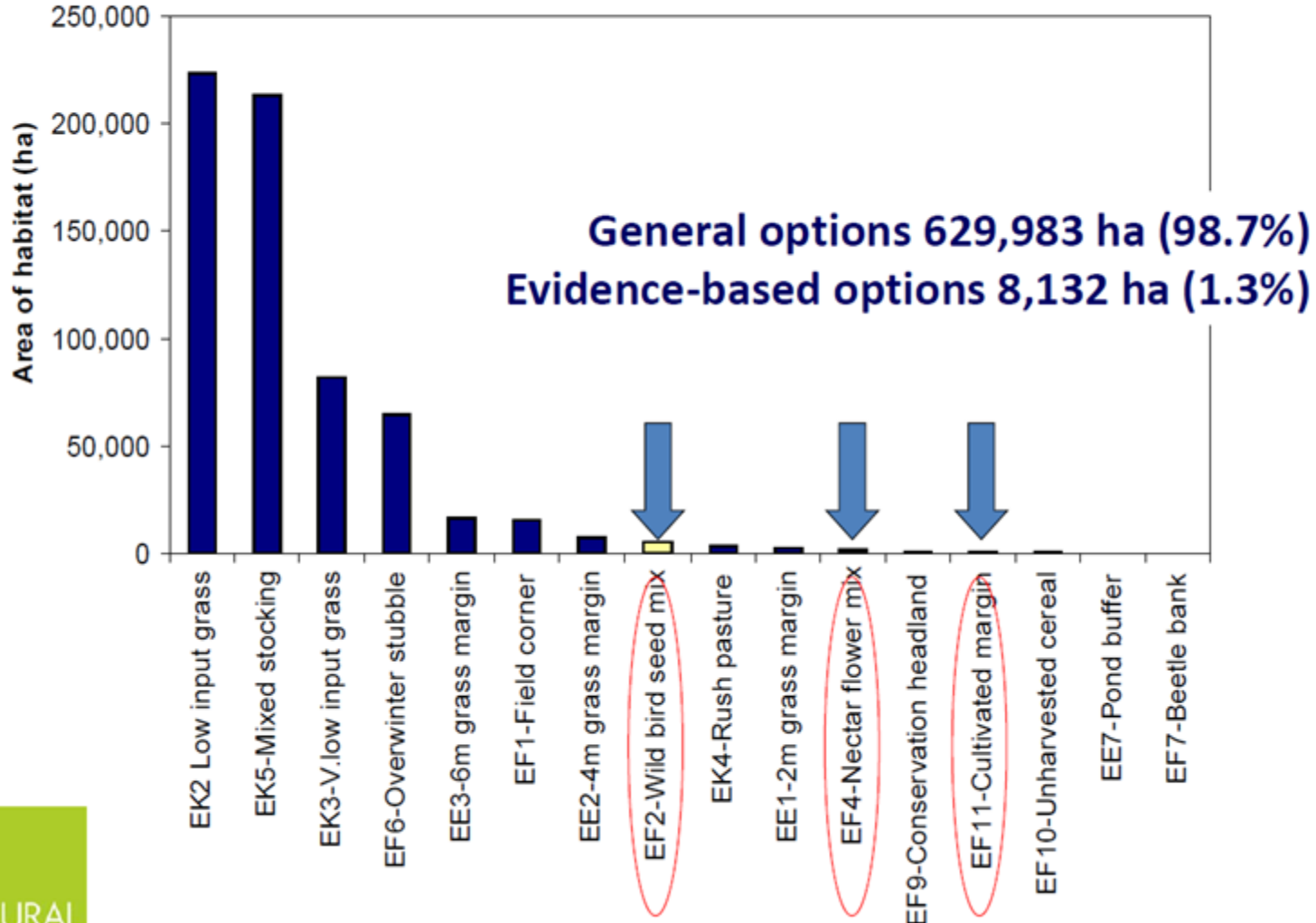
Agri Environment Schemes

Agriculture → **Environment**

Focus on conservation


Yield or environment?

Evidence-based *vs* General options



NATURAL ENGLAND

Agri Environment Schemes

Agriculture → **Environment**

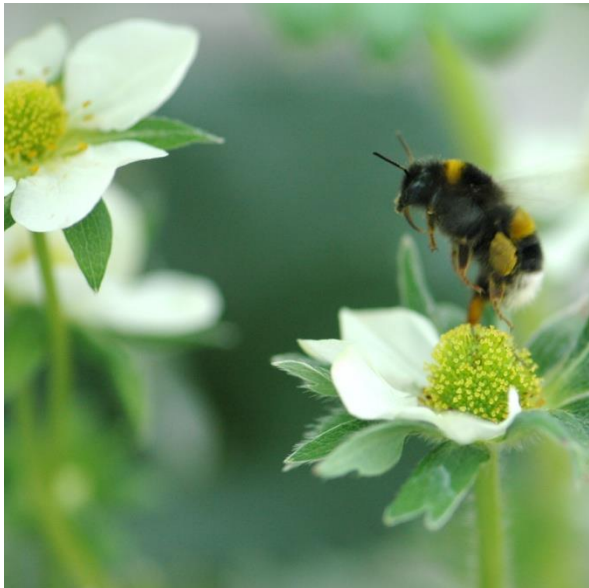
Focus on ecosystem services

€320 billion/year

€90 billion/year
(*Constanza 1997*)

How to optimize services?

Traditional paradigm: Enhance diversity (diversity = stability = services)



Does it work?

Example biological pest control

How to optimize services?

Traditional paradigm: **Enhance diversity**

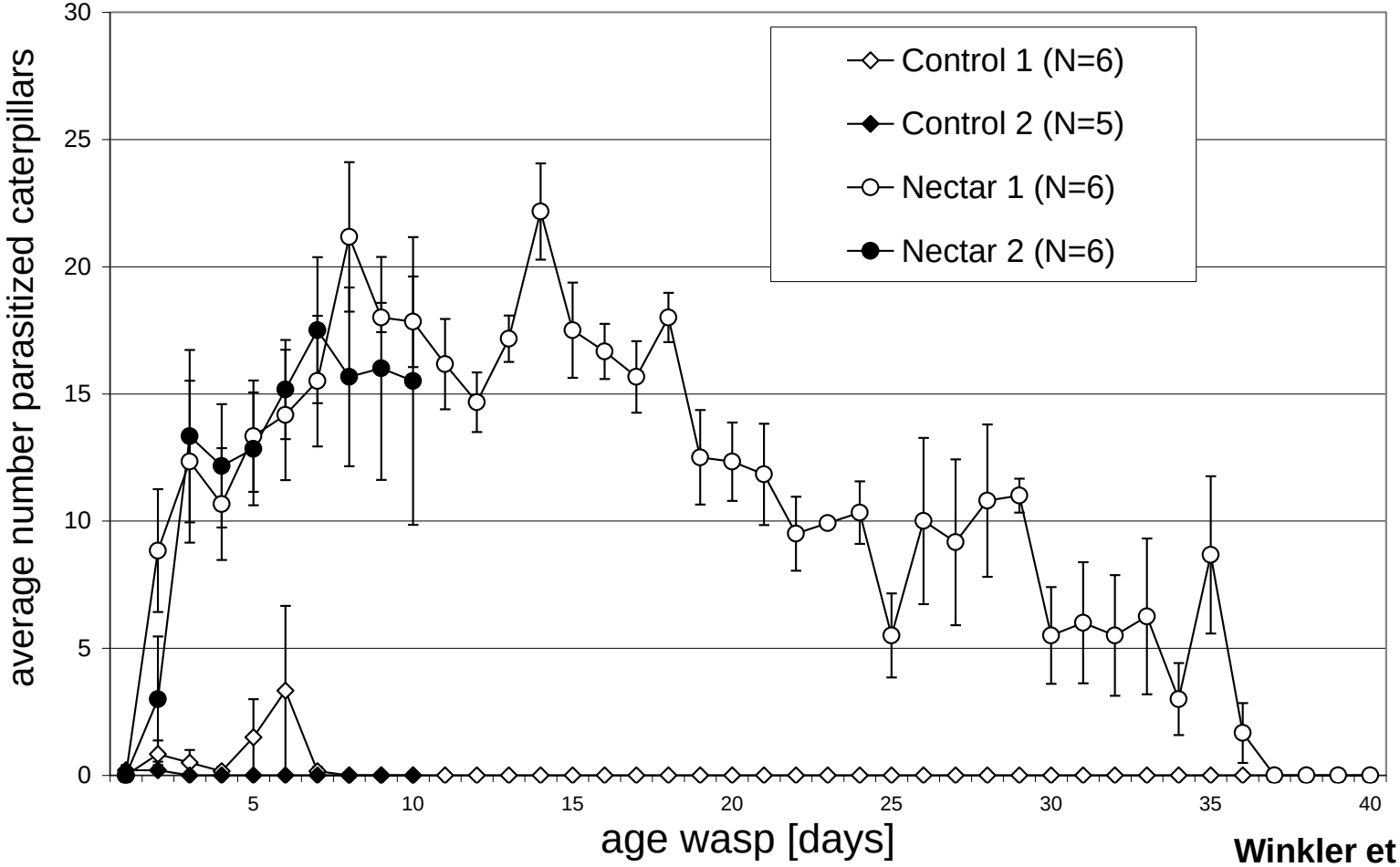
Functional biodiversity: Selectively enhance diversity

Focus on functional groups that provide ecosystem services

Targeted landscape management

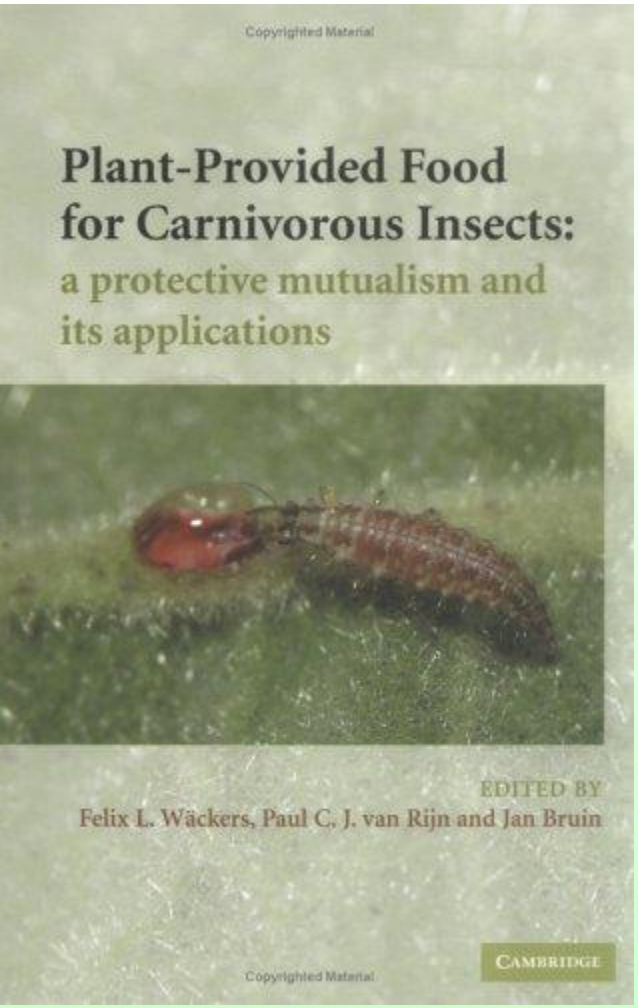
Bottleneck: Lack of nectar and pollen in many crops

The impact of nectar sources on biocontrol efficacy



Winkler et al., (2006)

Biological control agents depending on nectar/pollen feeding.



Type	Plant-feeding stage	Arthropod examples can be found within:		Type of plant food utilised
Life-history omnivory	adult	Neuroptera: Diptera: Hymenoptera: Coleoptera:	Chrysopidae (green lacewings) Syrphidae (hoverflies) Cecidomyiidae (gall midges) Tachinidea (parasitoid flies) Ichneumonidae, Braconidae, a.o. (parasitoid wasps) Vespidae (social wasps) Formicidae (ants) Meloidae (blister beetles)	nectar, pollen nectar, pollen nectar nectar nectar nectar nectar, fruit nectar nectar, pollen
	juvenile	Heteroptera:	Pentatomidae (stink bugs)	plant-juice
Temporal omnivory	adult	Hymenoptera: Coleoptera:	Ichneumonidae, Braconidae, a.o. (host feeding parasitoids) Cicindelidae (tiger beetles)	nectar seeds
	juvenile	Araneae:	Araneidae (orb web spiders)	pollen
Permanent omnivory	adult & juvenile	Acari:Mesostigmat Heteroptera: Neuroptera: Thysanoptera: Coleoptera:	Phytoseiidae (predatory mites) Pentatomidae (stink bugs) Miridae (mirid bugs) Geocorinae (big-eyed bugs) Anthocoridae (flower bugs) *Chrysopa*, Hemerobiidae (brown lacewings) Aeolothripidae, Phlaeothripidae Coccinellidae (ladybirds) Carabidae (ground beetles)	nectar pollen plant juice plant juice plant juice pollen nectar, pollen leaves, pollen nectar pollen seeds

Targeted landscape management

Informed selection of non-crop plants as a multifunctional tool to optimize ecosystem services

- Select plants that optimize biological pest control or pollination

- Select plants that avoid stimulation of pests

- Select plants that generate multiple ecosystem services

(Wäckers and van Rijn, 2012)

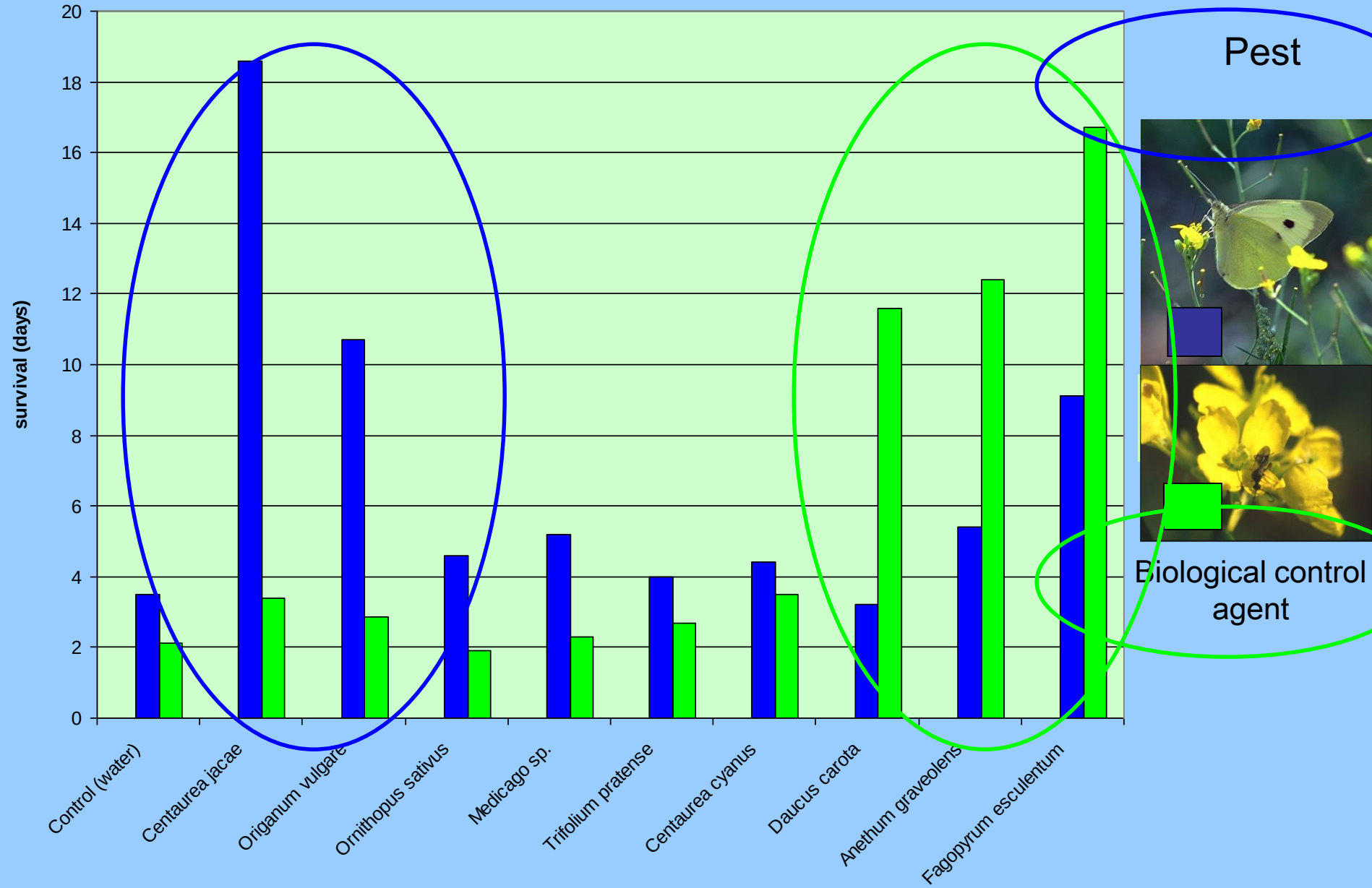
Select plants that optimize biological pest control

family	species	Floral Nectar depth	Longevity (AFLI) Hoverfly *E. balteatus*	Longevity (AFLI) Lacewing *C. carnea*	Longevity (AFLI) Parasitoids	References parasitoids (species)
Apiaceae	*Ammi majus*	0				
Apiaceae	*Coriandrum sativum*	0				
Apiaceae	*Daucus carota*	0				
Apiaceae	*Foeniculum vulgare*	0				
Apiaceae	*Heracleum spondylium*	0				
Apiaceae	*Pastinaca sativa*	0				
Polygonaceae	*Fagopyrum esculentum*	0				
Boraginaceae	*Borago officinalis*	0				
Ranunculaceae	*Ranunculus acris*	0				
Caryophyllaceae	*Gypsophila elegans*	1				
Asteraceae	*Matricaria chamomilla*	1				
Asteraceae	*Achillea millefolium*	1				
Asteraceae L	*Cichorium intybus*	1				
Asteraceae	*Chrysanthemum segetum*	2				
Asteraceae	*Anthemis tinctoria*	2				
Asteraceae	*Leucanthemum vulgare*	2				
Asteraceae	*Tanacetum vulgare*	2				
Asteraceae	*Calendula officinalis*	3				
Asteraceae	*Centaurea cyanus* (+EFN)	3				
Asteraceae	*Helianthus annuus* (+EFN)	3				
Asteraceae	*Cosmos bipinnatus*	4				
Malvaceae	*Malva sylvestris*	4				
Boraginaceae	*Phacelia tanacetifolia*	4				
Fabaceae	*Medicago sativa*	4				
Fabaceae	*Vicia sativa* (+EFN)	4				
Fabaceae	*Lotus corniculatus*	4				



Selecting plants that avoid stimulation of pests

(Winkler et al., 2009)

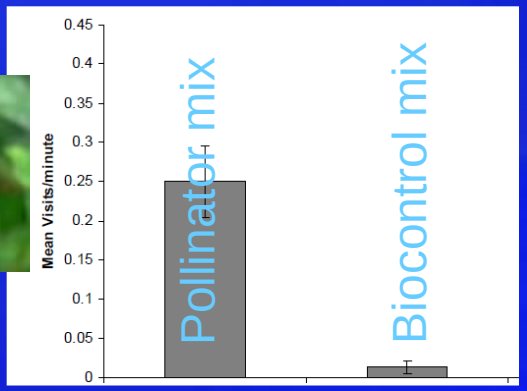


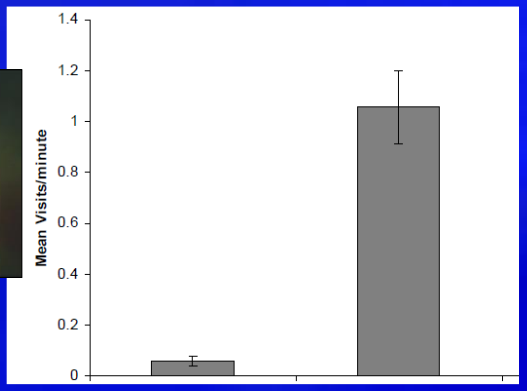
Selecting plants that generate multiple ecosystem services

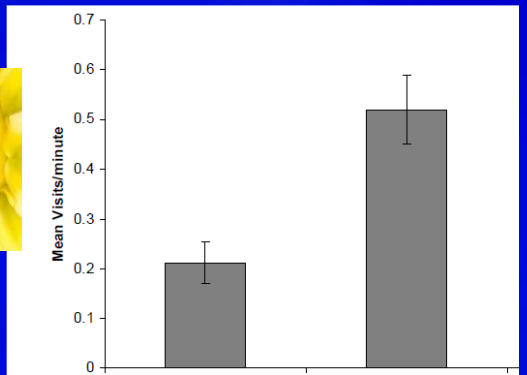
Pollination

Biocontrol

(Campbell, Biesmeijer Varma & Wäckers, 2012)

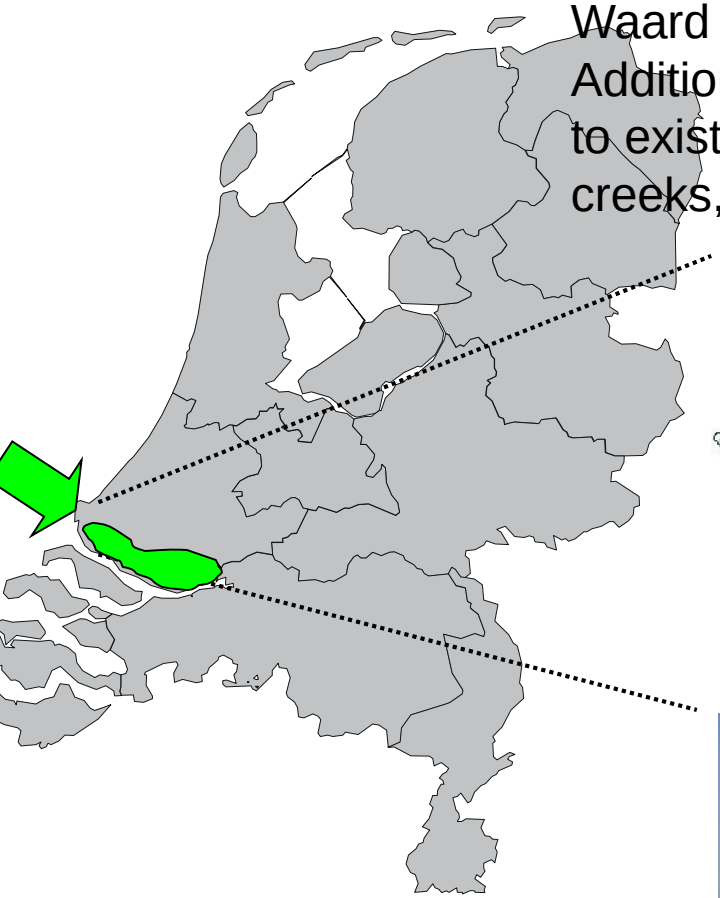


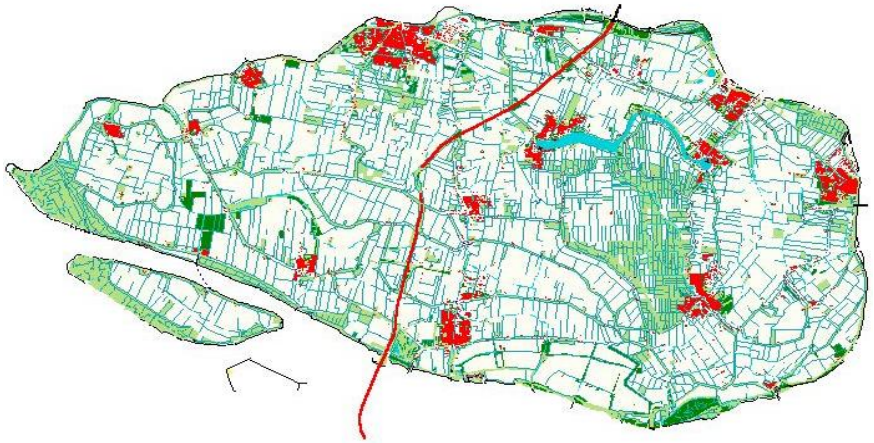




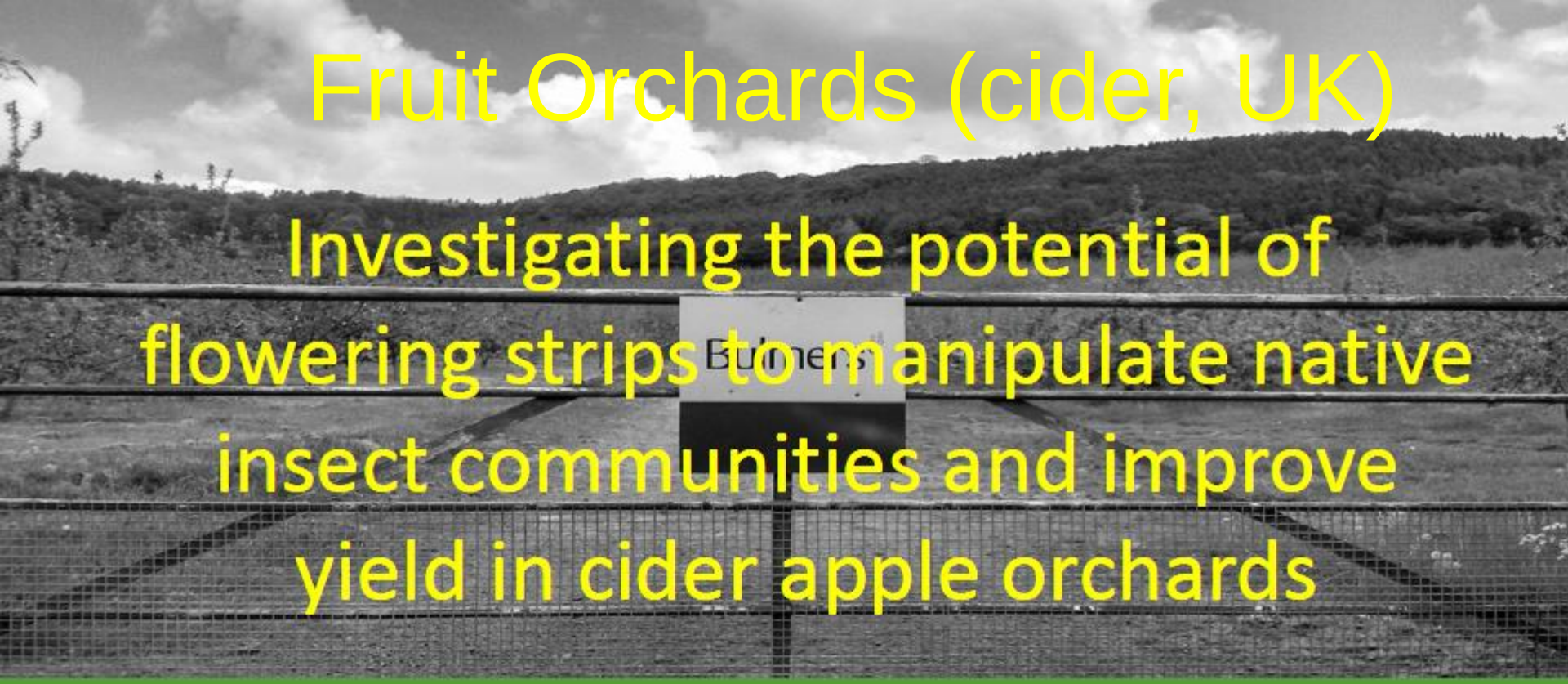
Taking it to the field

Large scale biodiversity project in the Hoekse Waard working with conventional growers. Addition of annual and perennial field margins to existing landscape features (polders, dikes, creeks, canal borders).





Fruit Orchards (cider, UK)



Investigating the potential of flowering strips to manipulate native insect communities and improve yield in cider apple orchards

Alistair John Campbell (PhD student)

Lancaster University

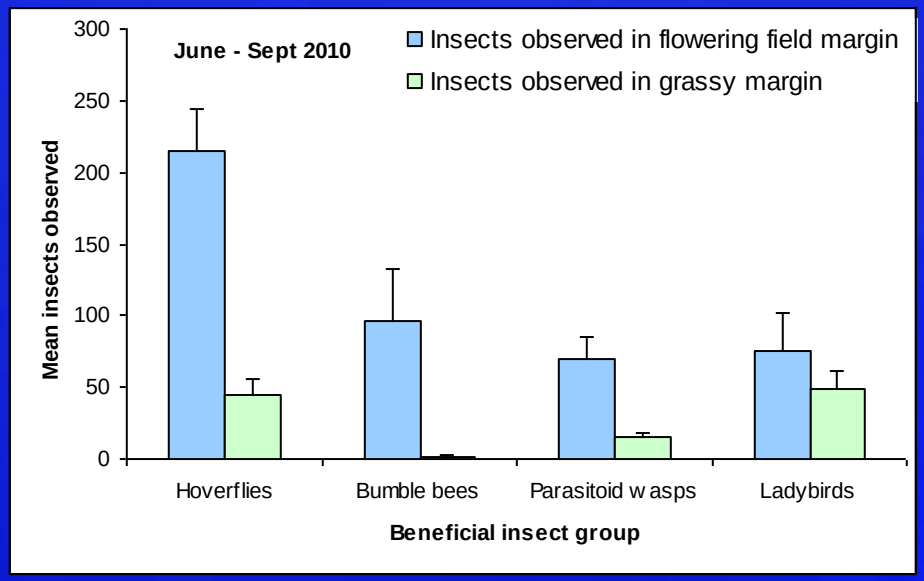
Supervisors: Felix L. Wäckers, Andrew Wilby & Peter Sutton

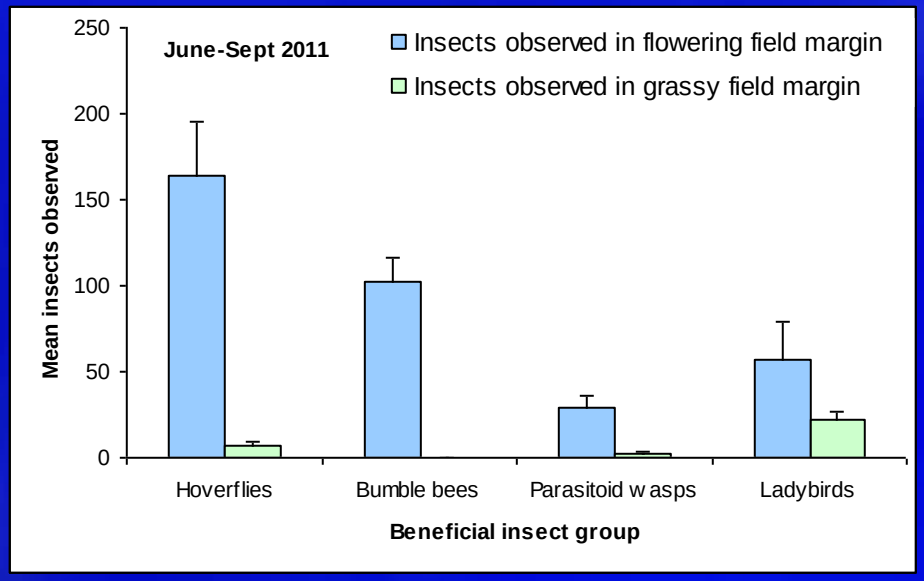
Syngenta Collaborations Event, Tuesday 3rd September 2013

a.campbell@lancaster.ac.uk

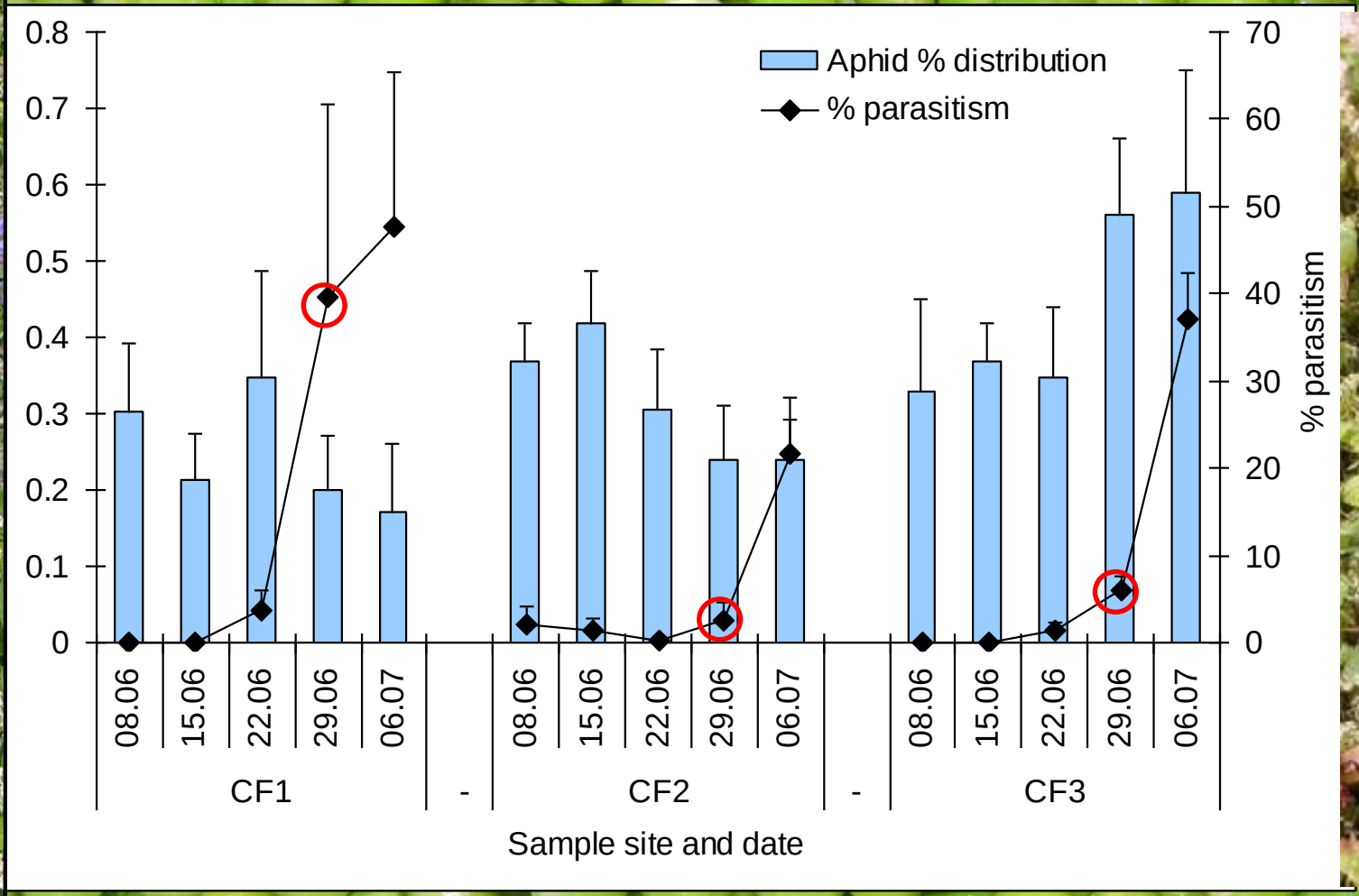
Optimizing Ecosystem Services in Terms of Agronomy and Conservation (ECOSTAC.CO.UK)

Beneficial insects in field margins





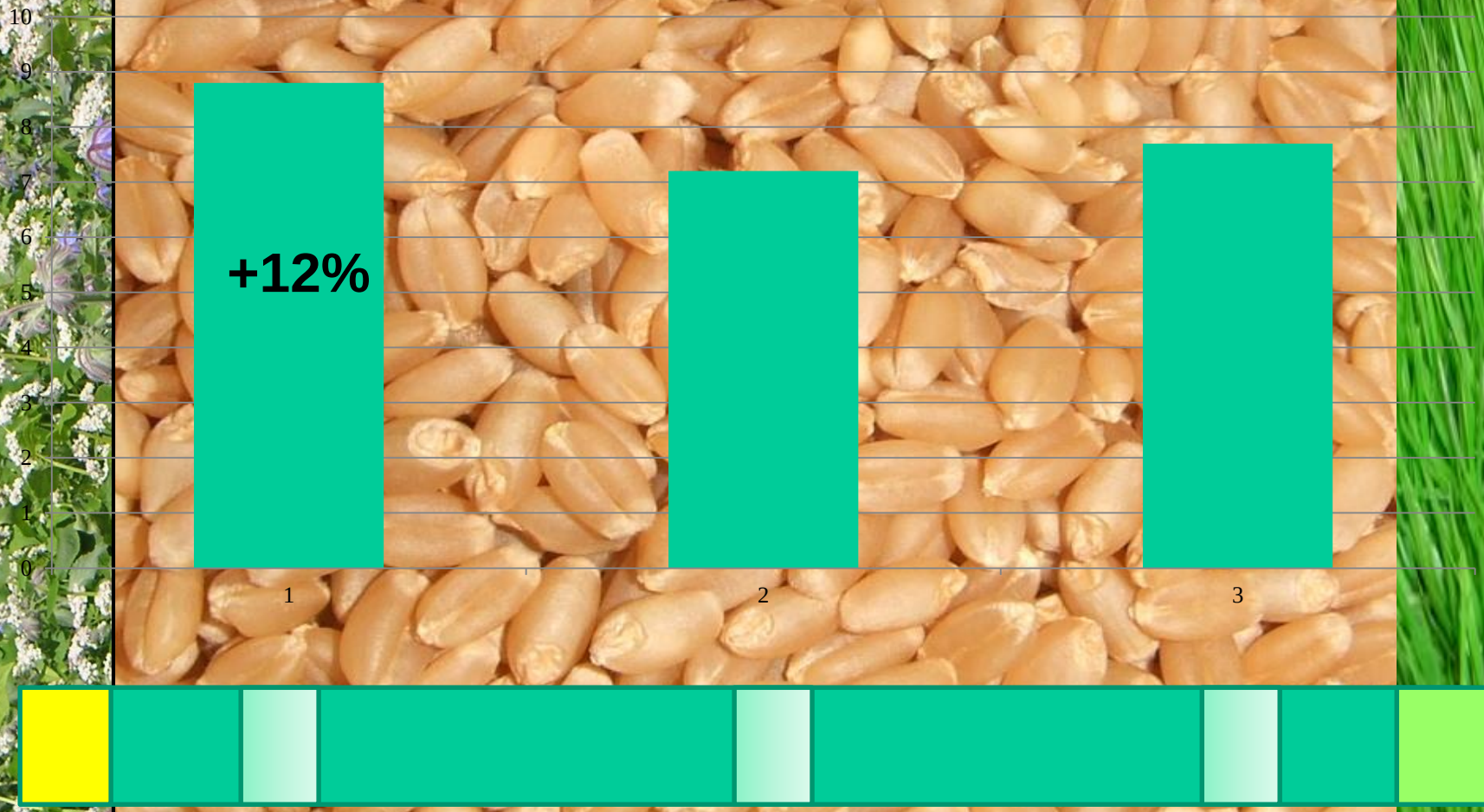
Aphids in peas



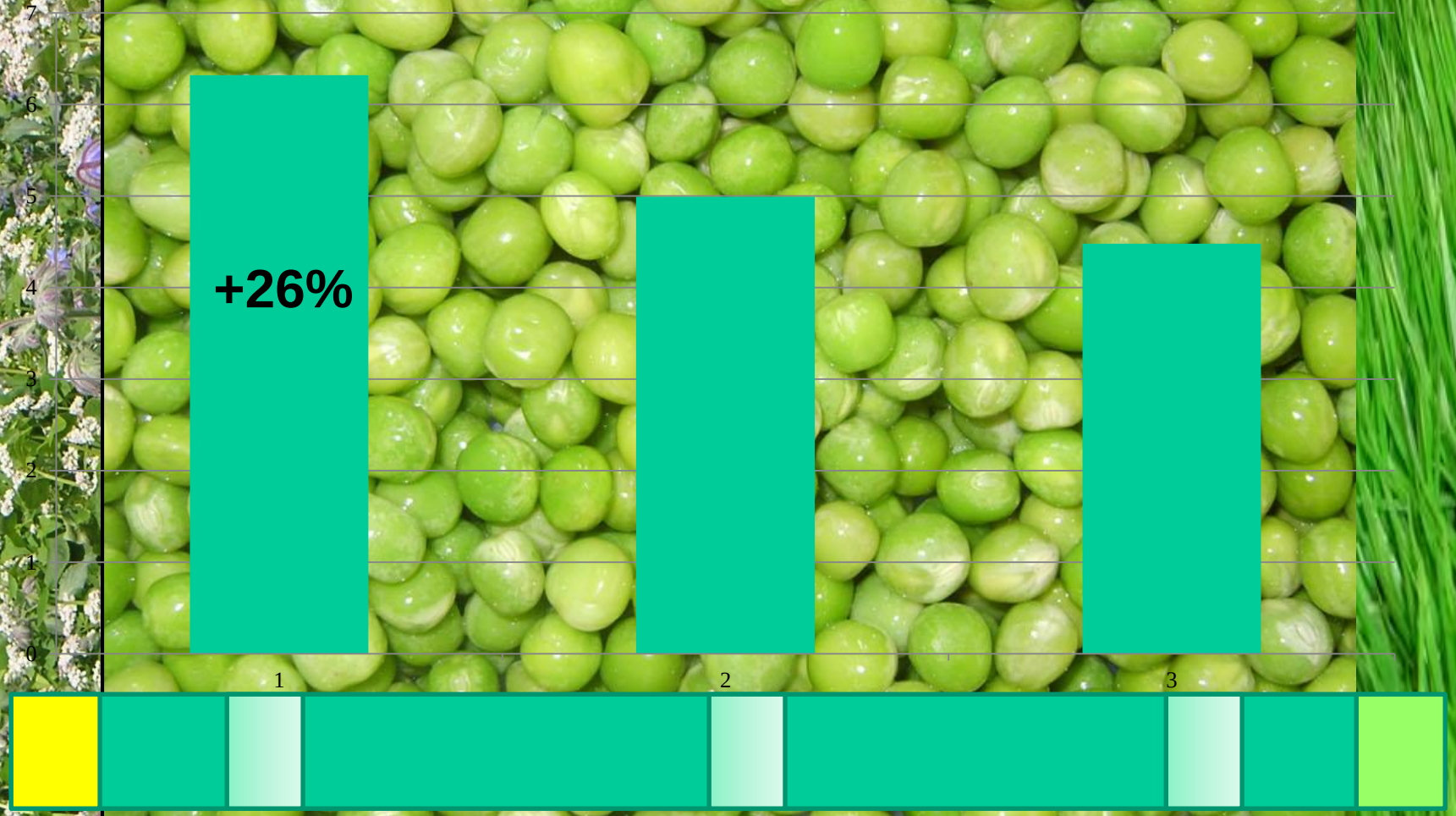

The positive spiral
More beneficials
Fewer pests
More biodiversity
Fewer pesticides


Yield impact?

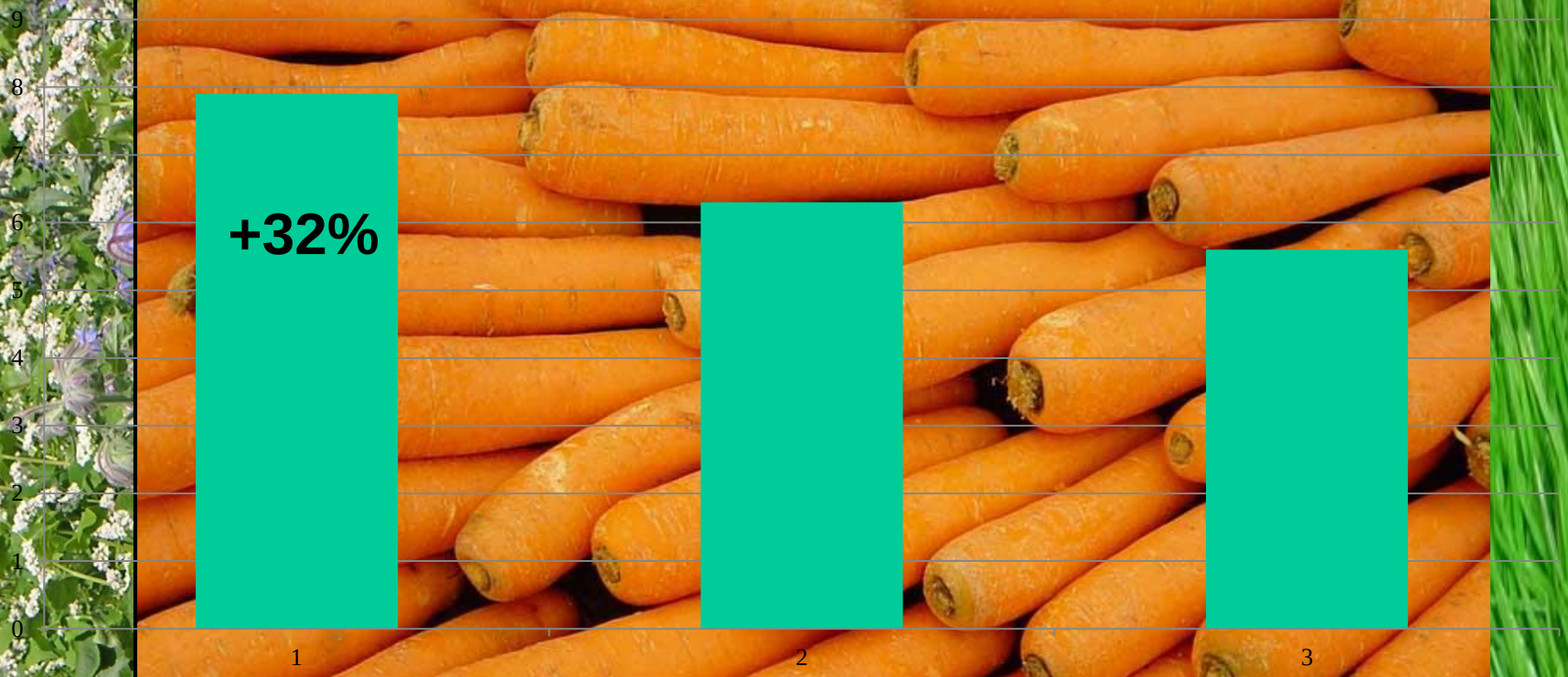
wheat (yield in tonnes/ha)



peas (yield in tonnes/ha)



carrots (yield in tonnes/ha)



Focus on benefits to the agricultural industry

Functional Biodiversity

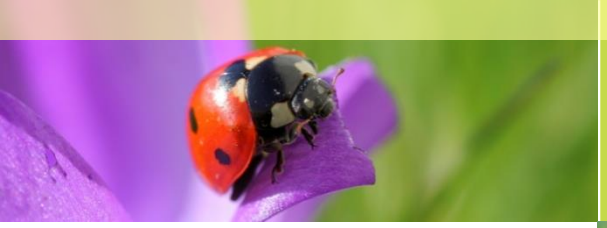
- Shows that yield and conservation are not conflicting objectives
- Helps growers cope with ongoing decline in pollinators and reduced availability of registered agrochemicals
- Compatible with current practices
- Creates additional economic incentives for farmers to engage in Agri-Environment Schemes
- Makes CAP greening a win-win for farmers and nature

Spraying Food Supplements

Nutrimite

Nutrimite™
Advice

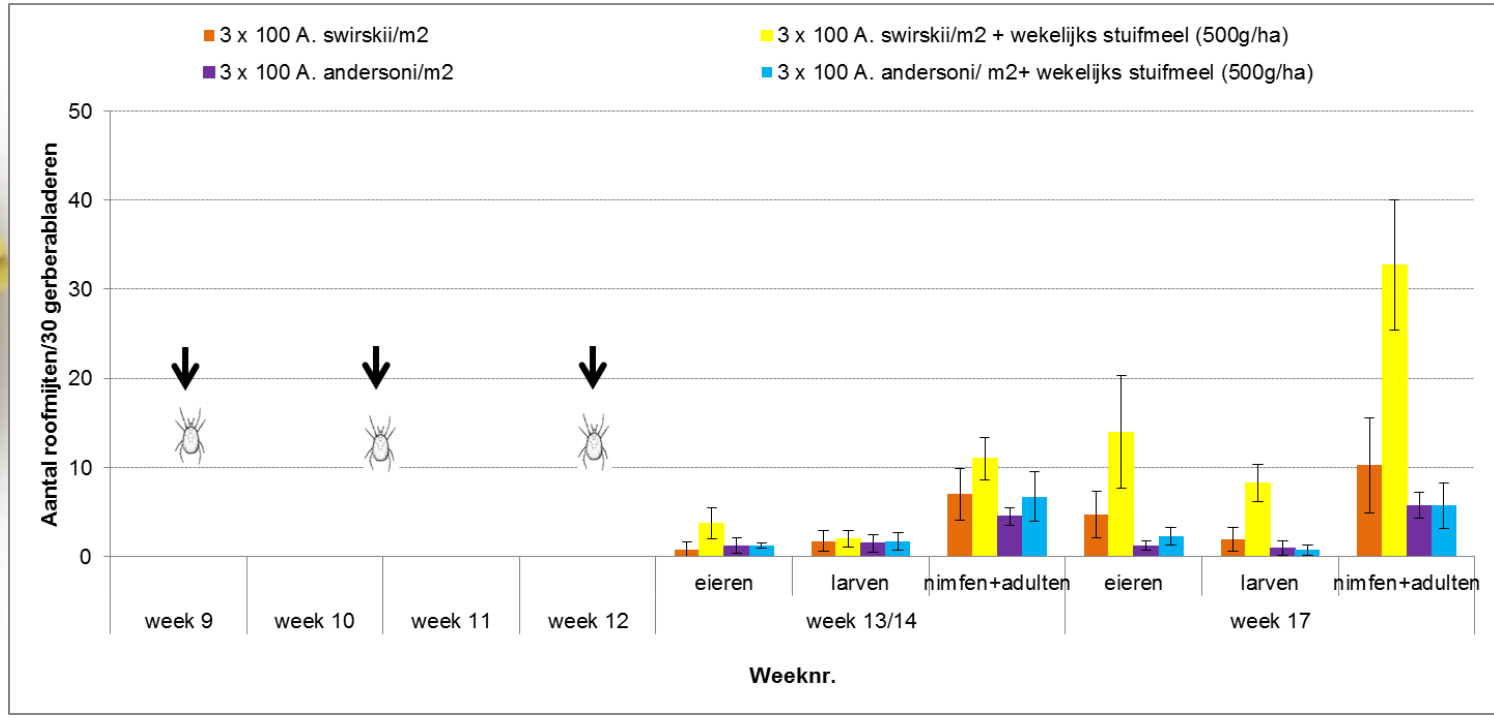
Dosage	500 g / ha / application (0,45 lbs / acre / application)
Interval	Every 2 weeks
N° of applications	min. 2-3 times, depending on predatory mite density
Application method	 To dust Use:  



Better establishment and rapid population growth even before pests arrive!

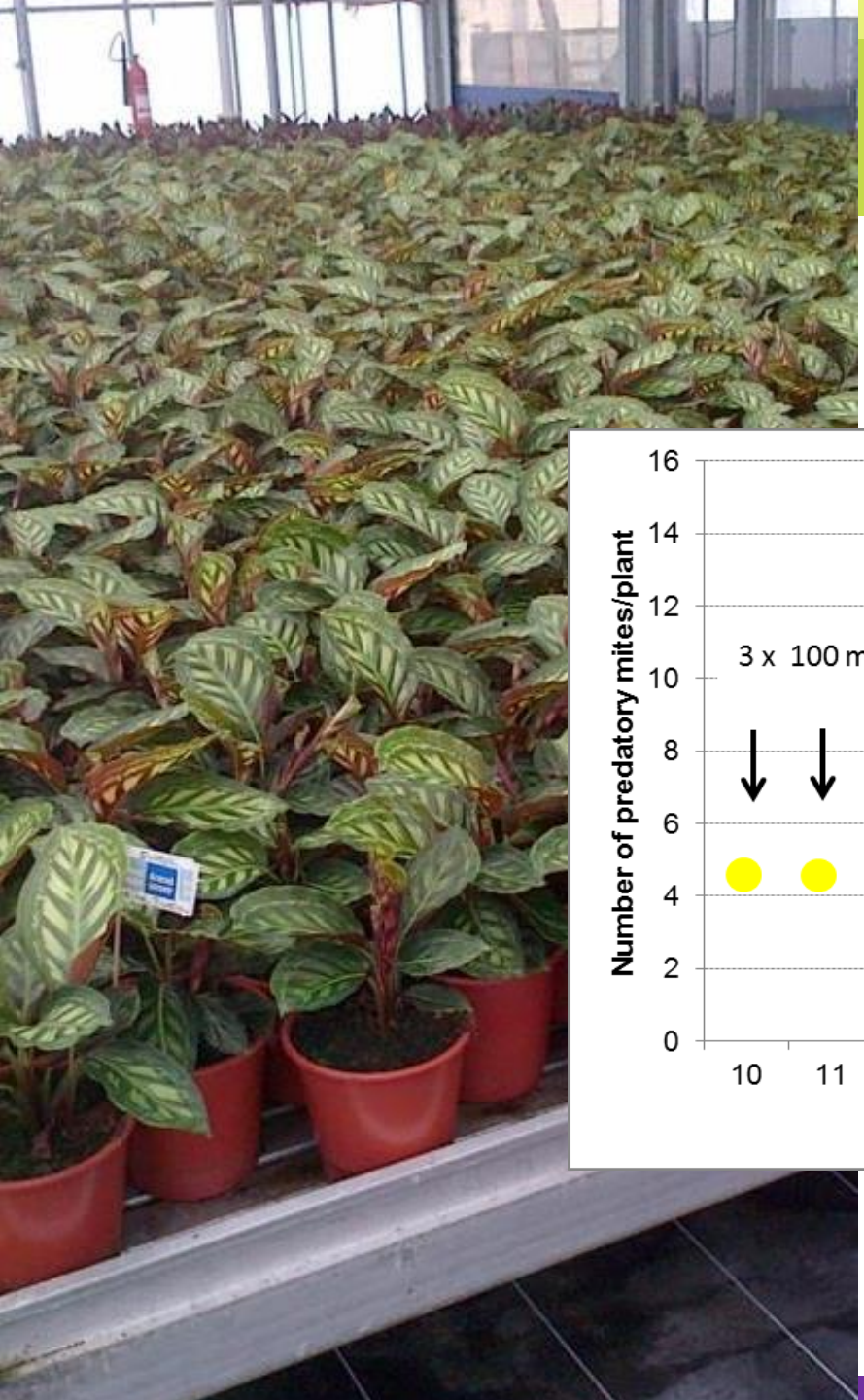
Effect Nutrimite in Gerbera

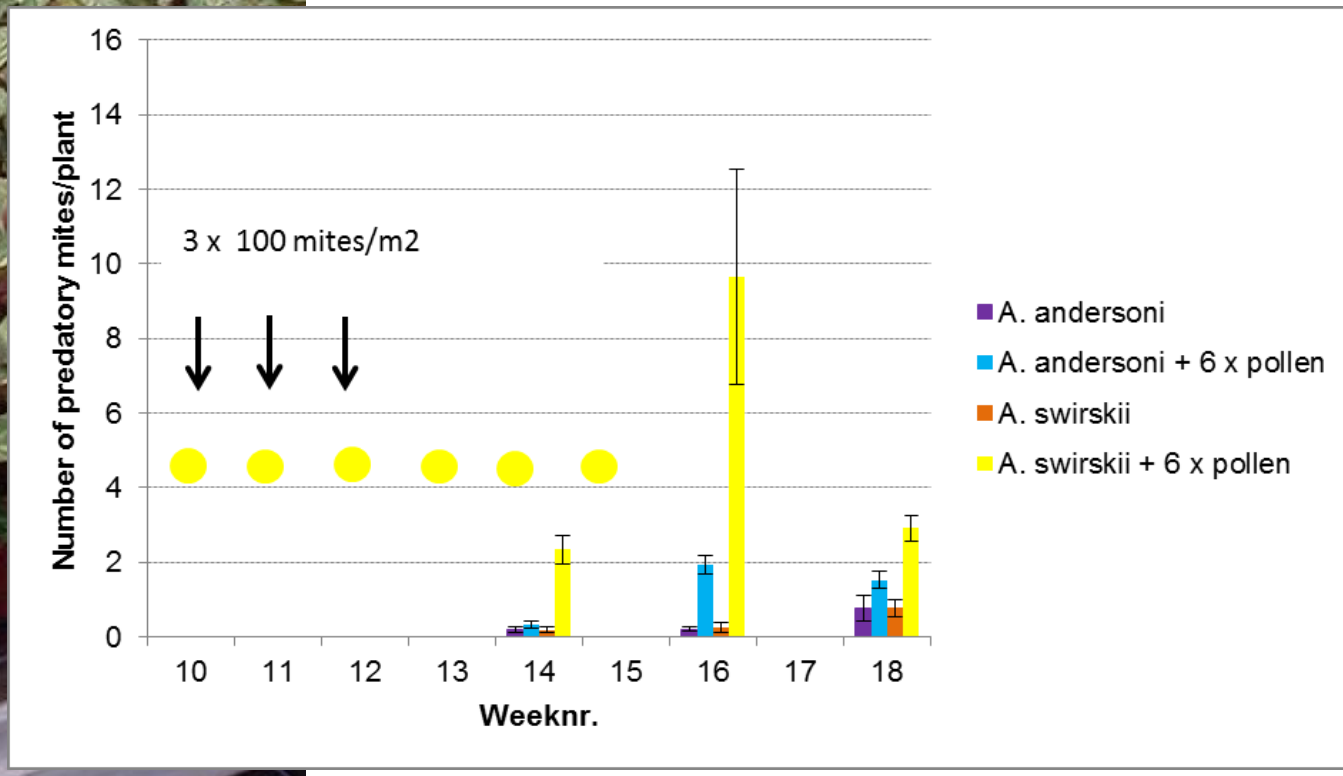
Juliette Pijnakker



Effect of nutrimite on *A. swirskii* in Calathea

Pijnakker & De Souza, Biobest



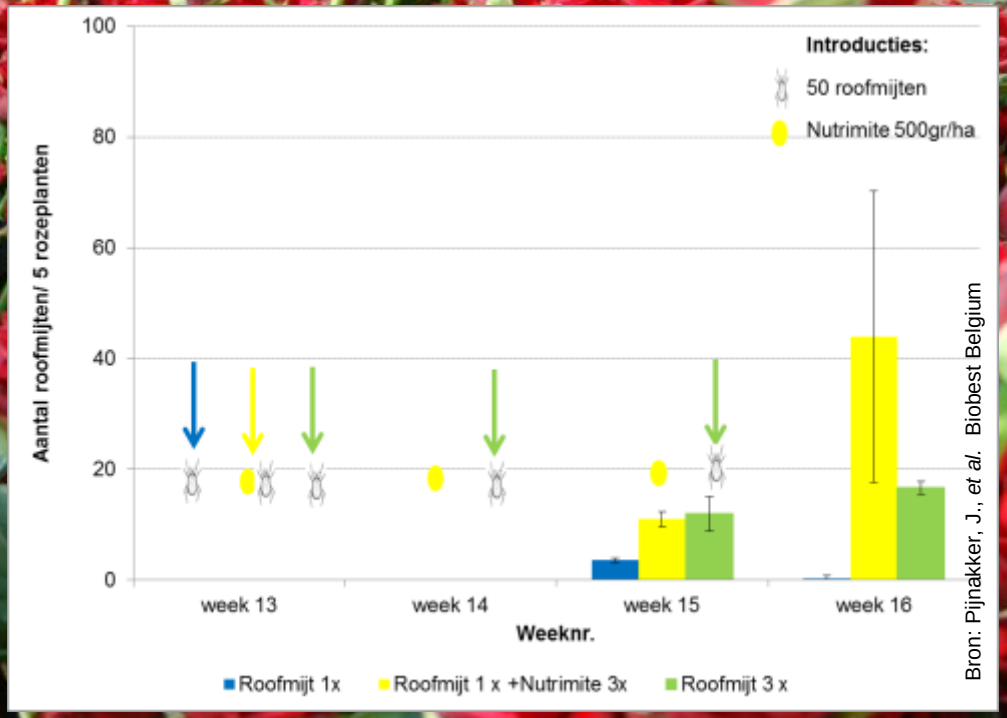


More with Less

Juliette Pijnakker, Biobest

Crop:
- Cut roses

Result:
- **2,5 times more** predatory mites **after 1 x introduction en 3 x Nutrimite** as compared to 3 x introductions!



Thanks

Is it worth the bother?

Aren’t existing landscape elements enough?

Do diverse bird conservation margins benefit biological pest control?

Meteorus autographae

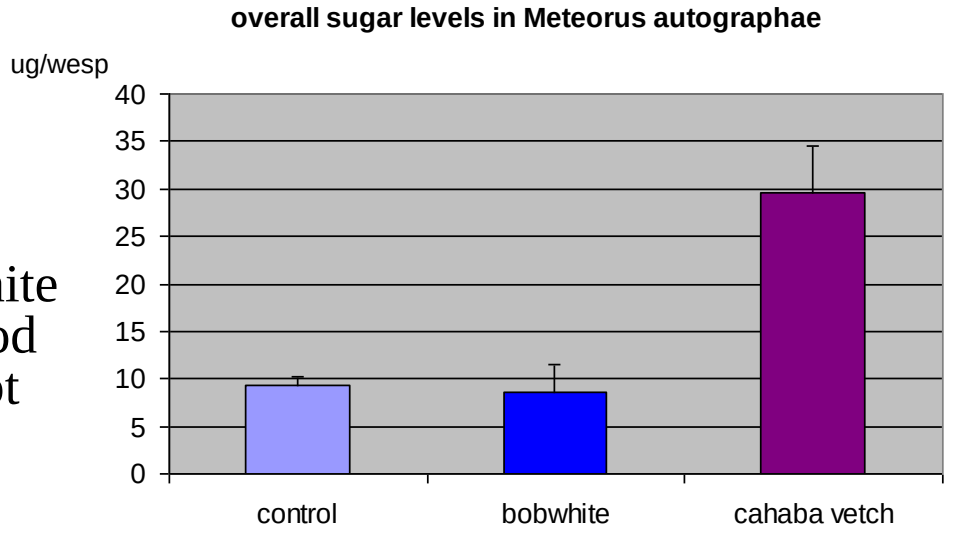
Parasitoid feeding at a vetch nectary

Conclusions

High diversity field margins for bobwhite quail conservation failed to provide food to a biological control agent and did not enhance biological pest control in the adjacent crop.

Parasitoids did clearly benefit from pure stands of cahaba white vetch.

Impact on Biocontrol is a function of **resource availability (*flower suitability*),** rather than diversity.



Parasitoid feeding at a vetch nectary