Long-term effects on parasitic wasps of insecticides used to control the pollen beetle

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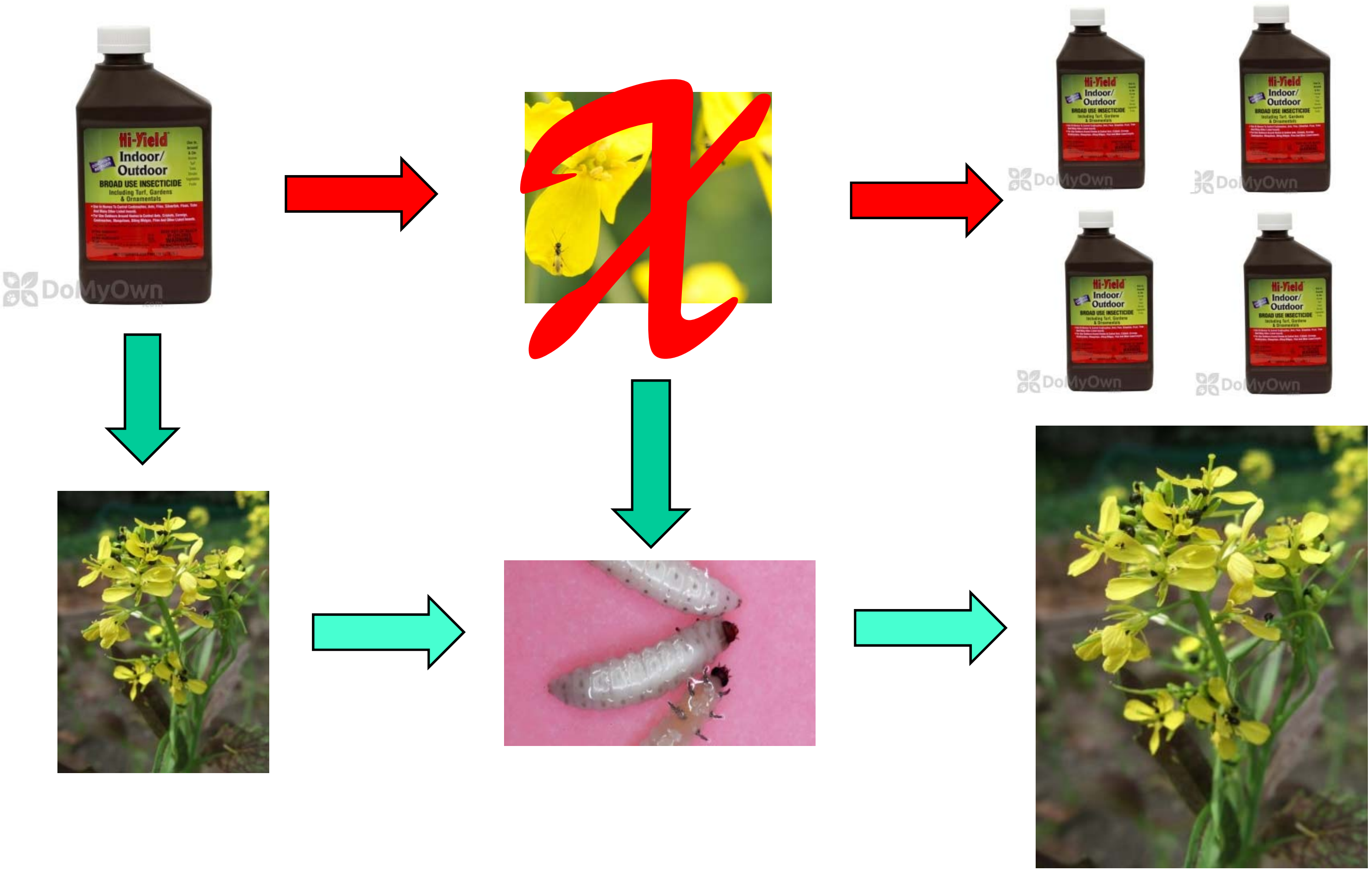
Control of Pollen beetle



Non selective products

- Outbreak of pests, more insecticides needed
- Insecticide resistance, secondary pest outbreaks, etc…
- Need selective insecticides for beneficials
- Oilseed rape difficulties
  - Negative or positive impact of product selection only seen at the next generation (= next year)
  - High dispersion of the pest and beneficial across fields
  - Low individual interest of farmers despite a high potential for IPM
- Global and long term approach rather than local and individual

Selective insecticide in oilseed rape ?

- Literature review: few info available
  - Products no longer used (dimethoate, parathion, deltamethrin, lambda-cyhalothrin,….)
  - Tests not easy to perform in the field, variability of data between different studies
- Set of field tests performed in 2013, 2014 and 2015
- Short term-effects
  - Pollen beetles
  - Adults of parasitic wasps
- Mid- to Long-term effects
  - Pollen beetle larvae parasitism
  - Balance population adults of pollen beetle/parasitic wasps for the next generations

Methods

- commercial field 15 -20 ha in total
- woody and pasture landscape
- 5 to 6 products + control
- 6-7 x0.6ha (200 x 30m)
- 4 plots of 30 x 50m
- sampling zone 20 x 40m
- Cantus (boscalid)
- no other insecticides inside the plots
- rest of the field treated if needed (Mavrik 2F 2013, Biscaia 2015)

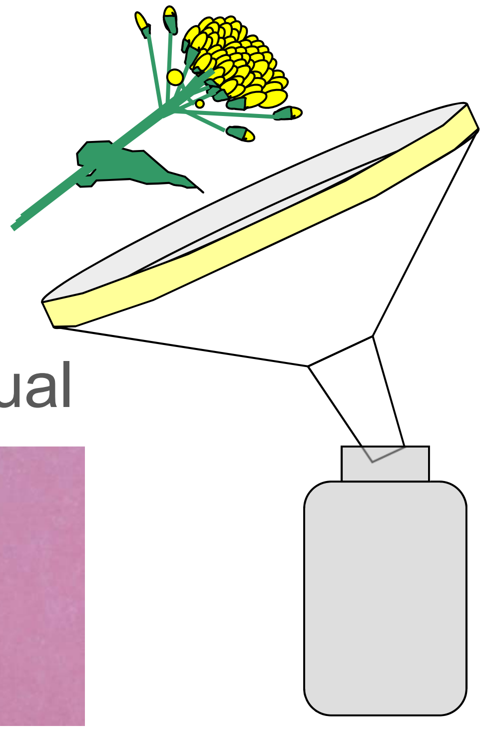
Test products

	g a.s./ha	2013	2014	2015	Total
Tau-Fluvalinate	48 g	Mavrik 2F	Mavrik 2F	Mavrik 2F	3
Pymetrozine	75 g	Plenum	Plenum	Plenum	3
Thiacloprid	72 g	Biscaya	Biscaya	Biscaya	3
Chlorpyrifos-ethyl	187,5g	Pyrinex	Cyren 4E	Cyren 4E	3
Phosmet	750 g	Boravi WG	Boravi WG	-	2
Indoxacarb	25,5g	-	-	Steward (WG) and Avaunt (EC)	2

- treatments applied at bud stage just before flowering (BBCH 55 to 59)
- good conditions (15-20°C, dry)
- 200 l of water/ha

Sampling procedures

- DAT-5, DAT 1, DAT3 then once a week from DAT8 till DAT45-53
- Beating sampling methods (pollen beetle adults and larvae)
  - 20 stems/plants in each plot
  - First pollen beetle larvae detected =>
    - Laboratory assessment of parasitism rate by dissection and visual inspection



Sampling procedures

- Sweep nets (Parasitic hymenoptera)
  - 20 go – back moves (3-4 m²)/plot
  - Collected in water and soap
  - Laboratory counts and identification at family level

Analysis

- Adult pollen beetle (target)
- Adult parasitic hymenoptera
- Pollen beetle larvae and their parasitism rates
- Balance parasitic wasp/pollen beetle expected for the next year (R)
  - Balance parasitized larvae/unparasitized larvae (*100)
  - Prospect of adult wasps for 100 pollen beetle for the next year
- GLM – ANOVA (p=0.05)
  - Tukey (pair-wise comparisons)
  - Data transformation (arcsin, log) to normalize distribution when required

Results

Efficacy on pollen beetle: Estimated days after treatment to reach 90, 75 and 50% of control (linear regression)

		90%	75%	50%
Pymetrozine	2013	1	3	6
	2014	1	3	8
	2015	0	1	5
	mean	***0,7***	***2,3***	***6,3***
Tau-Fluvalinate	2013	3	8	16
	2014	1	3	10
	2015	0	3	9
	mean	***1,3***	***4,7***	***11,7***
Thiacloprid	2013	3	7	15
	2014	3	9	20
	2015	1	3,4	7
	mean	***2,3***	***6,5***	***14,0***
Indoxacarb (2015)	Steward	4	8	16
	Avaunt	3	8	16
	mean	***3,5***	***8***	***16***
Chlorpyrifos-ethyl	2013	6	13	26
	2014	3	10	21
	2015	3	11	23
	mean	***4,0***	***11,3***	***23,3***
Phosmet	2013	13	36	74
	2014	0	10	34
	mean	***6,5***	***23,0***	***54***

Efficacy

- All products are effective to control pollen beetle populations at short-term
- Plenum less effective and short-lived than the other ones
- Most effective products are organophosphates (not used in Belgium) and indoxacarb (not widely used)
- Mavrik and Biscaya (key products) less effective

Effects on adult parasitic hymenopetra (sweep nets)

2013	Tersilochinae	Pteromalidae	Total
Control	36.00 a	7.75 a	43.75 a
Pymetrozir			
Tau-Fluvali			
Phosmet			
Thiaclopric			
Chlorpyrifc			

2014	Tersilochinae	Pteromalidae	Total
Control	7.50 ab	7.00 a	16.00 a
Pymetrozine			
Tau-Fluvalinat			
Phosmet			
Thiacloprid			
Chlorpyrifos-e			

2015	Tersilochinae	Pteromalidae	Total
Control	7.3 a	8.5 a	17.0 ab
Indoxacarb (Avaunt)	7.3 a	9.3 a	19.8 a
Indoxacarb (Steward)	6.5 ab	5.8 a	14.5 ab
Pymetrozine	4.8 ab	7.3 a	13.5 ab
Tau-Fluvalinate	5.5 ab	9.5 a	16.5 ab
Thiacloprid	2.5 b	8.5 a	13.3 ab
Chlorpyrifos-ethyl	2.8 b	6.3 a	11.0 b

Adults parasitic wasps

- Variability of populations between years and inside replicates
  - Not easy to sample
  - Not easy to interpret
- Observed each year:
  - Effects of thiacloprid and chlorpyrifos on Tersilochinae populations
- Other products, depending on the year, population levels and variability

Effects on pollen beetle larvae parasitism

2013	Total larvae	% parasitism	Long term- Adult parasite/100 adult pollen beetle
Control			
Pymetrozine			
Tau-Fluvalinate			
Phosmet			
Thiacloprid			
Chlorpyrifos			

2014	Total larvae	% parasitism	Long term- Adult parasite/100 adult pollen beetle
Control			
Pymetrozine			
Tau-Fluvalinate			
Phosmet			
Thiacloprid			
Chlorpyrifos			

2015	Total larvae	% parasitism	Long term- Adult parasite/100 adult pollen beetle
Control	202.3 abc	3.48% a	3.61 a
Pymetrozine	254.3 a	4.50% a	4.71 a
Tau-Fluvalinate	201.8 abc	3.33% a	3.45 a
Indoxacarb (Avaunt)	117.0 c	3.64% a	3.79 a
Indoxacarb (Steward)	146.0 bc	3.93% a	4.12 a
Thiacloprid	244.8 ab	1.08% b	1.09 b
Chlorpyrifos	146.8 bc	1.35% b	1.37 b

Long term-effects, sum-up

- Reduction of long term-ratio compare to the control (R) and IOBC toxicity class (1<25%; 25<2<50%; 50%<3<75%; 4>75%)

		2013	2014	2015
Pymetrozine	R (%)	32,50%	2,20%	-30,50%
	IOBC class	**2**	**1**	**1**
Tau-Fluvalinate	R (%)	38,40%	14,20%	4,40%
	IOBC class	**2**	**1**	**1**
Indoxacarb Steward	R (%)	-	-	-5,00%
	IOBC class	**-**	**-**	**1**
Indoxacarb Avaunt	R (%)	-	-	-14,10%
	IOBC class	**-**	**-**	**1**
Phosmet	R (%)	-1,10%	2,40%	-
	IOBC class	**1**	**1**	**-**
Thiacloprid	R (%)	78,30%	100,00%	69,80%
	IOBC class	**4**	**4**	**3**
Chlorpyrifos-ethyl	R (%)	60,30%	57,10%	62,00%
	IOBC class	**3**	**3**	**3**

Comparison between years

	2013	2014	2015
Date of treatment	24 April	1 April	22 April
Pollen beetle/plant at DAT0	0,81	1,93	1,97
First adult parasitic hymenoptera (date)	25 April	23 April	25 April
First adult parasitic hymenoptera (DAT)	DAT1	DAT22	DAT3
First pollen beetle larvae	DAT22	DAT28	DAT6
Total adult parasitic hymenoptera (control)	43,75	16	17
Total adult Tersilochinae (control)	36	7,5	7,3
% pollen beetle larval parasitism (control)	43,20%	6,00%	3,48%
Ratio year +1 parasitic wasp/100 pollen beetle	79,1	6,36	3,61

DAT= days after treatment

OSR Insecticides effects on parasitic hymenoptera « indicator species »

Effects of OSR insecticides on *Aphidius rhopalosiphi*, *A. matricariae*, *A. colemani*. Data from IOBC Pest Select database (including DAR-EFSA), Koppert and Biobest

	Initial toxicity	Extended lab	Field aged & semi-field
Pymetrozine	3-2	1	1
Tau-Fluvalinate	4	3	3-1
Phosmet	4		3-1
Indoxacarb	4	3-2	
Chlorpyrifos-ethyl	4	4	4
Thiacloprid	4	4	4

1 = Harmless, 2 = Slightly harmful, 3 = Moderately harmful, 4 = Highly harmful

Discussion and conclusions

- Despite huge difference between years, same effects for the same products
- Effects on parasitism larvae not always linked to activity against adults
  - Duration of the activity of the product and recovery if initial effects
  - Timing of application
  - Other mechanisms (systemic products ?)
- Phosmet and Chlorpyrifos: both OP but different non-target effects !

Discussion and conclusions

- Negative list for IPM
  - Effective for pollen beetle control but affect long term parasitism of beetle : Thiacloprid and Chlorpyrifos-ethyl
- Positive list for IPM
  - Effective for pollen beetle control and no long term effects: Tau-Fluvalinate, Phosmet, Indoxacarb, Pymetrozine
  - 4 different modes of actions, possible resistance management ?
- Global approach
  - Need for selective products also for other pests
    - E.g. Non sense to use selective product for pollen beetle and later apply non selective for seed weevil

Thank you for your attention