Maize-based rotations - Economic and environmental evaluation of IPM strategies

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Costs-benefit analysis (CBA)

- **Gross margin**
  - Gross margin: Financial yield – variable costs
- Financial yield
  - Yield
    - Derived from the experiments
  - Price
    - Average price (Eurostat) or regional prices
    - No extra price for IPM-strategies

Cost Benefit Analysis

Total variable costs

- Inputs
  - Seeds, pesticides, herbicides, biological agents, fertilisers
- Application costs
  - Contract work prices
    - Including cost for labour, machinery and fuel
    - Regional contractor prices

Environmental risks

- SYNOPS
  - Calculates risks of pesticide use
    - Aquatic life
    - Terrestrial life
    - Groundwater leaching
  - Same conditions for all experiments
    - Buffer zone: 1 m
    - Drift reduction pesticide application: 50%

Overall sustainability

- DEXiPM
  - Evaluates sustainainability of systems
    - Economic
    - Environmental
    - Social
  - Only used for *on-station* experiments
  - Adjusted ex-post version using the quantitative results of CBA and SYNOPS

On-station experiments
Gross margin at rotation level

Site	Cropping systems and level of crop protection		
	CON	**IPM1 (ADV)**	**IPM2 (INN)**
IT	Maize-maize-winter wheat-maize (2nd cycle)	Maize-winter wheat-soybean-maize(2nd cycle)	Maize-winter wheat-CC-soybean-CC-maize (2nd cycle)
HU	Maize-maize-winter wheat-maize (2nd cycle)	Maize-winter wheat-peas-maize(2nd cycle)	Maize-winter wheat-CC-peas-CC-maize(2nd cycle)
FR	Continuous maize	Maize/soybean	Maize/soybean

Site	Financial yield (€/ha)		Total variable costs (€/ha)		Gross Margin (€/ha)	
	ADV	INN	ADV	INN	ADV	INN
IT	-121	-224	-341	-269	**220**	**45**
HU	-375	-389	113	122	**-489**	**-511**
FR	-392	-541	-62	-102	**-330**	**-439**

On-station experiments

Environmental risks, mean value in rotation

		Acute			Chronic		
		Aquatic	Terrestrial	Groundw	Aquatic	Terrestrial	Groundw
Italy	CON	1.174363	0.007557	0.926424	29.83097	0.194401	0.196472667
	ADV	0.150414	0.03073	0.144526	1.071505	0.262366	0.029236667
	INN	0.022155	0.000754	0.102721667	0.092419	0.020359	0.020544333
Hungary	CON	1.747639	0.005756	0.000426	24.74839	0.037292	8.53333E-05
	ADV	0.633759	0.00725	0.004726667	13.1587	0.066189	0.000945333
	INN	0.55124	0.006737	4.33333E-06	4.558679	0.06162	0.000001
France	CON	0.856261	0.009179	32.104336	4.531933	0.356362	6.420867
	ADV	0.742561	0.007961	16.347719	3.38607	0.329185	3.2695435
	INN	0.403019	0.002627	0	0.403019	0.273971	0

Four risk categories of SYNOPS	acute risk	chronic risk
very low risk	ETR<0.01	ETR<0.1
low risk	0.01<ETR<0.1	0.1<ETR<1
medium risk	0.1<ETR<1	1<ETR<10
high risk	ETR >1	ETR >10

Risk (ETR)= calculated Exposure/Toxicity

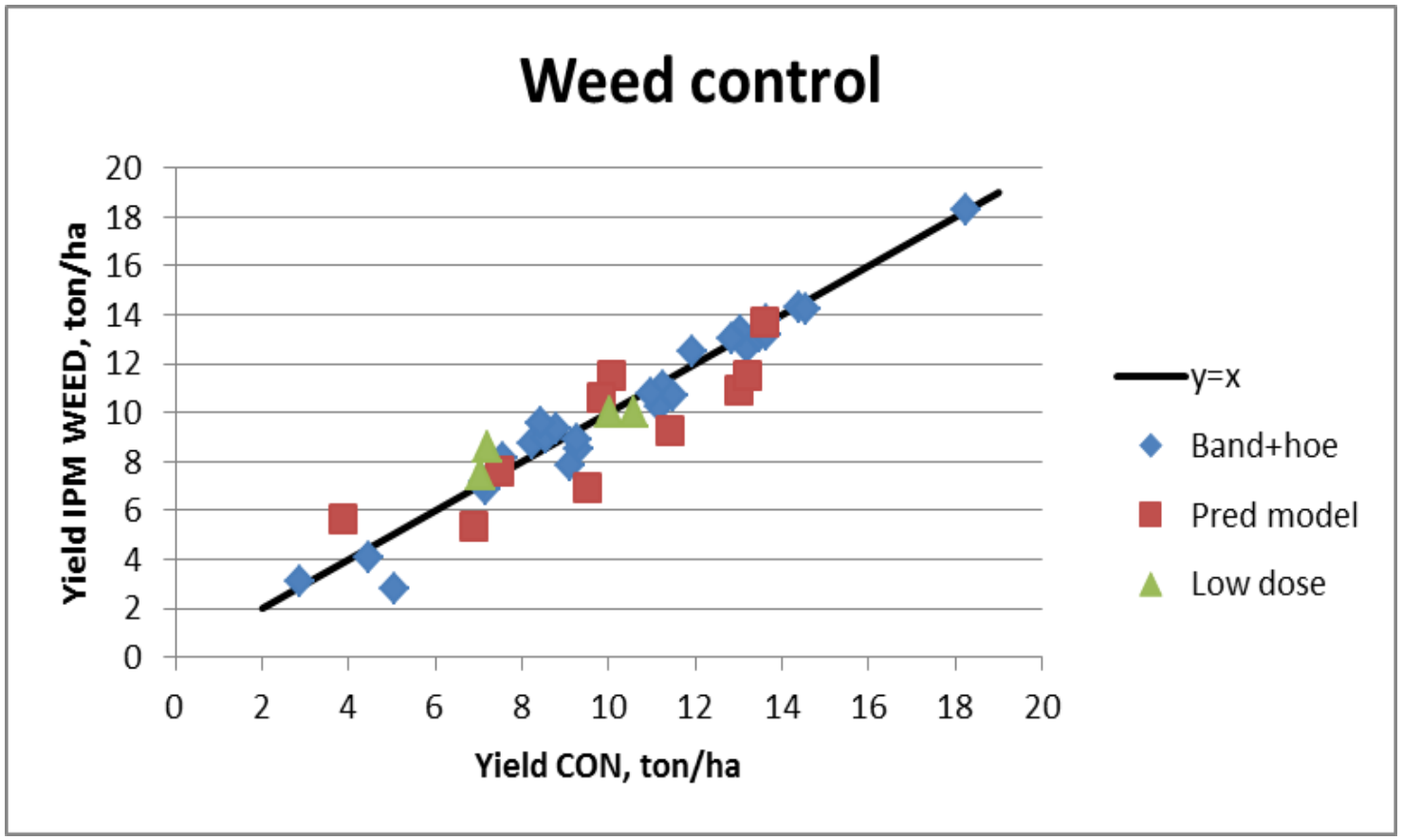
On-station experiments

DEXiPM results

Country	System	Sustainability			
		Economic	Environmental	Social	***Overall***
Italy	CON	M	VL	H	***M***
	ADV	H	M	H	***H***
	INN	H	H	H	***VH***
Hungary	CON	M	L	H	***M***
	ADV	L	L	VH	***M***
	INN	L	H	VH	***M***
France	CON	M	VL	M	***L***
	ADV	M	L	H	***M***
	INN	L	M	H	***M***

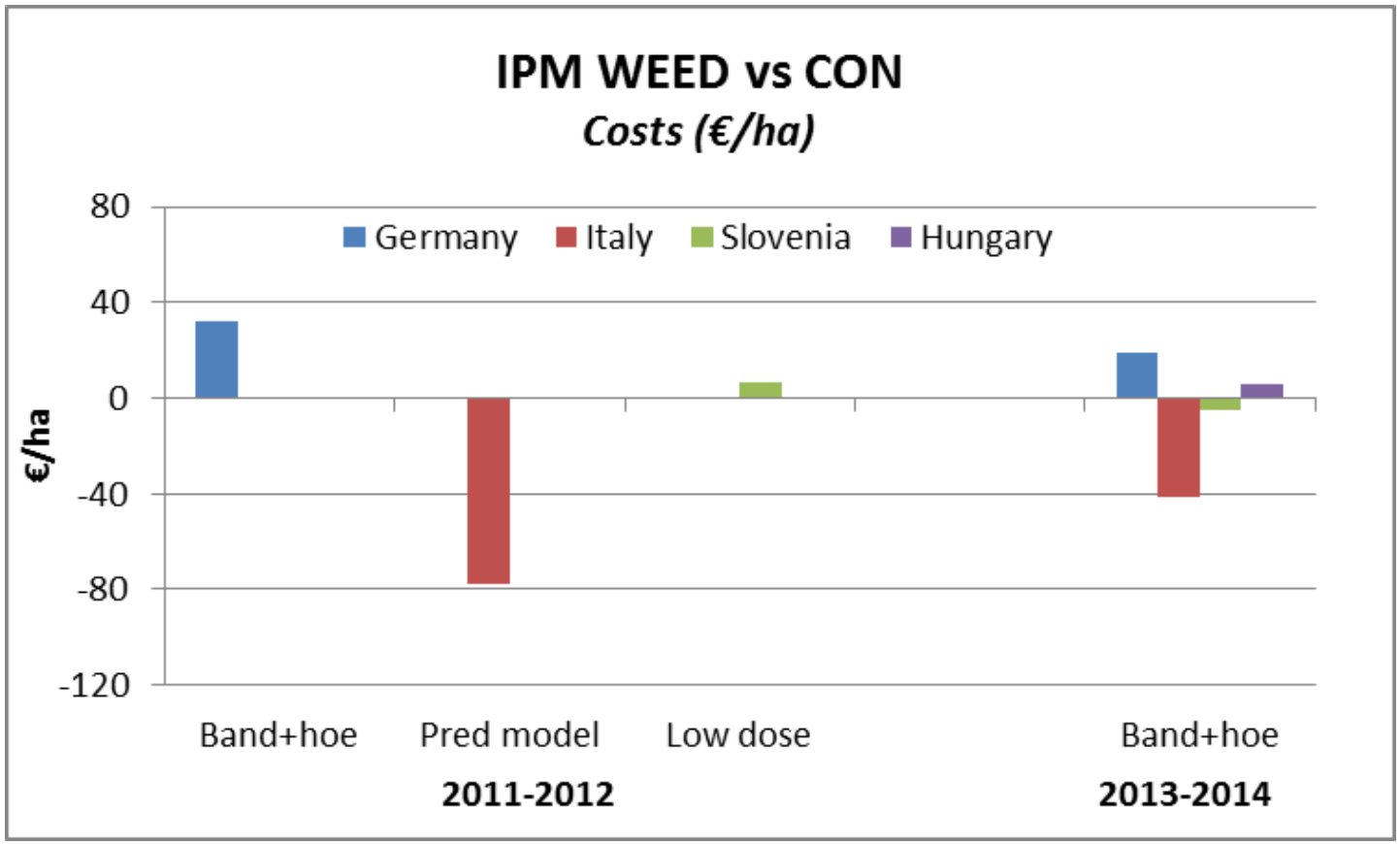
On-farm experiments

Weed control, Yields



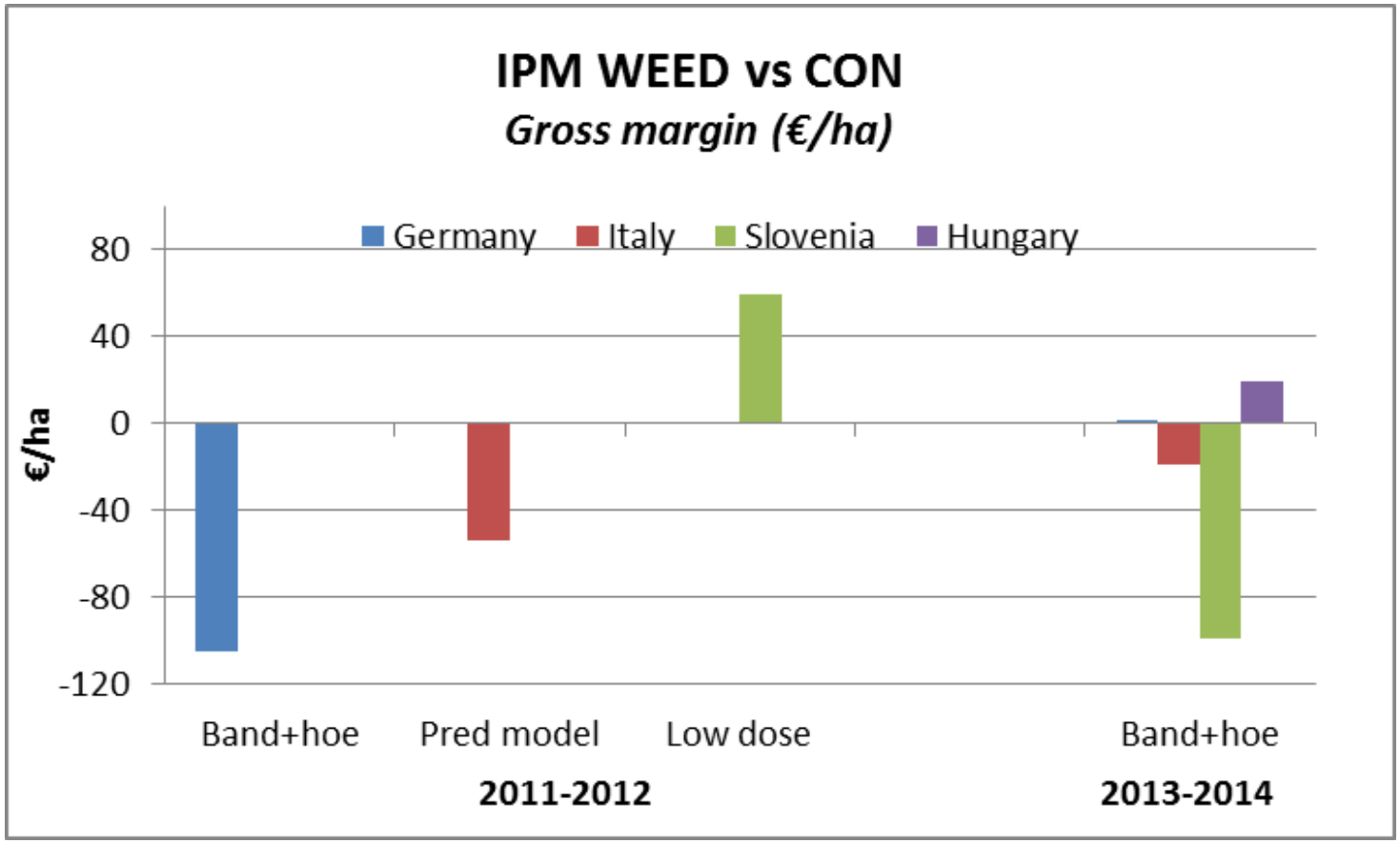
On-farm experiments

Weed control, total costs



On-farm experiments

Weed control, gross margin



On-farm experiments

Weed control, environmental effects

		Acute			Chronic		
		AQUA	TER	GW	AQUA	TER	GW
GE	CON	0.60	0.00	6.29	5.32	0.01	1.26
	IPM	0.41	0.00	2.11	3.61	0.00	0.42
SLO	CON	0.39	0.01	1.26	2.85	0.12	0.25
	IPM	0.19	0.00	0.19	1.24	0.02	0.04
HU	CON	0.32	0.00	0.00	3.06	0.02	0.00
	IPM	0.24	0.00	0.00	2.24	0.01	0.00
IT	CON	0.44	0.00	0.78	3.00	0.10	0.16
	IPM	0.27	0.00	0.03	1.39	0.03	0.01

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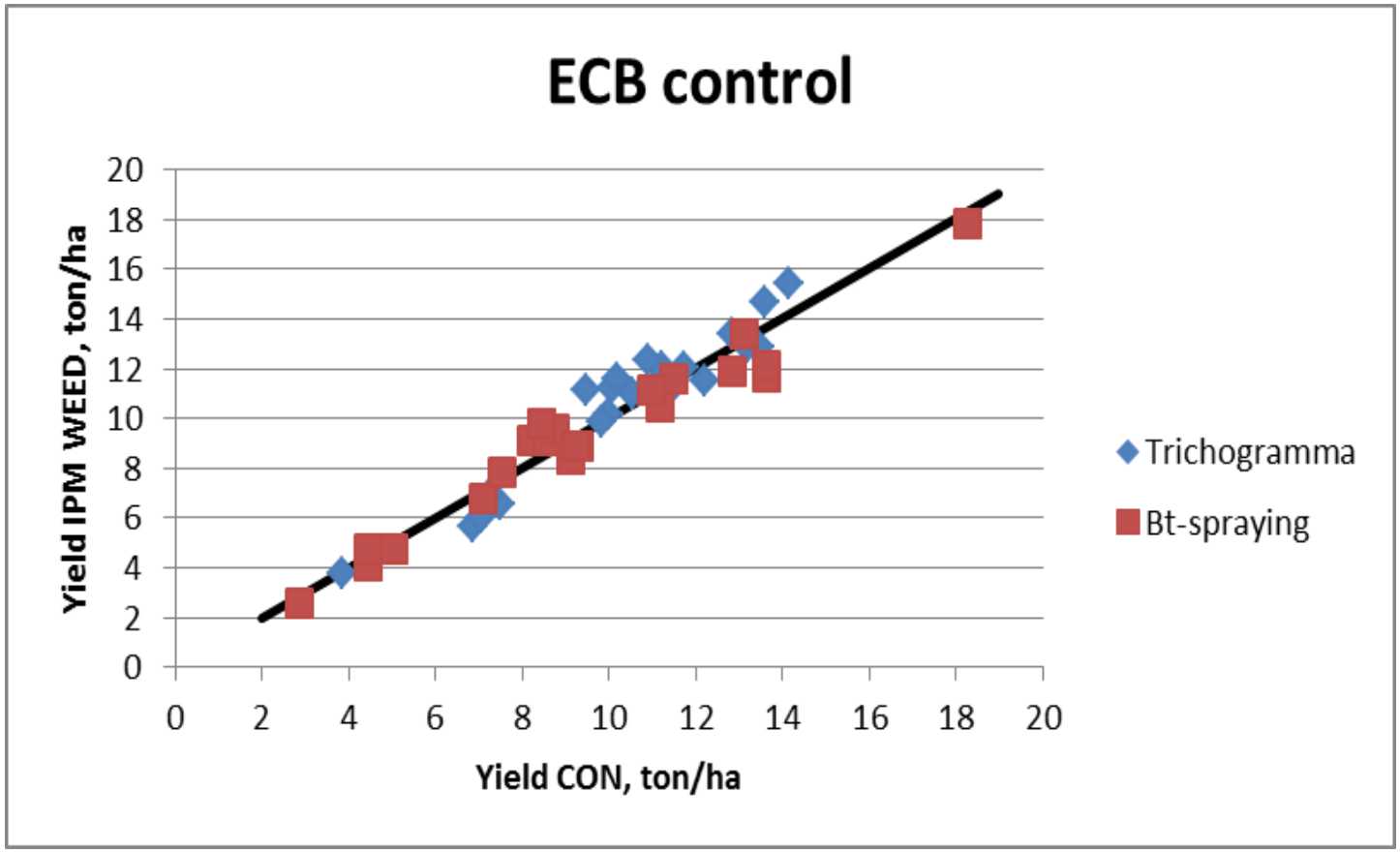
Risk (ETR)= calculated Exposure/Toxicity

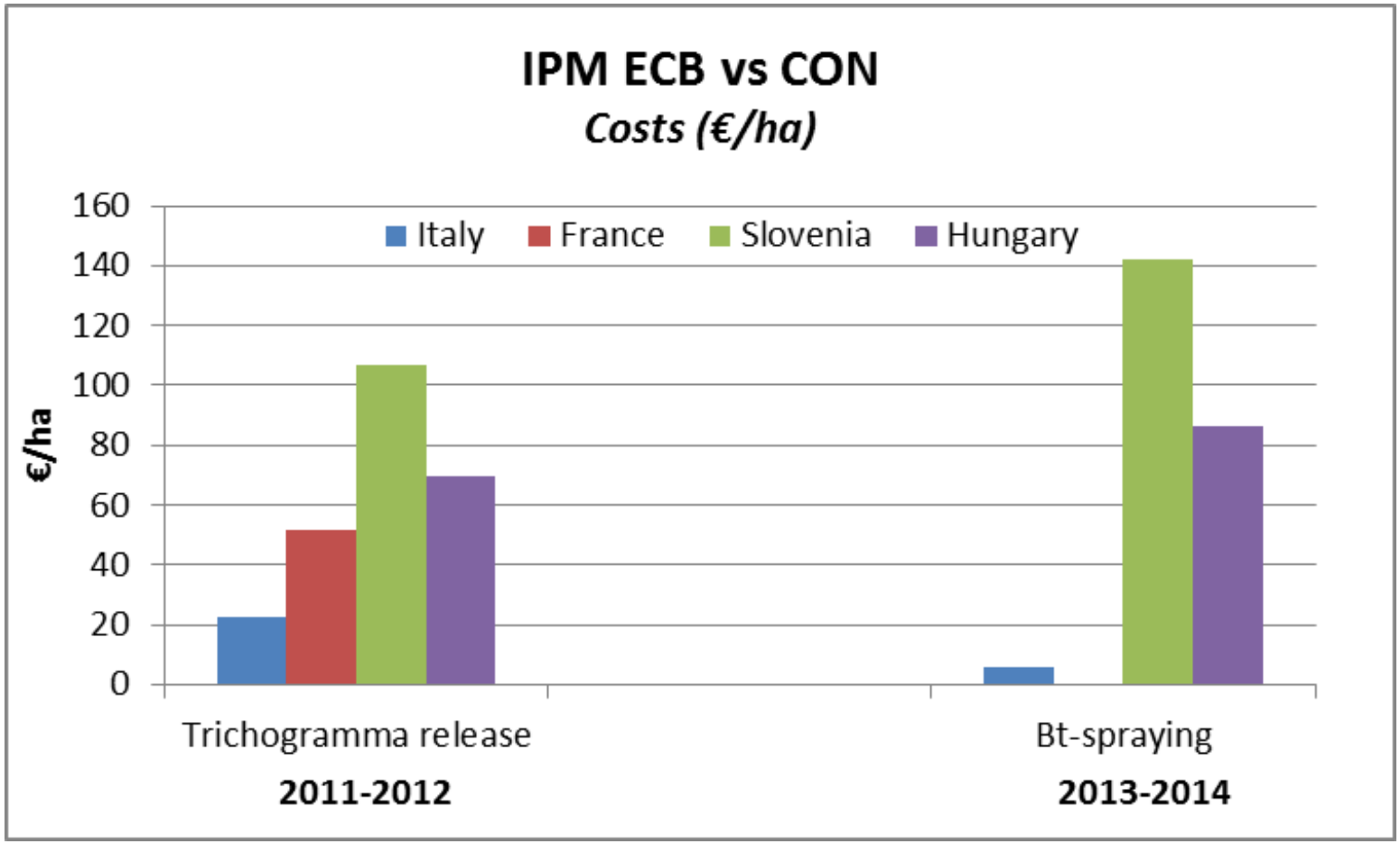
On-farm experiments

ECB control, Yield



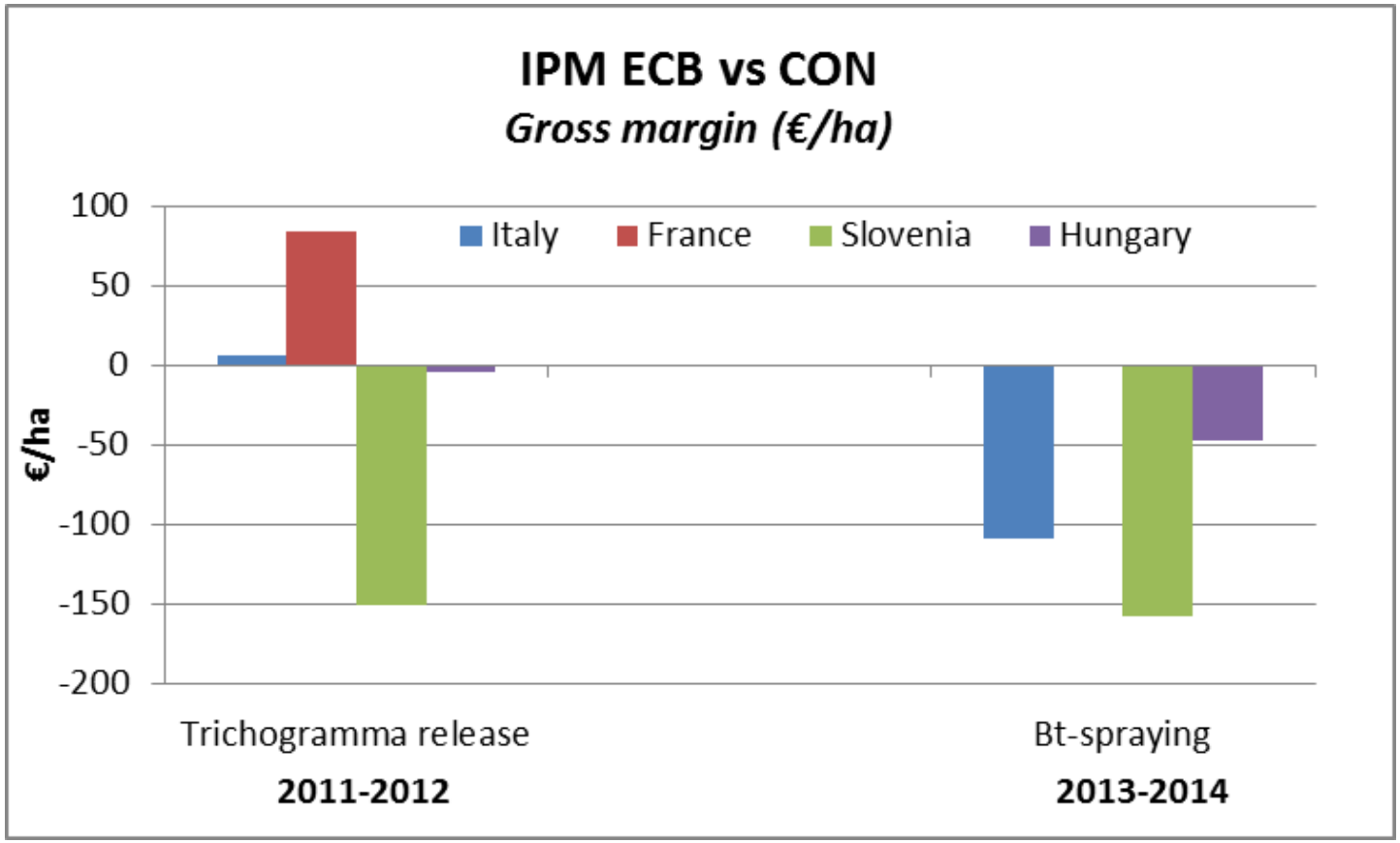
On-farm experiments

ECB control, total costs



On-farm experiments

ECB control, gross margin



Conclusions (I)

- Tested on-station IPM-systems
  - Overall sustainability improved or the same
    - Economic sustainability decreased in HU and FR due to lower gross margin substituting maize in a sequence and to a lesser extent lower yields
    - Environmental sustainability improved
  - Rotation effects more visible after repeated rotation cycles

Conclusions (II)

- Tested on-farm tools
  - Weed control
    - On average IPM-tools combining chemical and mechanical weed control do not affect costs and gross margin and decrease the environmental risks
  - ECB control
    - On average the gross margin of the tested biological tools is lower than in the CON treatment, however, effects are not significant

Overall conclusions

- Overall IPM seems to be applicable even though for an arable crop (low value)
- Tools tested on-station and validated on-farm in real conditions provided sufficient pest or weed control
- IPM greatly reduced maize reliance in pesticides
- IWM tools tested are economically sustainable
- Pests and weeds can be managed with an advanced IPM level using tools that are already available
- Capacity building and willingness of farmers and/or contractors important to use tools in the proper way and have sustainable results

Thank you for your attention!

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