Resistance of pollen beetles (*Brassicogethes aeneus*) to insecticides complicates control of cabbage stem weevils (*Ceutorhynchus pallidactylus*) in winter oilseed rape crops

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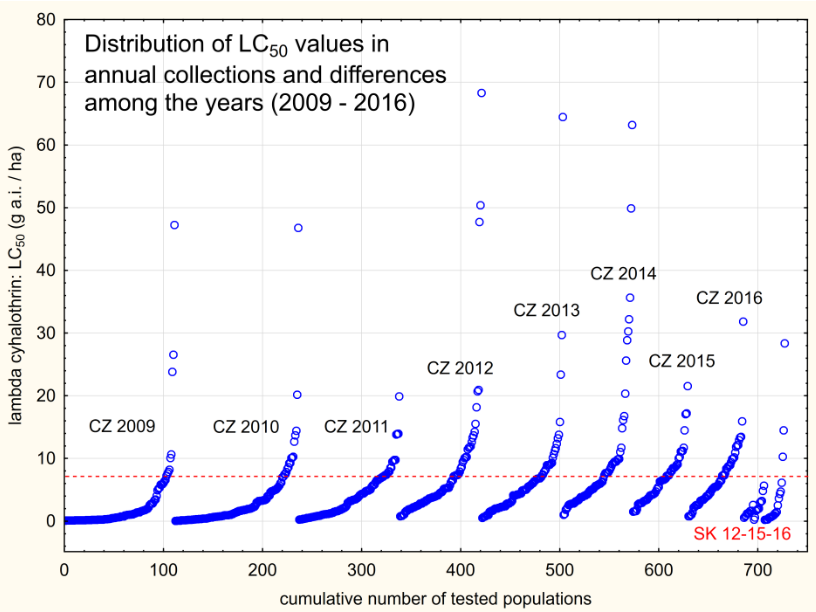
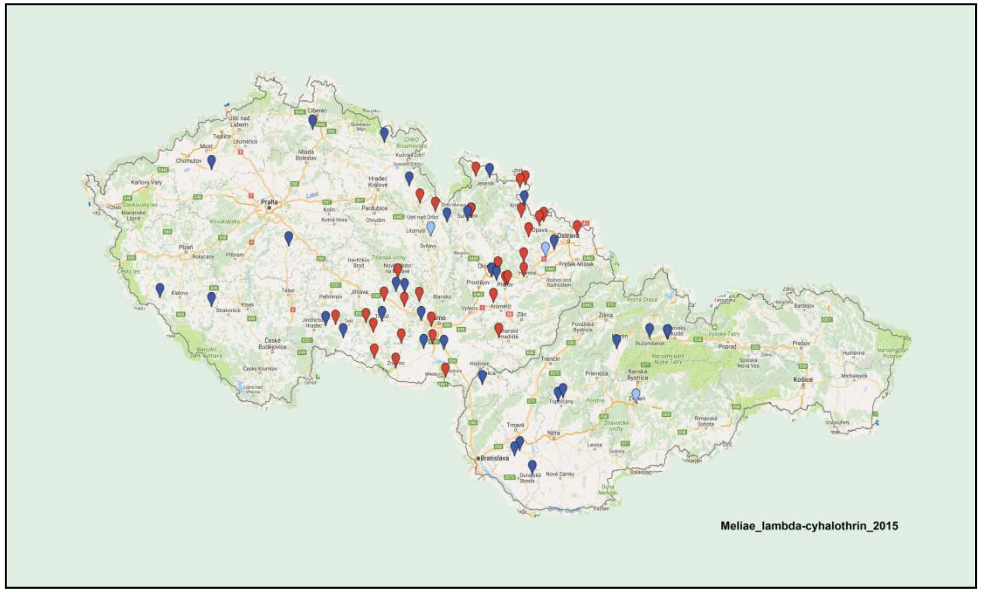
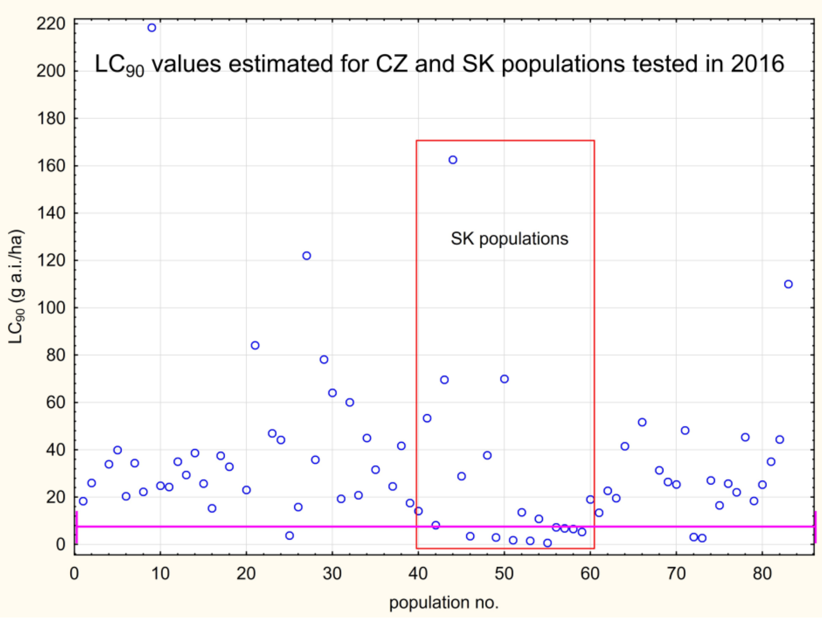
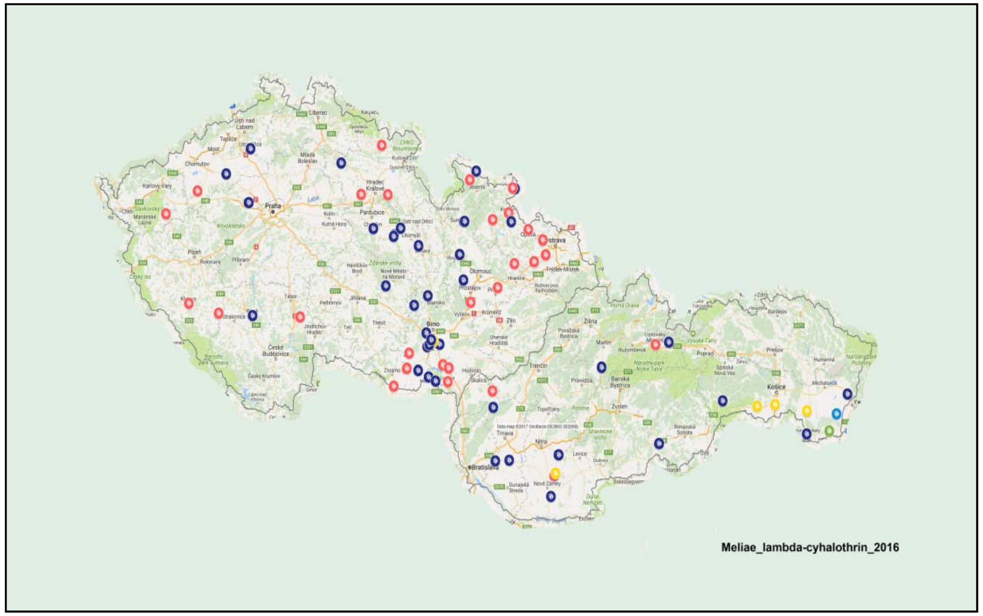
CZ (SK) populations of pollen beetles are resistant to pyrethroids

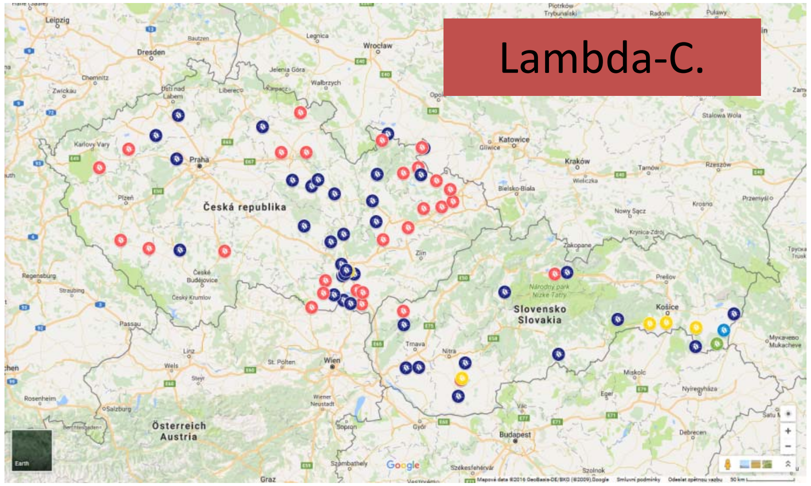


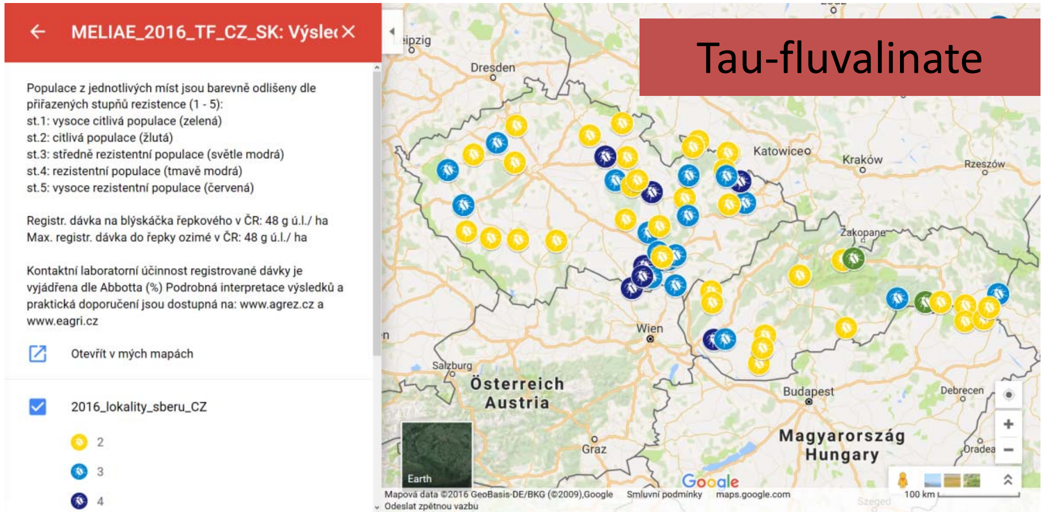


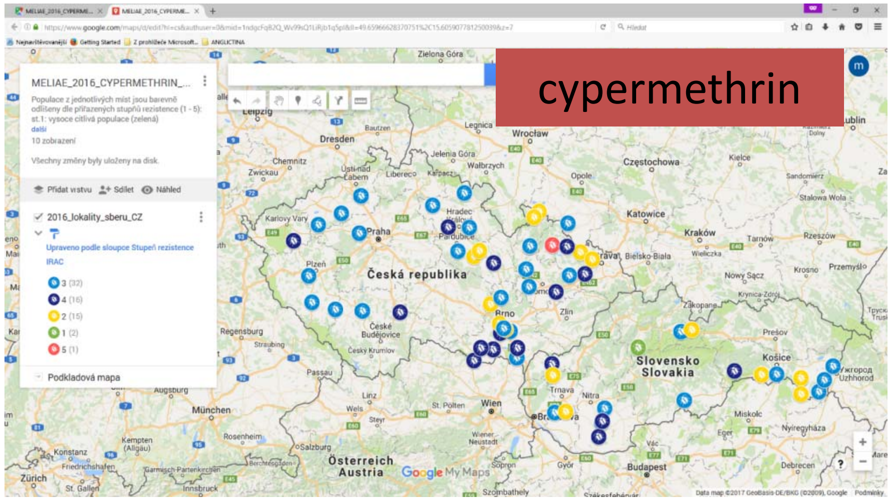




Relationships between LC_{50}, registered dose, lab. effectiveness of the registered dose and the resistance degree assigned to the individual populations according to IRAC guidelines

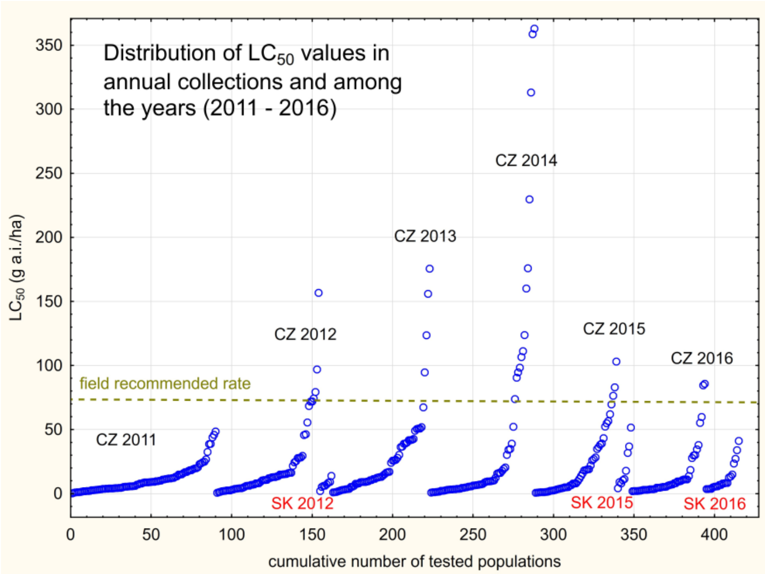






Is it possible to recommend pyrethroids (at least those which are registered in higher rates) to farmers to apply them against stem weevils and pollen beetles?

Susceptibility of CZ pollen beetles to thiacloprid



season	number of tested pairs	correlation analysis between **Log** values of:	Correlation coefficient **r**	Probability (p)
2011	86	LC_{50}	0.16	0.14
		LC_{90}	0.15	0.17
		LC_{95}	0.12	0.28
2012	68	LC_{50}	0.18	0.15
		LC_{90}	**0.39**	**0.001**
		LC_{95}	**0.40**	**0.001**
2013	60	LC_{50}	-0.10	0.46
		LC_{90}	0.03	0.82
		LC_{95}	0.05	0.70
2014	65	LC_{50}	**0.44**	**0.00**
		LC_{90}	**0.58**	**0.00**
2015	58	LC_{50}	0.18	0.18
		LC_{90}	**0.37**	**0.01**
		LC_{95}	**0.39**	**0.00**
2016	63	LD_{50}	-0.13	-0.20
		LD_{90}	-0.01	0.03
		LD_{95}	-0.01	0.08

Are neonicotinoids good alternative for pyrethroids? On the base of our results NO – but that is in strong conflict with respected papers *

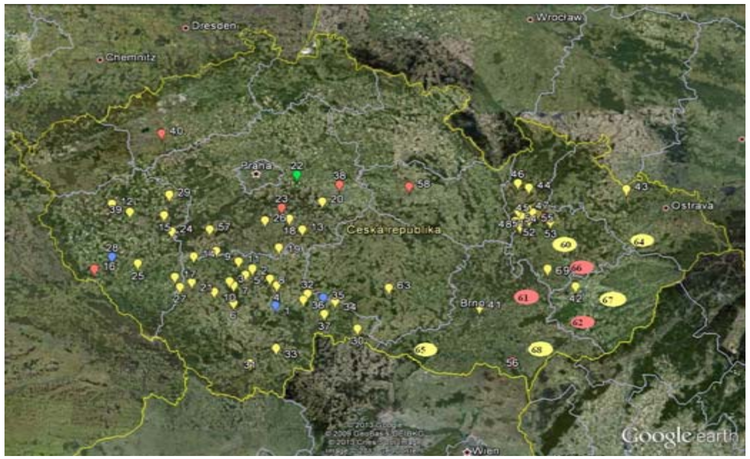
*Zimmer CH.T., Nauen R. (2011): Pyrethroid resistance and thiacloprid baseline susceptibility of European populations of *Meligethes aeneus* (*Coleoptera*: *Nitidulidae*) collected in winter oilseed rape. *Pest. Manag. Sci*. 67: 599 – 608.
Zimmer CH.T., Köhler H., Nauen R. (2014): Baseline susceptibility and insecticide resistance monitoring in European populations of Meligethes aeneus and Ceutorhynchus assimilis collected in winter oilseed rape. *Entomol. Exp. Appl*. 150: 279 – 288.

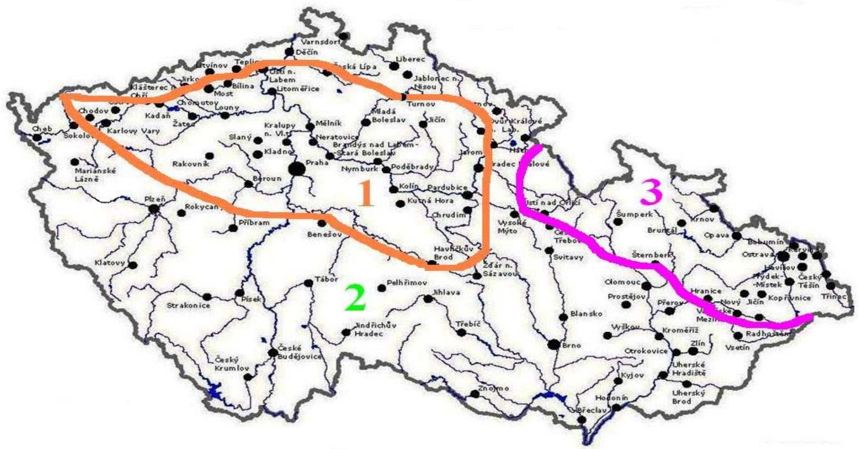
Does the wide distribution of resistant populations of pollen beetles in CZ :

- complicate controlling stem weevils in crops?
- pose other threat to pollen beetle´ s (+ stem weevil´s and flea beetle´s) parasitoids in crops?

Stem weevils = more species in CZ: ***C. pallidactylus****;* ***C. napi****; C. sulcicolis; C. picitarsis*

Importance of *C. pallidactylus* and *C. napi* differs according to regions and seasons



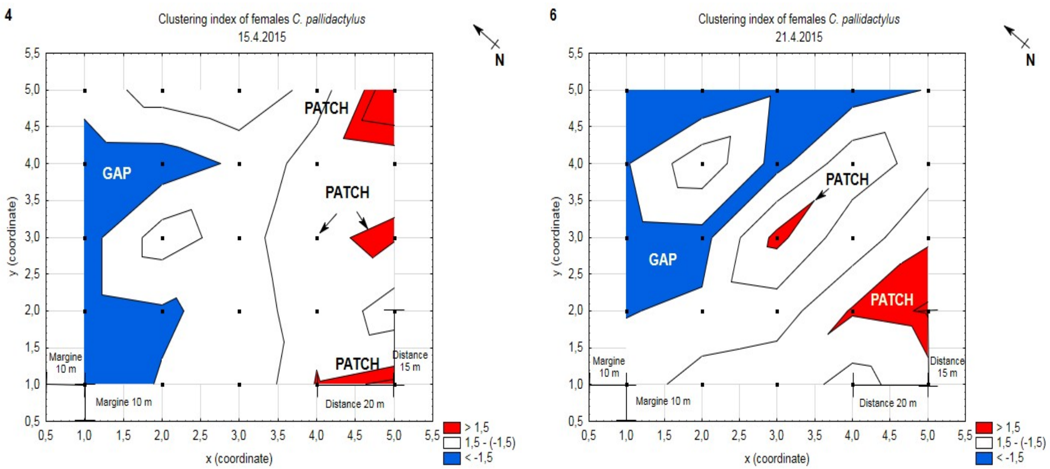


Recurrent problems in control of stem weevils in CZ:

1) Many sprays have been purposeless every year

- some reliable and simple prediction system for adult abundances leaving the hibernation sites and migrating to rape stands is needed (*systems based on knowledge of the effects of simply available meteo factors recorded in some periods during the winter on inducing mortality in populations of hibernating adults**)

- monitoring of fly activity with usage of yellow water traps (to be valuable more than usually recommended 3 traps per field are needed = high consumption of time - farmers need service)



Adults are not distributed uniformly in crops. Distribution is random or in some cases individuals are significantly aggregated into clusters (patches and gaps). The locations, shapes and acreages of the patches (and gaps) changed in the course of crop colonization.

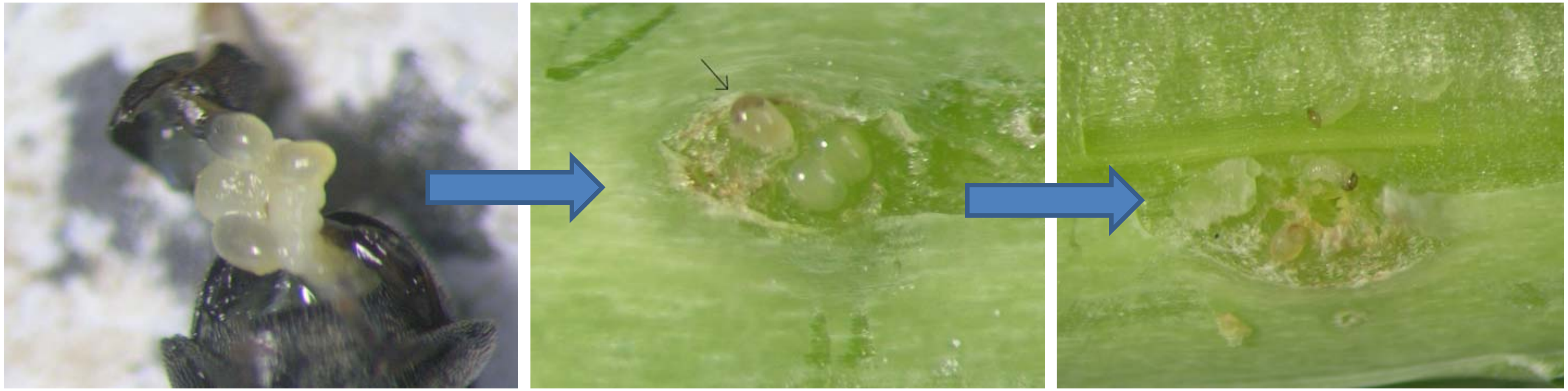
*M. Eickermann et al. (2015): Forecasting the breaching of the control threshold for Ceutorhynchus pallidactylus in oilseed rape. Agricultural and Forest Entomology 17: 71-76.
K. Klem and T. Spitzer (2017): Prediction model for cabbage stem weevil Ceutorhynchus pallidactylus occurrence on winter rape based on artificial neural networks. Agricultural and Forest Entomology DOI: 10.1111/afe.12209

Recurrent problems in control of stem weevils in CZ:

2) Many applications against stem weevils have incorrect timing (insecticides are usually applied too early = first spring application is usually rash)

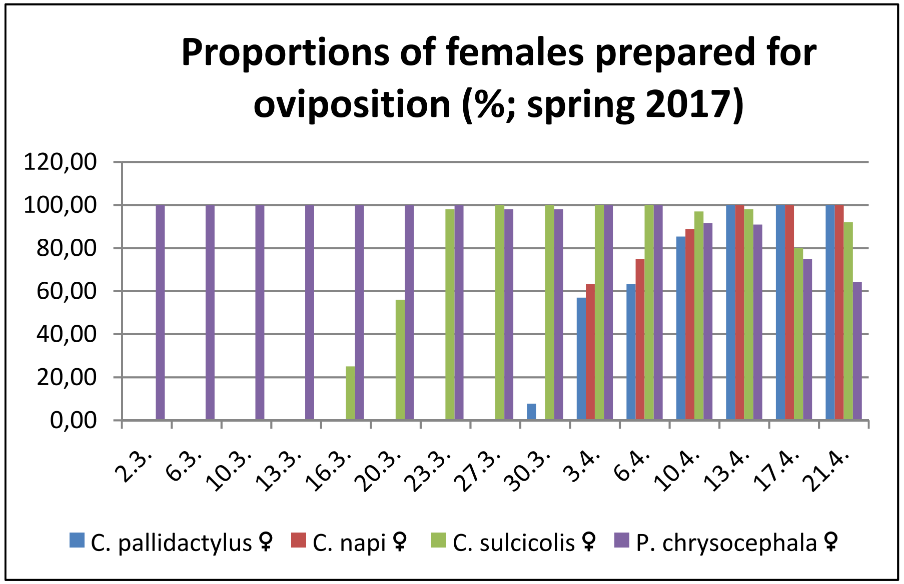
- to detect the start of egg-laying period is possible (a field only for monitoring purposes – sufficient number of yellow water traps placed in time - dissecting females from the traps)

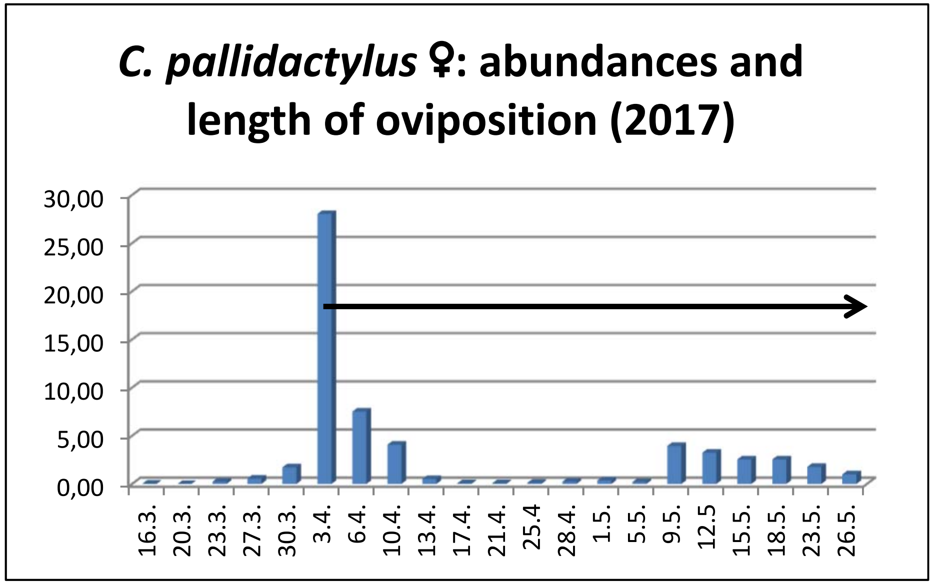
- prediction of total length of the egg-laying period is not possible; it can be lengthy process – especially in the case of *C. pallidactylus* (*effect of climate change (will) play a role**)

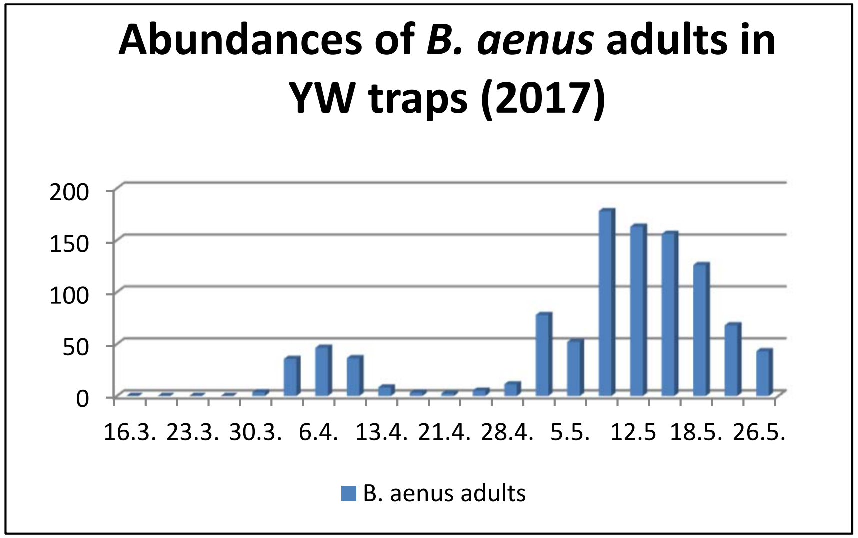


* Junk J., Eickermann M., Gorgen K., Beyer M., Hoffmann L. (2012): Ensemble based analysis of regional chmate change effects on the cabbage stem weevil (Ceutorhynchus pallidactylus (Mrsh.)) in winter oilseed rape (Brassica napus L.). Journal of Agricultural Science 150: 191-202.

When do the spring insect pests start to lay eggs and how long *C. pallidactylus* can continue with the activity (locality Sumperk, CZ, 2017) – WHEN, WHAT to spray ? What is the main target? HOW many sprays?



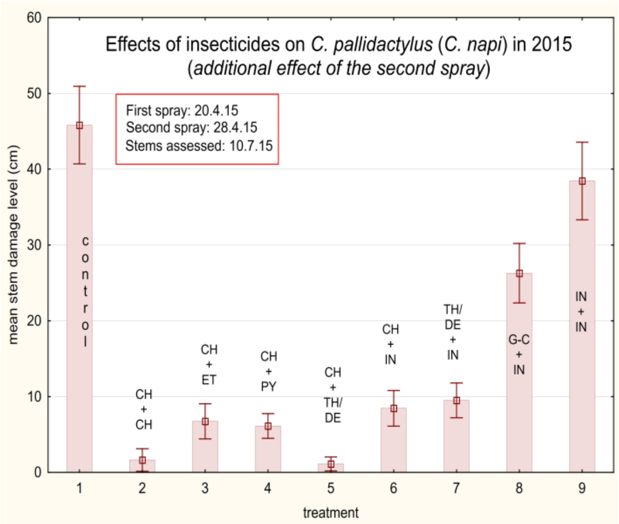


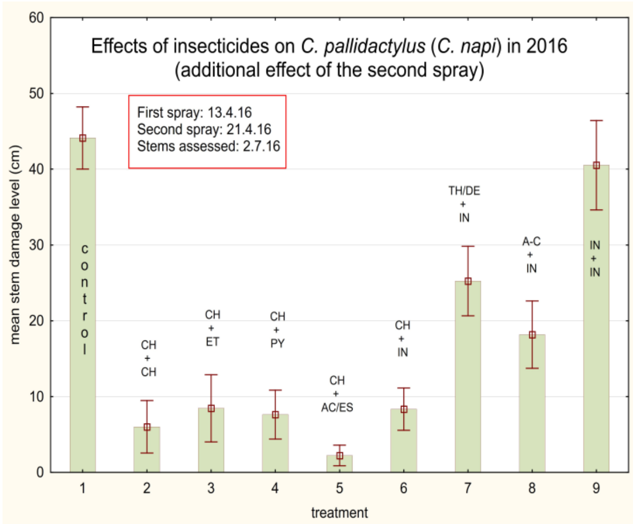


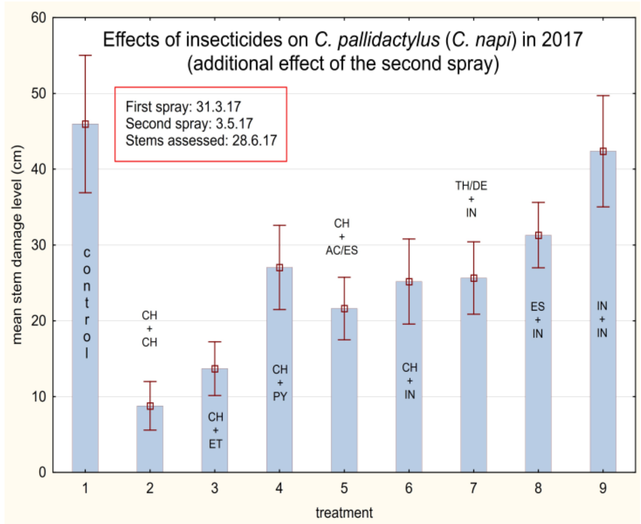
In some years it is not possible to control stem weevils and pollen beetles with one spray even if the method based on dissecting C. pallidactylus females is used (delayed application).

The effects of insecticides on stem weevils substantially differ especially in the years when egg-laying period is lengthy

- Second spring spray influences the final level of stem damage







- Especially for the second spring application the active ingredients which are highly effective against both pollen beetles (not pyrethroids; neonicotinoids?) and stem weevils are required
- The new alternatives (indoxacarb; pymetrozine?) seem to be less effective against stem weevils

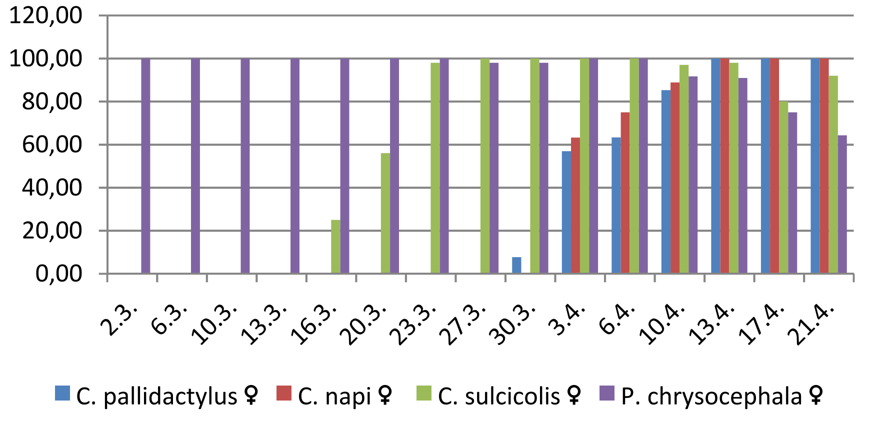
indoxacarb	*C. napi*	*C. pallidactylus*	*B. aeneus*
lab. contact effect. of registered dose (25 g a.i. /ha; %)	63.38	68.26	100
mean LC_{50} (g a.i./ha)	14.28	15.64	< 0.20
mean LC_{90} (g a.i./ha)	75.35	73.56	< 0.94

There is a one real consequence of this in the Czech Republic:

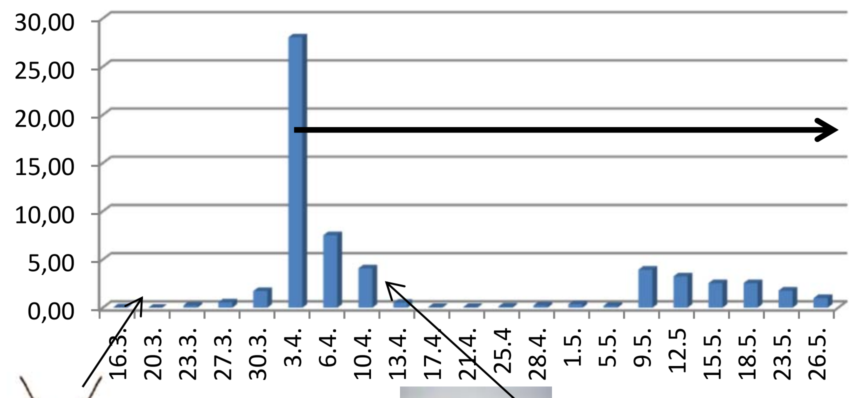
More repeated aplications of organophospahates (chlorpyrifos-ethyl or chlorpyrifos-methyl) every year

That is not what we need: the situation privileges insecticides with long term negative effects on parasitoids populations*

Proportions of females prepared for oviposition (%; spring 2017)



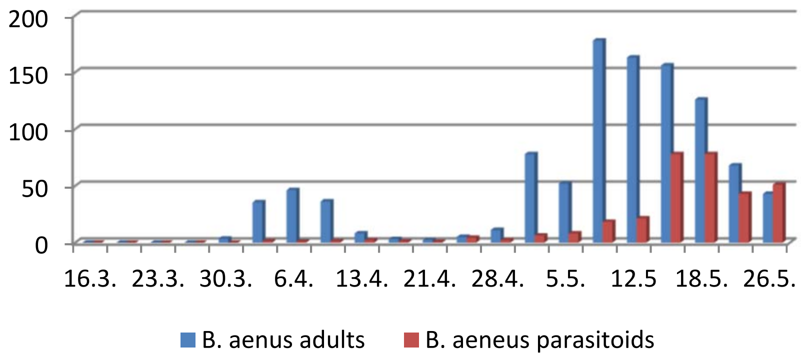
***C. pallidactylus* ♀: abundances and length of oviposition (2017)**

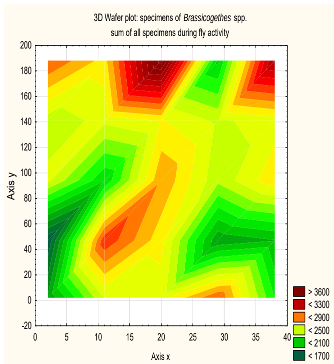


T. quadristriatus: pitfall traps - from March

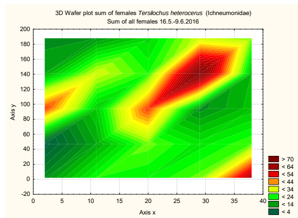
Ters. microgaster – active from April

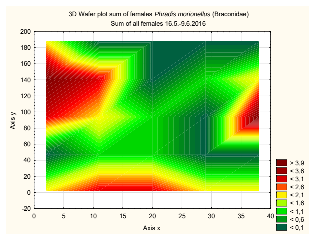
pollen beetle and its parasitoids: adult abundances in YW traps (2017)





P.morionelus x *T. heterocerus* niche partitioning





* J-P Jansen (2016): Field trials to assess the short-term and long-term effects of several insecticides used to control the pollen beetle on parasitic hymenoptera in oilseed rape . *Integrated Control in Oilseed Crops IOBC-WPRS Bulletin Vol. 116* : 16. ISBN 978-92-9067-300-2 .

Conclusions:

Does the wide distribution of resistant populations of pollen beetles in CZ :

- complicate controlling stem weevils in crops?
YES
- pose other threat to pollen beetle´ s (+ stem weevil´s and flea beetle´s) parasitoids in crops?
YES