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Peach aphid management in organic and conventional orchards : How to reconnect efficiency and ecology ?

S. Penvern, J. Fauriel, S. Bellon

Servane.penvern@avignon.inra.fr

INRA UR 767, Ecodevelopment Unit, 84914 Avignon, France

ALIMENTATION
AGRICULTURE
ENVIRONNEMENT



Introduction

- Peach in France : 16 000 ha (316 ha in OF)
- Aphids => serious damage

Direct symptoms :
Leaves' deformation
Reduced tree vigour



Undirect symptoms :
Plum Pox Virus

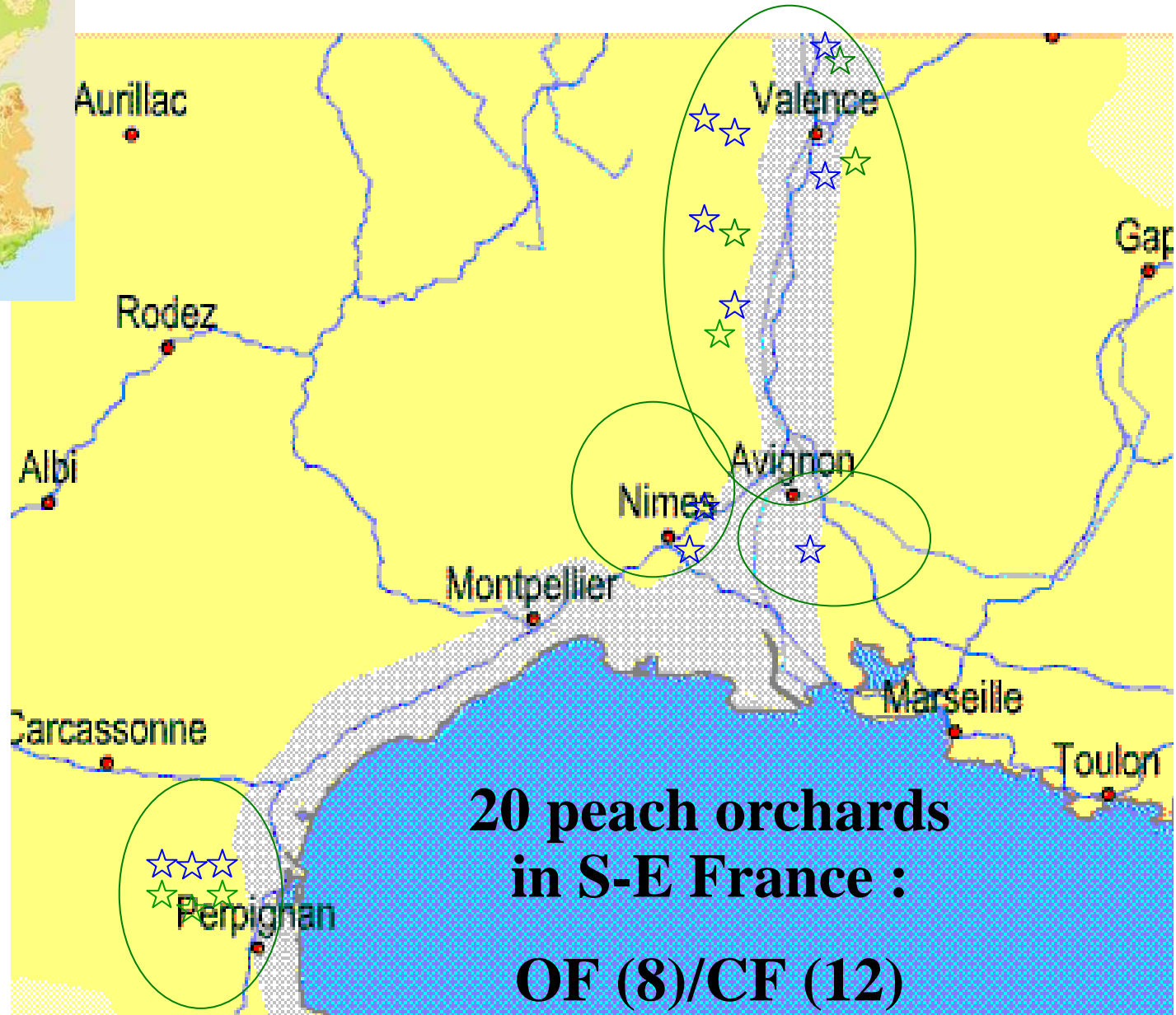
- Protection dominated by chemicals
- ⇒ Shift towards an agroecosystem approach



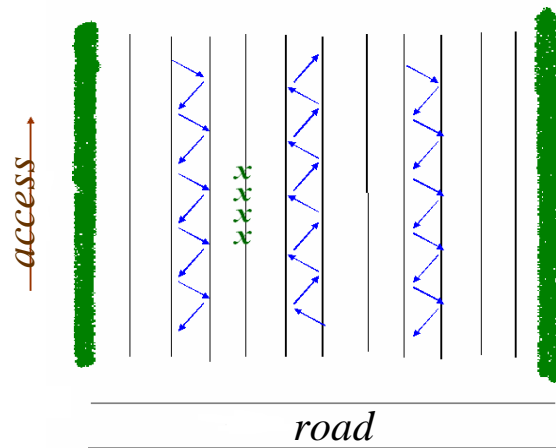
*The paradox between efficiency and ecology :
Is there a best management strategy ?*

- Identification of farmer's practices
- Characterisation of their strategy
- Assessment of its efficiency (impact on aphids) and ecological respect (impact on beneficials)
- Effect of the tree vigour (Price, 1991) ?

Material & Methods



Aphids' infestations (1)



Aphid's community:

- *Myzus persicae* (Sulzer)
- *Brachycaudus persicae* (Passerini)
- *Brachycaudus schwartzi* (Börner)
- *Hyalopterus amygdalii* (Blanchard)
- *Myzus varians* Davidson

Leclant's classification (1970):

degree of aphid infestation (d)	Number of aphids per shoot (N)
0	0
1	$0 < N < 5^1$
2	$5^1 < N < 5^2$
3	$5^2 < N < 5^3$
4	$5^3 < N < 5^4$
5	$5^4 < N < 5^5$

Infestation Index (Chen, 1997) :

$$IF = \frac{\sum 50 (f_d \times d)}{5 \times \sum 50 \times f_d}$$

f_d : frequency of d

Impact on Aphids' antagonists (2)

Antagonist's community :

Coccinellidae; Syrphyidae; Hemerobiidae and Chrysopidae;
Araneae; Earwigs; Aeolothripidae

⇒ H, shannon diversity index

⇒ A, abundance index

⇒ S, species richness

⇒ E, evenness index

$$H = - \sum [p_i \times \log_2(p_i)]$$

P_i : the fraction of the species

$$E = H / \log_2(S)$$

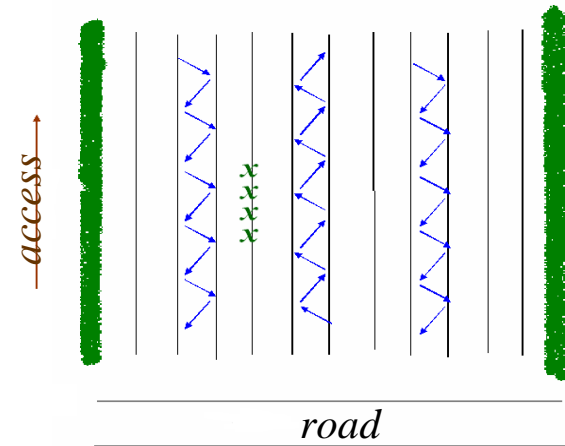
S : species richness



Effect of the vigour (3)

The morphological parameters monitored are:

- number of leaves (Nf),
- shoot length (Lp),
- fruit diameter (Dfr),
- trunk perimeter (DT),
- number of water-sprouts on the trunk and on fruiting branches (Gmd)
- nitrogen-contents in leaves (N).

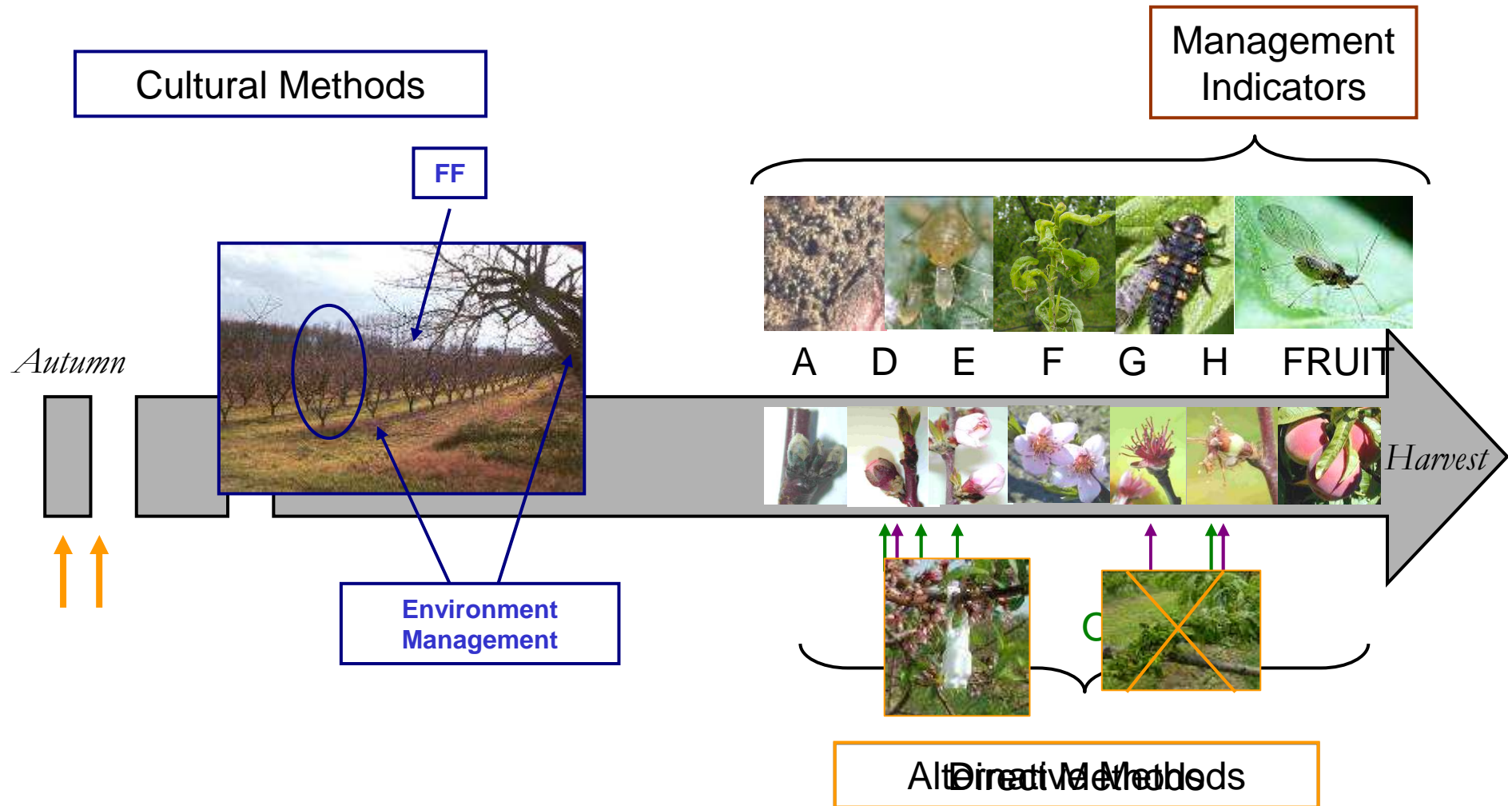


Vigour index (IV):

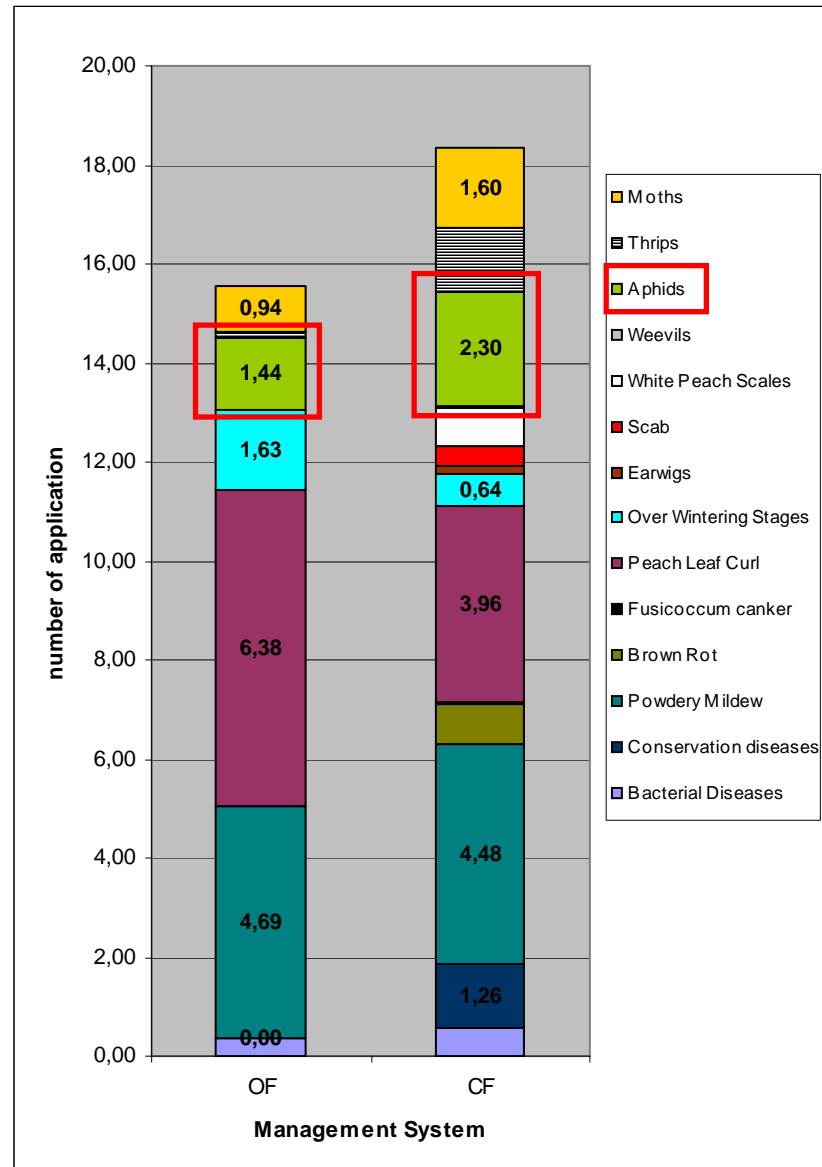
$$IV = \text{Log} (Dfr_AUC \times Lp_AUC \times Nf_AUC \times Gmd \times N \times DT)$$

Results

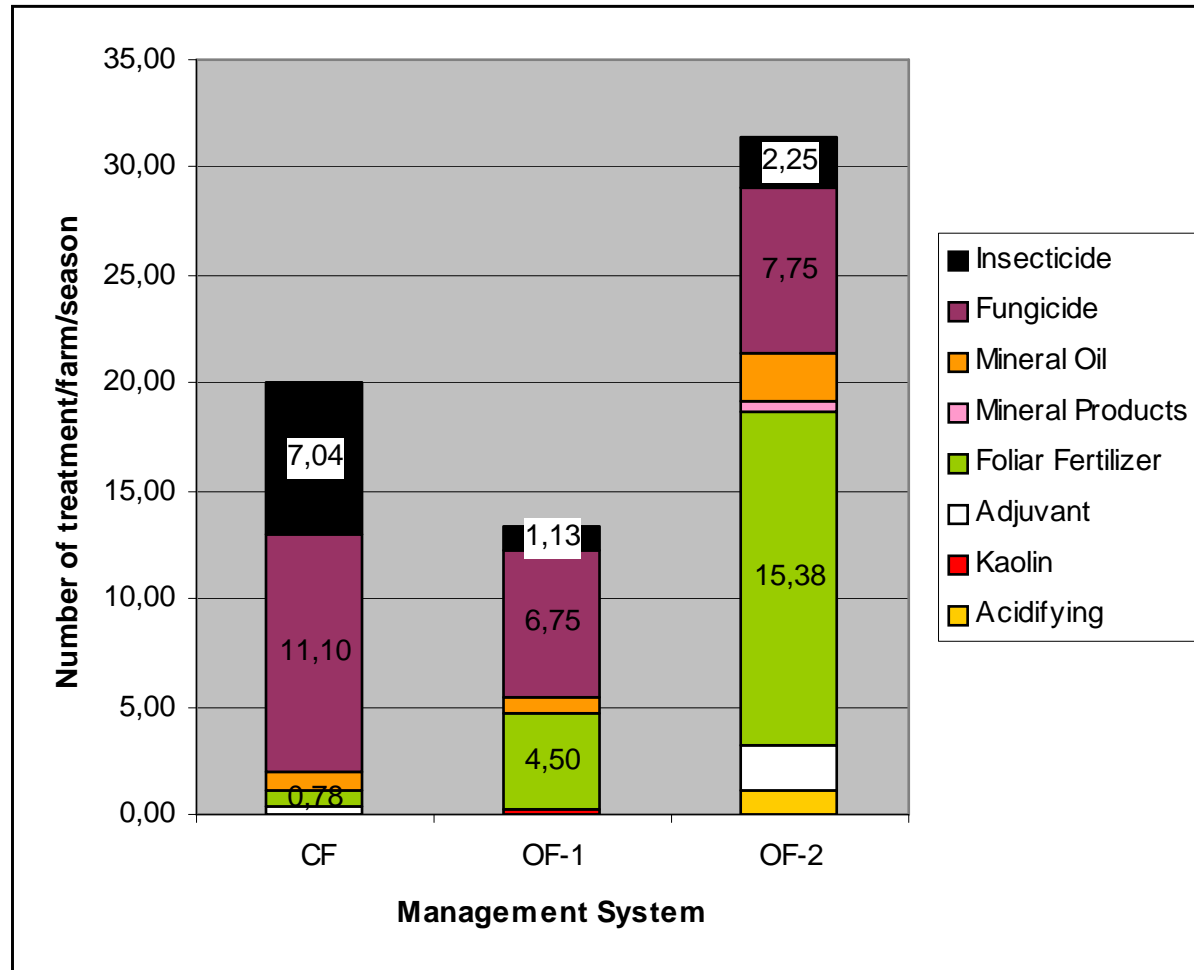
Farmer's practices (1)



Spray programs (2)



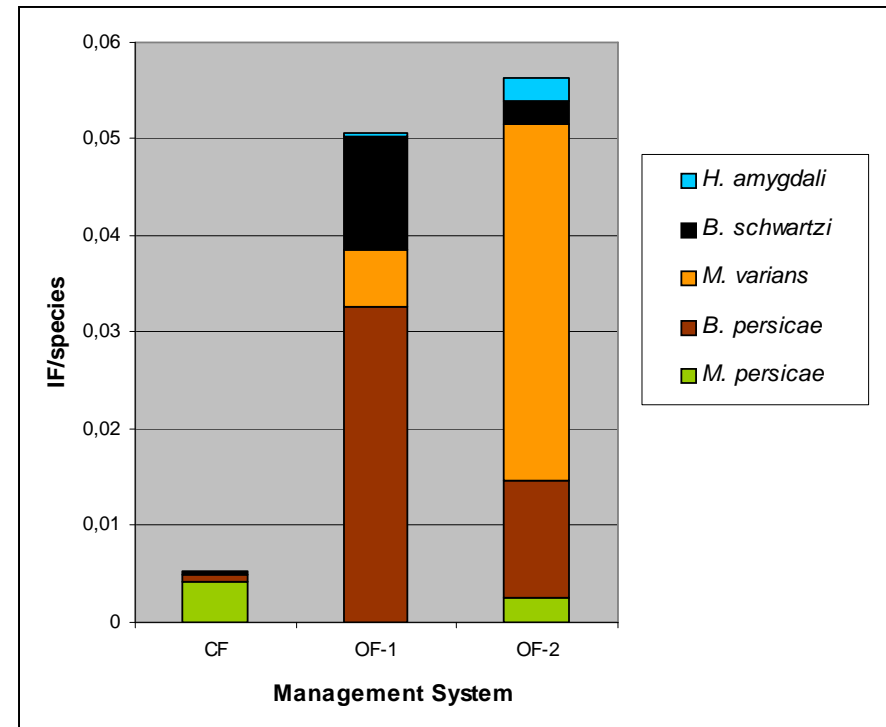
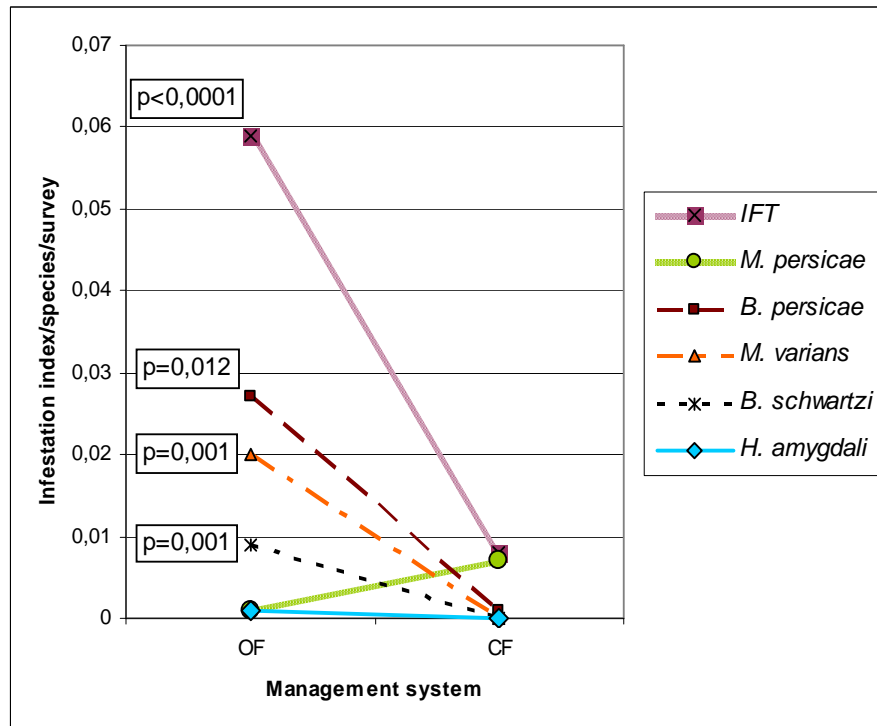
Spray programs (2)



Two strategies can be distinguished in OF

Impact on Aphids (3)

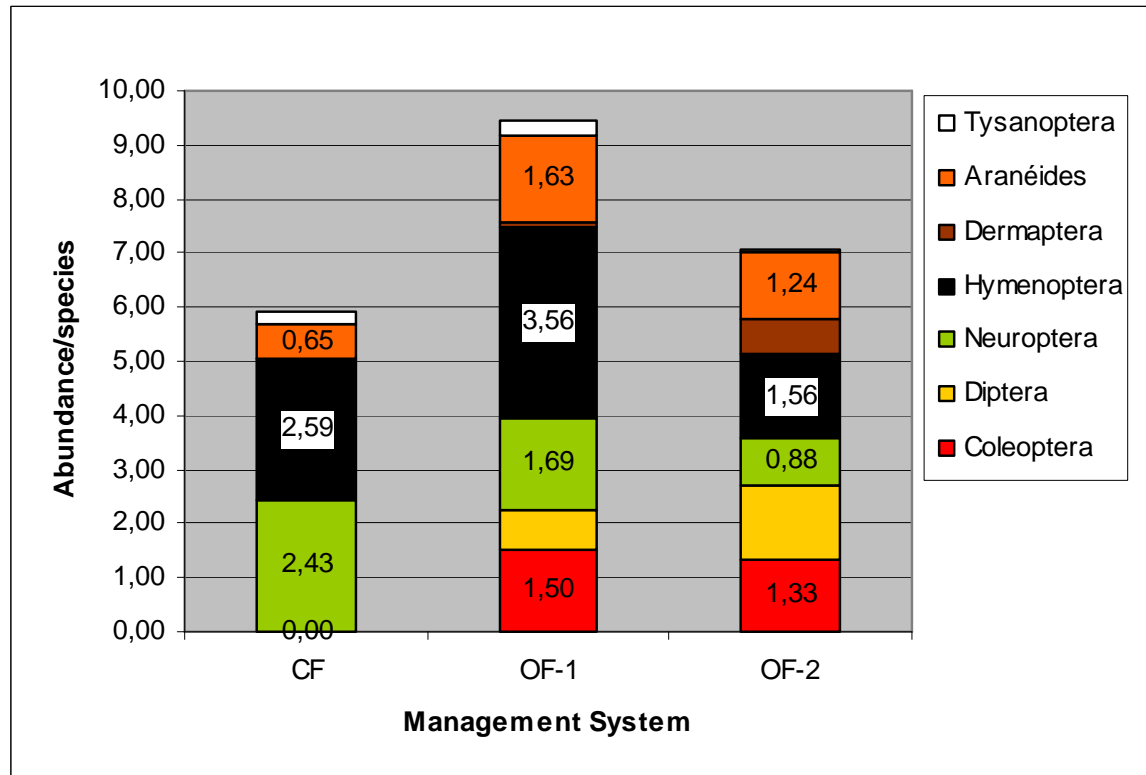
Aphids are more abundant and more diversified in OF



Despite two distinct strategies, equivalent level of infestation

Impact on beneficials (3)

Aphid's antagonists are more abundant and more diversified in OF



	<i>B. Persicae</i>	<i>B. Schwartzi</i>	<i>H. amygdali</i>	<i>M. Varians</i>	Total
Coccinellidae		0,011		0,017	0,001
Syrphydae	0,027		0,033	0,003	0,005
Araneidae	0,045			0,031	0,033
Aeolothripidae			0,015		
A					0,032

P-value from of correlation of Spearman between aphids' infestations and antagonists' abundance.

Effect of cultural methods (4)

- IV a good indicator ?
=> Only the N-content in leaves is not correlated to it, but no relation with the quantity of N-spread.
- Trees in OF tend to be less vigorous than in CF (ns)
- Vigour's effect on Aphid's infestation ?
 - No correlation between IV and IFT
 - IFT linked to shoot's length, and number of leaves/shoot, and dose of N ($p=0.001$)*=> But in all cases, the effect of the management system predominates*

Conclusion

- Conventional farmers limit their intervention to direct control
- Organic management strategies are more integrative, using many indicators and combining different methods
- CF is more efficient but OF preserve antagonists, thus respect ecological processes
- This can be explain through farmer's practices :
 - Therapeutic toxic treatments OR preventive numerous treatments explains low infestation
 - Non toxic, preventive treatments associated with cultural and alternative methods promote beneficials.

Conclusion

- We can distinguish two strategies among organic farmers
- OF-1 vs OF-2 show better results => the closest from a total system approach, but not yet efficient (Brown, 1999)
- Other techniques and methods available or on investigation to achieve better efficiency

Thank you for your attention

