



Low-Residue crop protection strategy for apples

Possibilities and limits

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Research issue - strategies

Goals of «Low-Residue» Strategy

- Reduction of chemical-synthetic pesticide use
- No pesticide residues detectable
- Production of premium quality apples



3 crop protection strategies

- Integrated crop protection (IP)
- Organic crop protection (OP)
- Low-Input / Residue (LR)

combination of IP and OP

- Until 2008 Low-Input: reduced number of applications
- From 2009 Low-Residue: no detectable pesticide residues

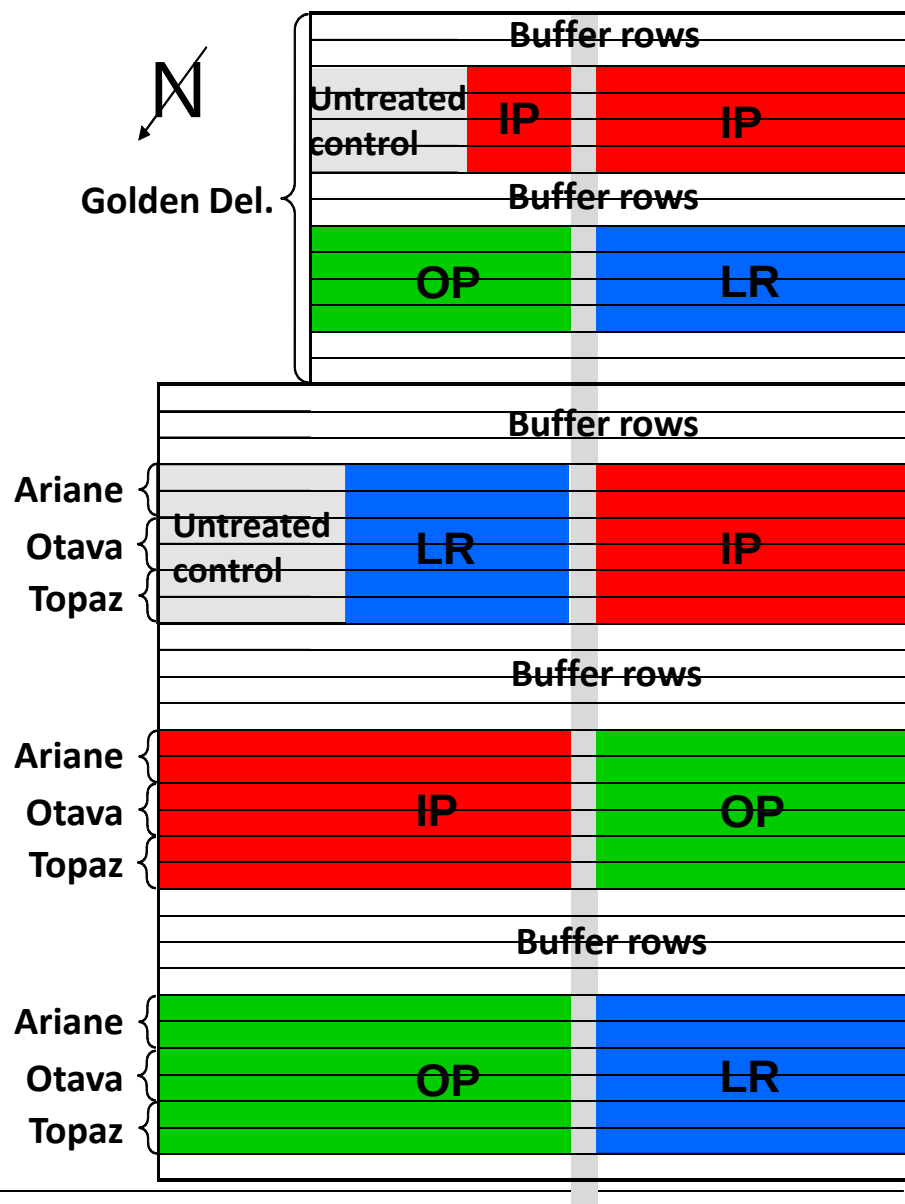
Trial design

• Varieties

- **Golden Delicious** (0.32 ha),
planting year 1999
- **scab resistant** (0.75 ha)
 - **Ariane (Vf)**, planting year 2006
 - **Otava (Vf)**, planting year 2004
 - **Topaz (Vf)**, planting year 2004

• Assessments:

- Disease incidences, pests, yield,
quality, storage properties, working
hours, economics, ...



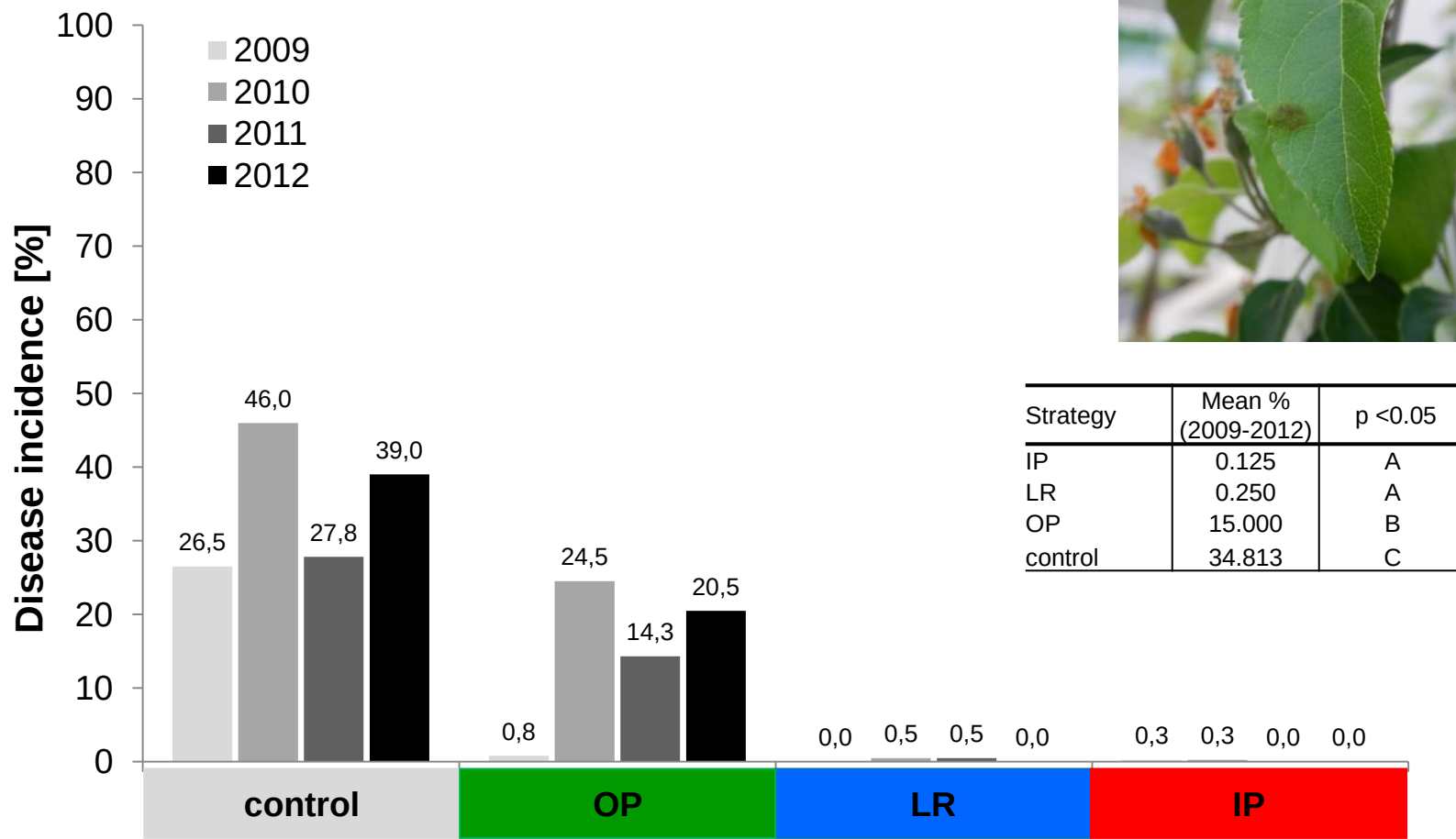


Crop protection strategies

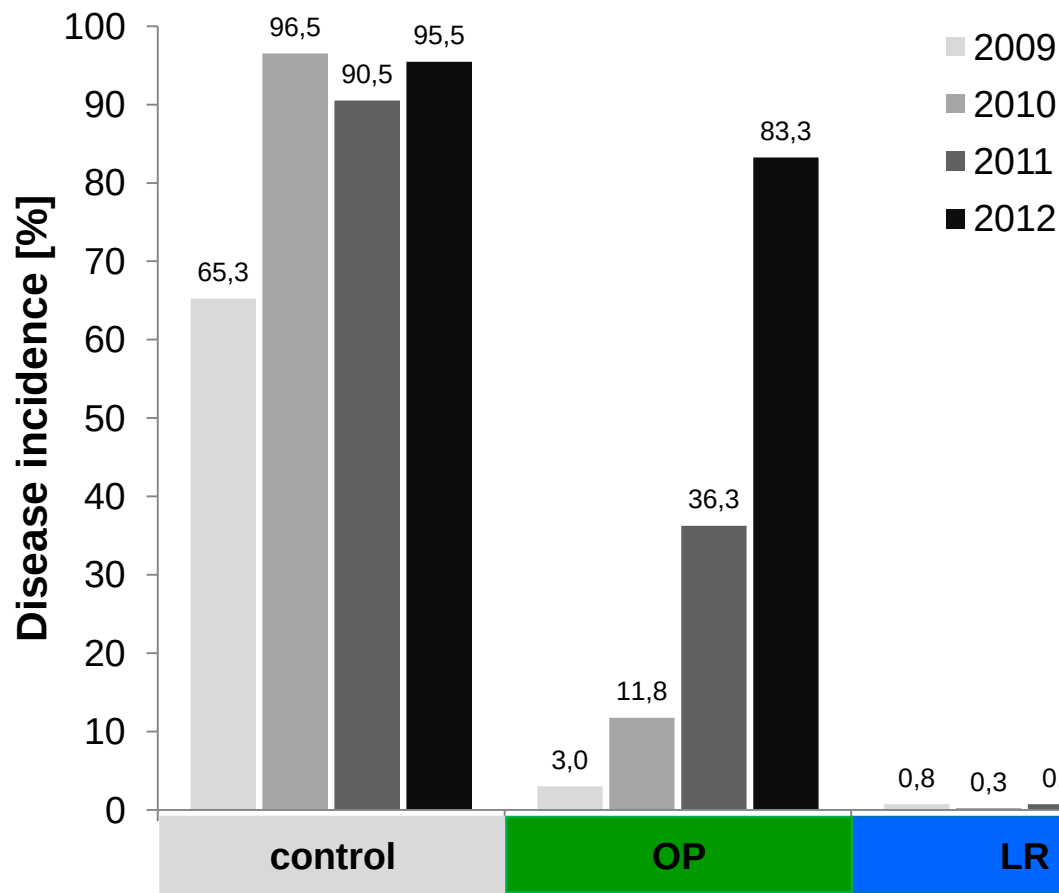
	Bud break	pre bloom	bloom	post bloom	summer	Final treat.	
	Scab primary season (Ascospores)				Scab secondary season (conidia)		
IP	1x Delan	2x Anilino-Pyrimidine	2x QoI + Captan	2x DMI + Captan	4 - 6x Captan	3 weeks	harvest
LR	1x Delan	2x Anilino-Pyrimidine	1x DMI + Captan	5 - 6x Bicarbonate + S	2 - 3x Acid clay + S	1x Bicar bonat 8 days	
OP	1x Copper Golden Del. only	3 - 4x Acid clay + S	5 - 6x Bicarbonate + S	2 - 3x Acid clay + S	1x Bicar bonat 8 days	8 days	
							hot water treatment

	thinnig	fertilization	fire blight		codling moth	other pests	weeds
IP	Chemical thinnig + handish	According to Swiss IP-guidelines	Streptomycin according to Maryblight	Hail net + exclusion netting (barrier for bees)	Exclusion netting + mating disruption	1 - 2x insekticides (IP)	1 - 2x herbicides (IP)
Low-Residue			Myco-Sin according to Maryblight			1 - 2x insekticides (OP)	Mechanical weeding (Ladurner)
OP	Mechanical thinnig (Darwin) + handish	According to Swiss organic guidelines					

Apple scab – Leaf scab end of June (Golden Delicious 2009 - 2012)

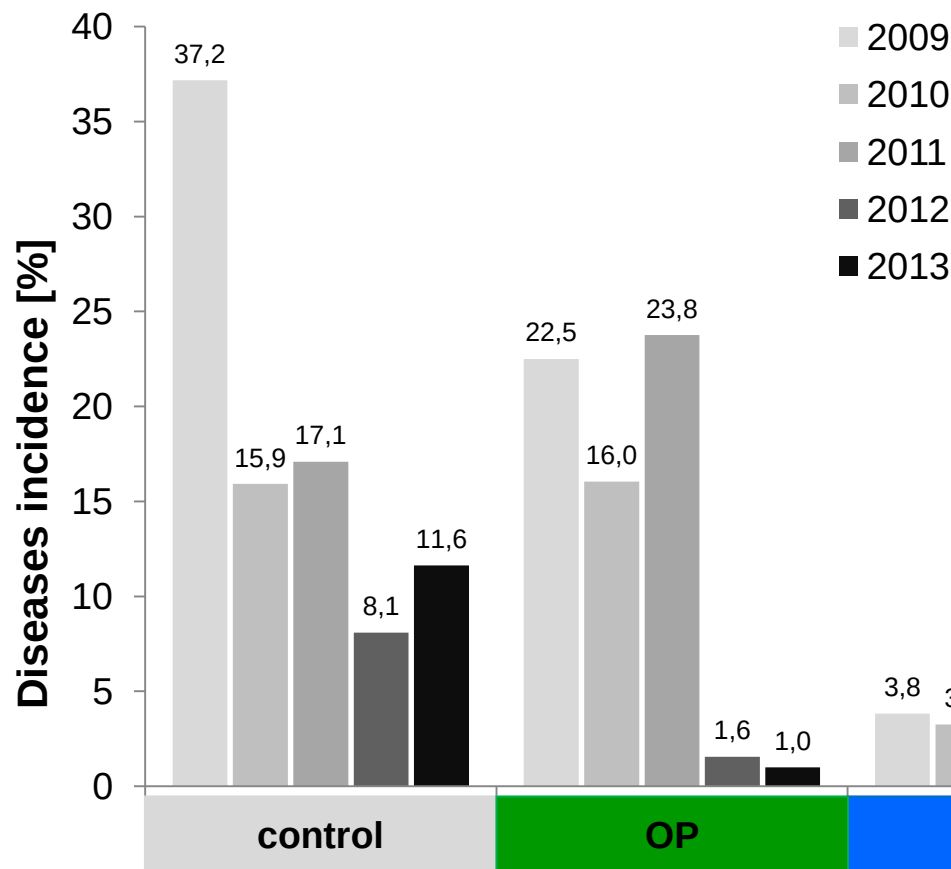


Apple scab – fruit scab before harvest (Golden Delicious 2009 - 2012)



Strategy	Mean % (2009-2012)	p <0.05
IP	0.875	A
LR	1.000	A
OP	33.563	B
control	86.927	C

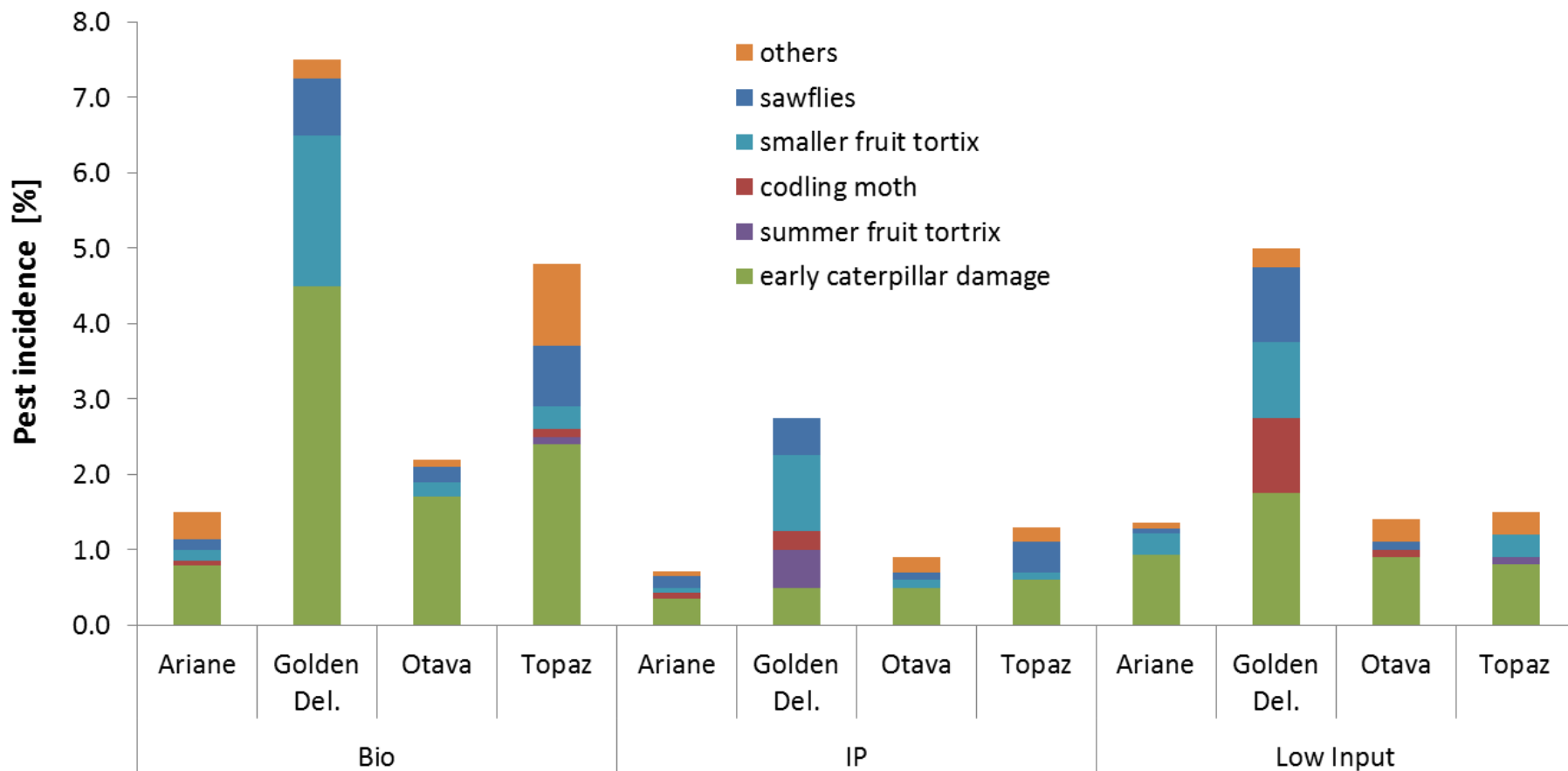
Powdery mildew on scab resistant variety (mean 2009 - 2013)



Strategy	Mean % (2009-2013)	p <0.05
IP	3.083	A
LR	3.922	A
OP	12.969	B
control	17.975	B

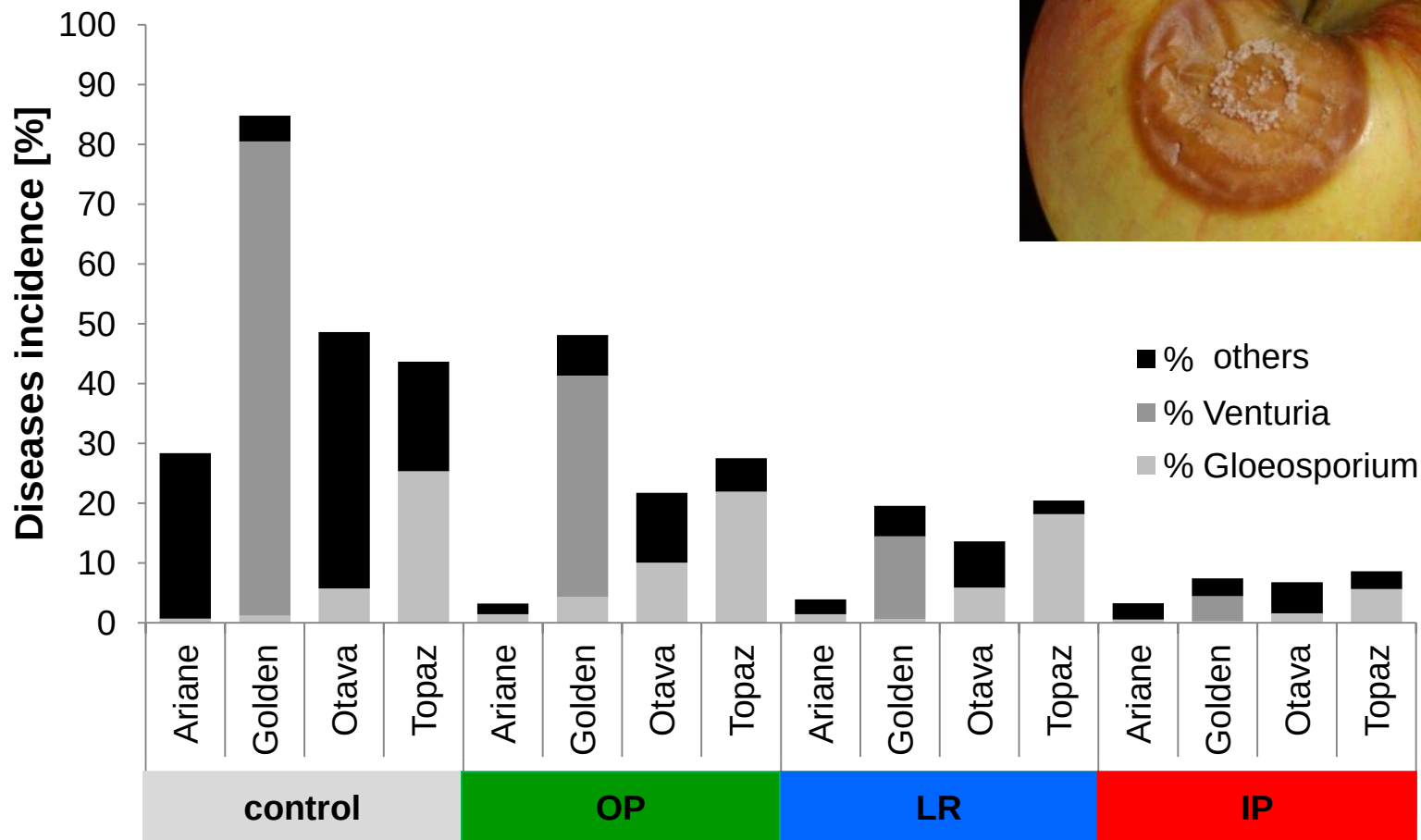


Damage by insect pests (mean 2009-2013)

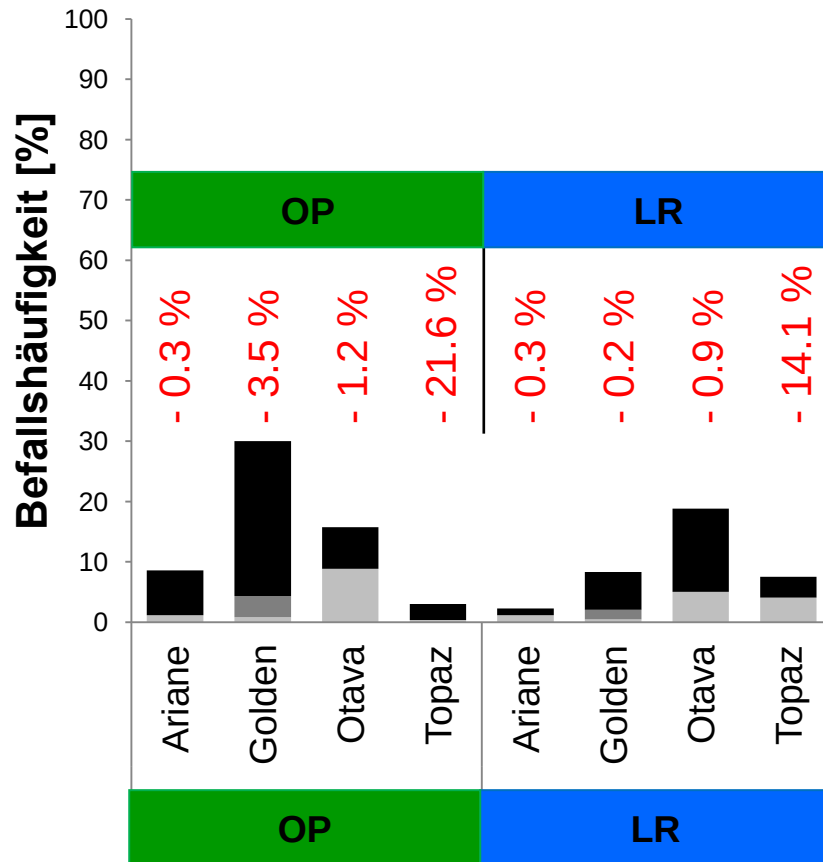




Storage rot after 6-7 months CA-Storage (mean 2009-2013)



Storage rot after 6-7 months CA- Storage with Hot-Water Dipping (mean 2009-2011)



■ % others
 ■ % Venturia
 ■ % Gloeosporium

Variety	temperature	Tauchzeit
Ariane	52°C	2.5 min
Golden Delicious	50°C	2.5 min
Otava	52°C	2.5 min
Topaz	52°C	2.5 min



Detectable pesticide residues

MRLs:

- Captan 3 mg/kg,
- Trifloxystrobin 0.5 mg/kg
- Pirimicarb 1 mg/kg

Year	Variety	residues detected / concentration (mg/kg)			
		IP		LR	OP
2009	Golden Del.	Captan	0.07	No residues	No residues
		Trifloxystrobin	0.03		
	Topaz	Captan	0.12	Trifloxystrobin 0.01 Drift from IP!	
		Trifloxystrobin	0.07		
2010	Golden Del.	Captan	0.32	No residues	
		Trifloxystrobin	0.02		
	Topaz	Captan	0.58	No residues	
		Trifloxystrobin	0.03		
2011	Golden Del.	Pirimicarb	0.05	No residues	
		Captan	0.12		
		Trifloxystrobin	0.03		
	Topaz	No residues			
2012	Golden Del.	Captan	0.18	No residues	
	Topaz	Captan	0.20		



Cash flow from 2009 to 2012 for each plot (Fr./ha)

	OP				IP				LR			
	Ariane	Golden Del.	Otava	Topaz	Ariane	Golden Del.	Otava	Topaz	Ariane	Golden Del.	Otava	Topaz
2009	1'574	4'324	8'646	113	-8'636	-4'105	-6'862	-5'660	-7'905	2'226	-4'284	-5'663
2010	5'642	-9'512	-7'397	9'958	-5'238	-7'750	-9'024	-3'773	-8'242	-13'214	-10'083	-4'549
2011	-539	X	7'643	17'200	-5'941	-625	-2'481	-854	-6'679	-179	-3'591	-1'858
2012	1'545	-27'400	-8'388	2'574	-6'383	-12'129	-5'795	-2'916	-6'909	-16'087	-9'141	-11'417

Conclusions for Low-Residue strategy



- The Low-Residue management begins with the choice of the right variety
- Production of residue free apples at a comparable yield is possible using a combination of IP and OP strategies
- Vf-varieties have to be treated with fungicides to prevent other diseases and Vf-resistance breakdown
- Little problems with pests; successful control of codling moth with exclusion netting and mating disruption
- The reduction of synthetic fungicides (LR) caused problems also observed in OP (Gloeosporium, Marssonina,...)
- With post-harvest hot water treatments the incidence of Gloeosporium could be reduced
- Economic evaluation shows an increased production risk for Low-Residue production compared to IP



Thank you for your attention



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