– GCIRC technical meeting –

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Breeding for insect resistance in rapeseed: Is it a dream?

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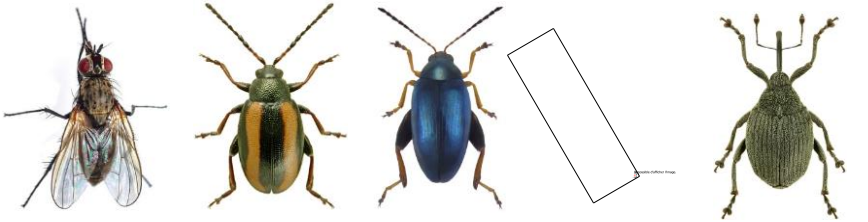
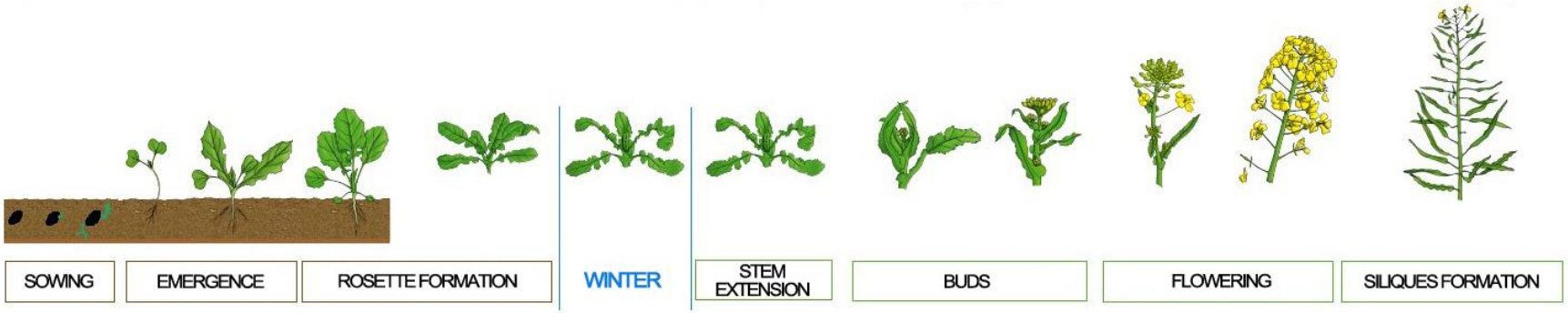
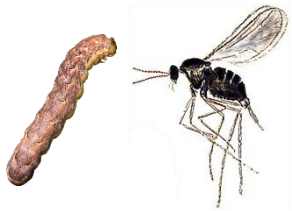
Dealing with insect pests is one of the biggest challenges rapeseed cultivation is facing. Insect pests are numerous, especially on winter oilseed rape (OSR) where the crop needs about 10 months growth before it can be harvested. Insect pests are usually combatted using insecticides but resistance is spreading and the socio-economic context argues against the sole use of these substances. Why not, therefore, develop plant resistance as classically done against pathogens? Obviously, that will not be an easy task since no insect-resistant cultivar is available on the market yet. Looking around at other crop species, insect-resistant cultivars are much rarer than disease-resistant ones. This can be explained by some serious constraints. These include purely logistic ones but also the complexity of plant-insect interactions – where gene-for-genre relationships are the exception but not the rule – and difficulties in screening many accessions in the field. These constraints are particularly limiting in OSR. However, attempts have still been made and a few research programs are ongoing to develop insect resistance in this plant species. Three strategies have been considered: introducing resistance transgenes into the OSR genome, introgressing resistance from other brassicaceous species and using natural variation in resistance already present in *Brassica napus*. Some doors were closed, but some directions seem promising for the near future.

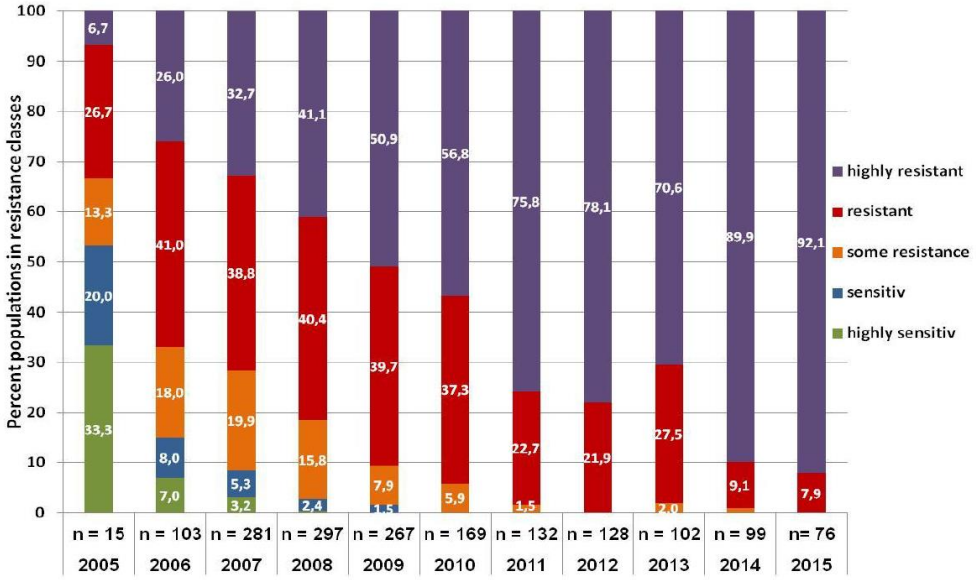
Diversity of rapeseed's insect pests

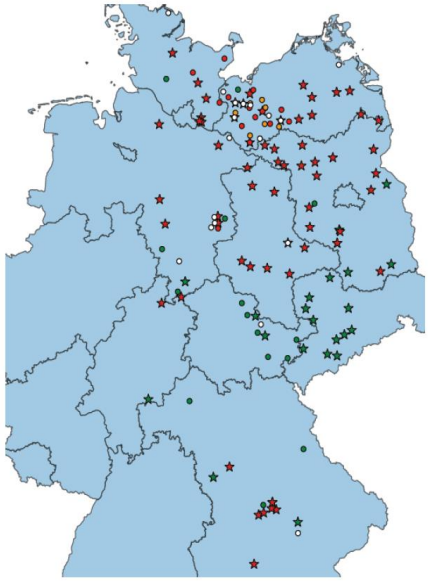






Insecticide resistance is spreading





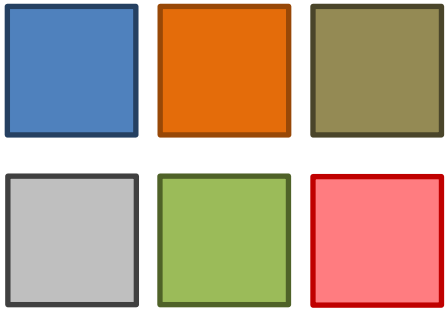
Hansen 2003, Slater *et al.* 2011, Heimbach & Müller 2012, Zimmer *et al.* 2014a, 2014b, Højland *et al.* 2015, Seidenglanz *et al.* 2015, Heimbach & Brandes 2016

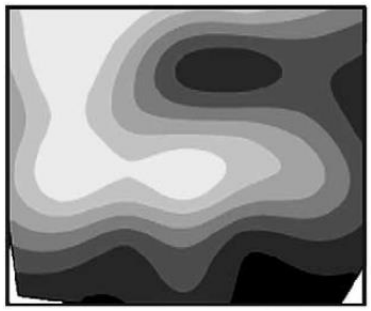
Insect-resistant cultivars in other species

Constraints

Bottleneck: phenotyping

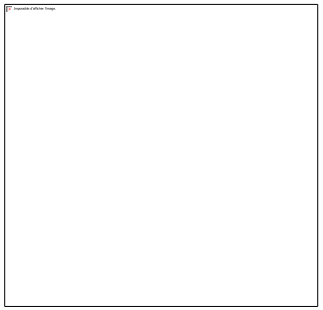
- Labor intensive
- Slow process
- Insect availability
- Mobility
- Spatial effects in the field

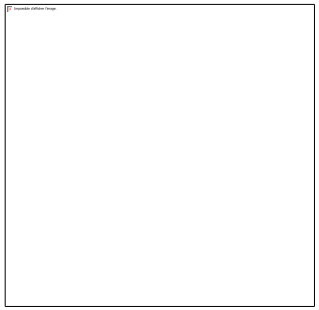


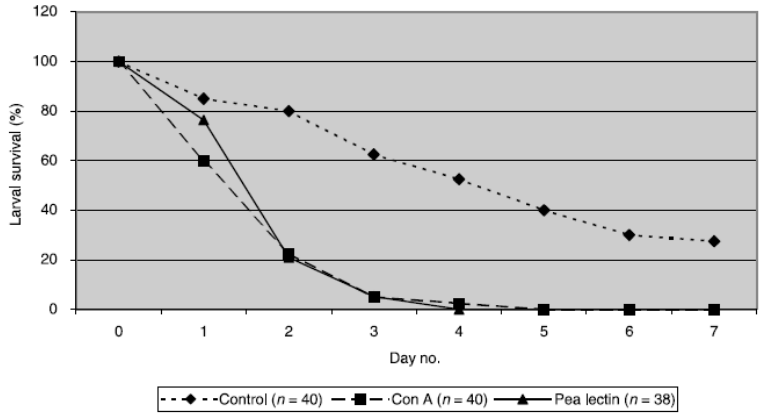


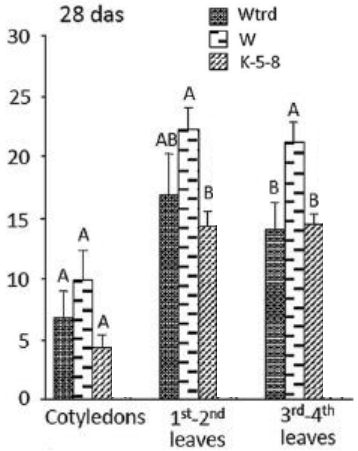
Very few major resistance genes

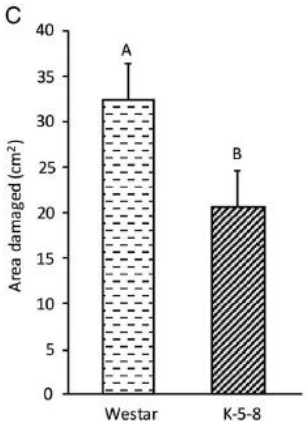
Strategy 1: transgenes

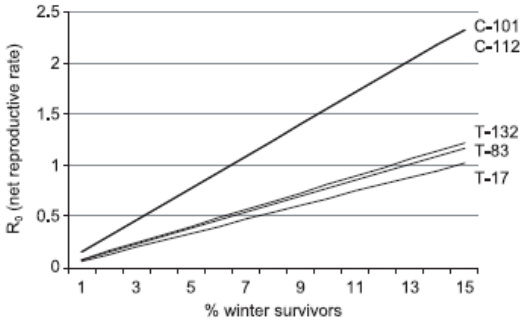








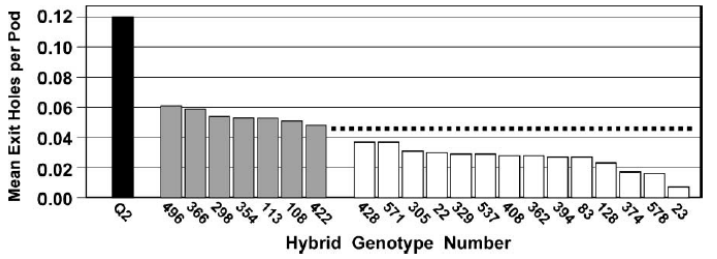




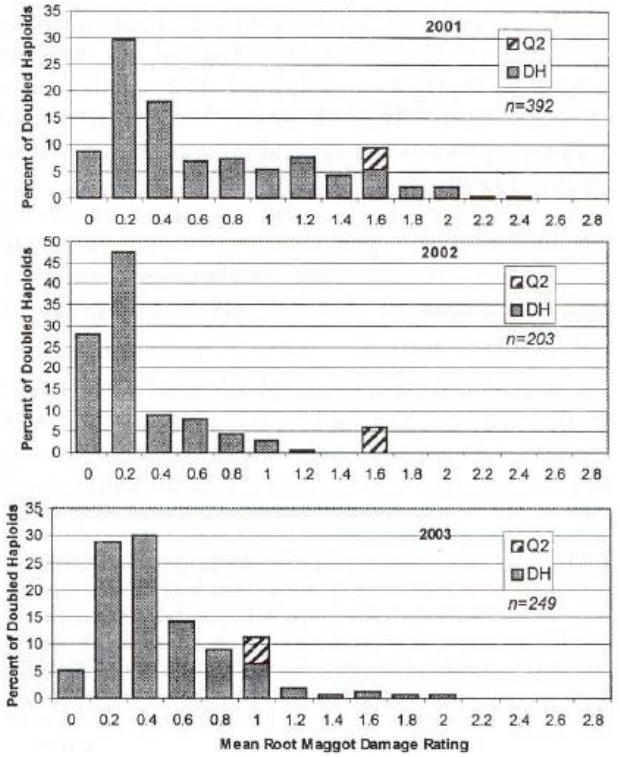
Gruber *et al*. 2006, Soroka *et al.* 2009, Alahakoon 2016a,b

Åhman & Melander 2003, Melander *et al.* 2003, Åhman *et al.* 2006, Lehrman 2007, Lehrman *et al.* 2007, Åhman *et al.* 2009

Strategy 2: introgression from relatives



Doucette 1947, Brown *et al.* 1999, Kalischuk & Dosdall 2004, McCaffrey *et al.* 2004, Dosdall & Kott 2006, Ulmer & Dosdall 2006, Cárcamo *et al.* 2007, Shaw *et al.* 2009, Tansey *et al.* 2010a,b,c, Lee *et al.* 2014



Dosdall *et al.* 1994, 2000, Kott & Dosdall 2004, Ekuere *et al.* 2005

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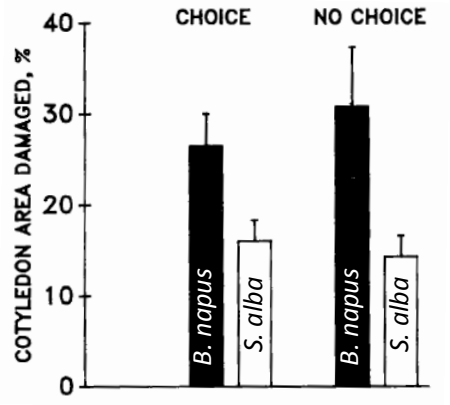
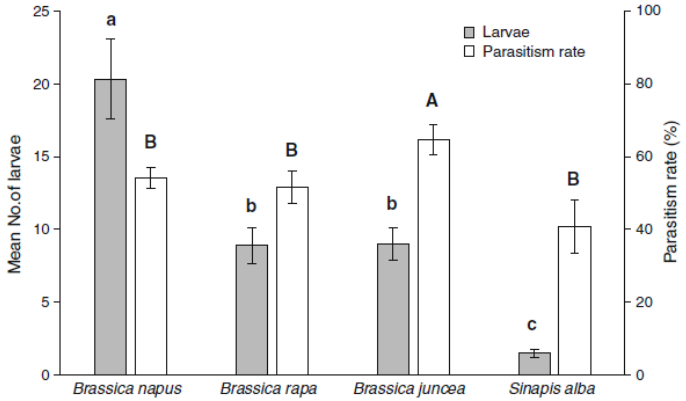


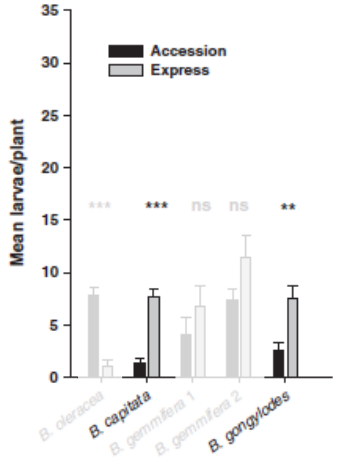
Bodnaryk & Lamb 1991, Gavloski *et al.* 2000, Soroka & Grenkow 2013

Species	Line	Larval weight (mg)	% larvae reaching 4th instar	% survival	Damage rating
		Experiment 1			
S. alba	AC Pennant	28.9±4.2*bcd*	48±8.5*c*	90±5.4	9.4
	L-GS	23.6±1.2*cd*	48±6.7*c*	94±6.0	9.1
B. carinata	Dodolla	37.4±3.1*abc*	54±8.4*bc*	86±8.0	6.9
	S-67	35.8±3.9*abc*	62±9.0*abc*	90±6.1	7.3
B. juncea	AC Vulcan	18.8±1.6*d*	2±2.0*d*	96±4.0	6.4
B. rapa	Echo	44.2±5.8*a*	56±11.0*abc*	80±10.0	7.5
	AC Boreal	43.7±3.0*a*	78±5.4*a*	98±2.0	9.1
B. napus	AC Excel	49.2±7.7*a*	68±10.8*abc*	86±6.1	7.8
	Midas	39.4±5.1*ab*	74±9.8*ab*	98±2.1	7.6
		Experiment 2			
B. juncea	AC Vulcan	24.6±5.8*c*	3±2.5*c*	83±4.4	4.1
	H-Allyl	26.5±6.5*c*	15±5.0*c*	83±4.5	4.6
	H-Butenyl	36.0±6.0*bc*	18±5.8*bc*	70±9.2	4.9
	L-GS	52.0±8.5*ab*	38±9.4*ab*	83±7.8	7.6
B. napus	AC Excel	56.3±7.2*a*	50±9.2*a*	95±3.2	8.3

Ulmer *et al.* 2001, 2002, Dosdall & Ulmer 2004

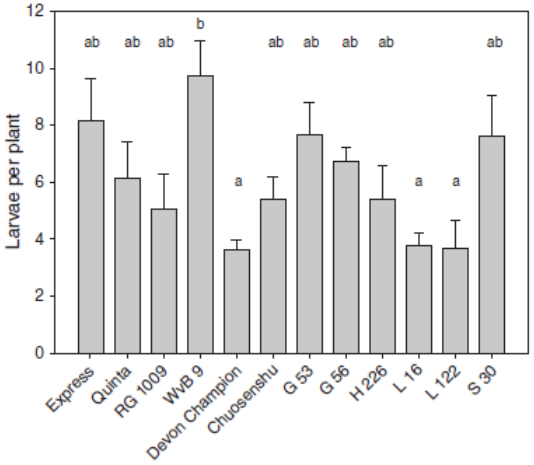


Borg & Ekbom 1996, Ekbom & Borg 1996, Hopkins & Ekbom 1996, 1999, Ekbom 1998, Hopkins *et al.* 1998, Veromann *et al.* 2012, 2014, Kaasik *et al.* 2014a,b

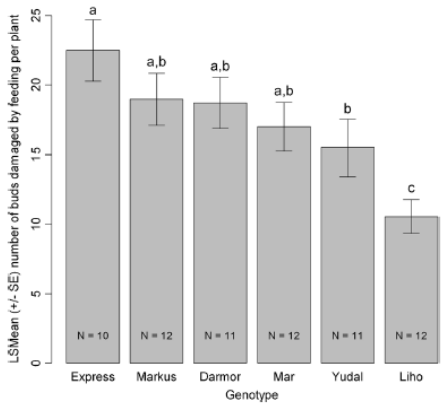


Eickerman & Ulber 2010

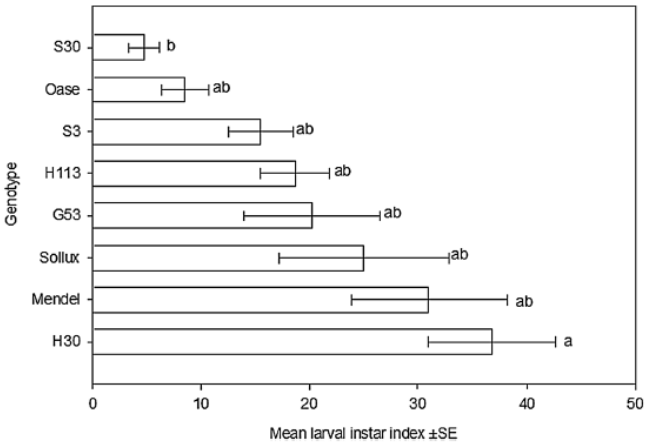
Strategy 3: natural resistance



Eickerman & Ulber 2010, Eickerman *et al.* 2011



Åhman 1993, Charpentier 1986, Hervé *et al.* 2014a,b, 2016a,b



Schäfer-Kösterke *et al.* 2016

NOTHING

Unpublished results

Conclusions

Breeding for insect resistance in rapeseed: Is it a dream?

No, it is not…

… but it will probably not be possible based on existing material

→ introgression from relative species (*S. alba*)
→ resynthetized oilseed rape

Challenge of phenotyping → (bio)marker-assisted selection

Resistance is not everything

Funding
Promosol
FSRSO
Terres Inovia

Thank you for your attention