– EPPO Workshop–

Berlin 22.09.2017

Breeding for insect resistance in OSR: is it a dream?

Maxime HERVÉ

Institute for Genetics, Environment and Plant Protection (Rennes, France)

Insect-resistant cultivars in other species

Constraints

Very few major resistance genes

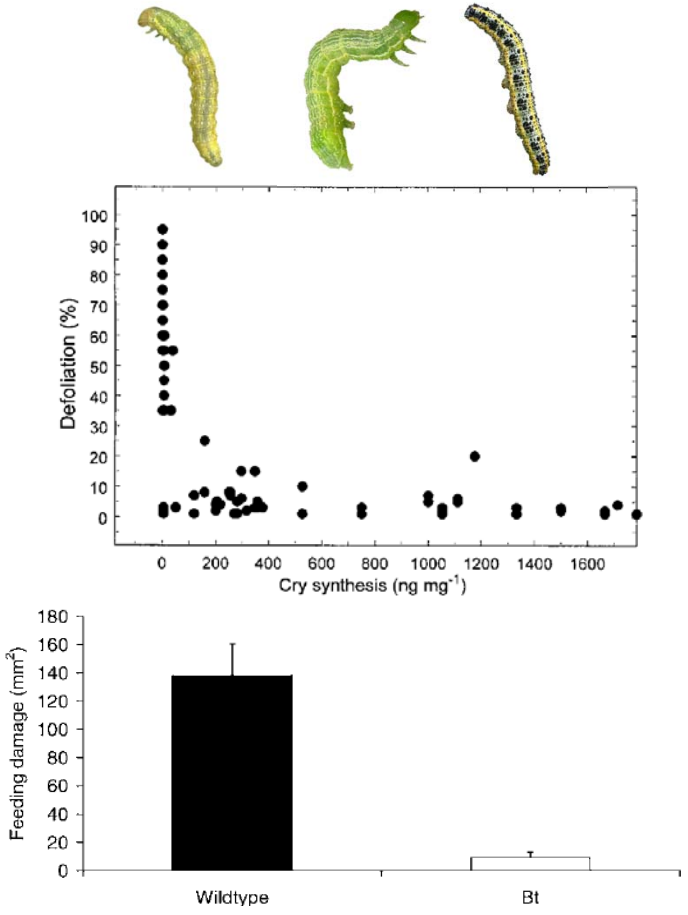
→ Need for (semi-)quantitative phenotyping

→ Labor intensive, slow process

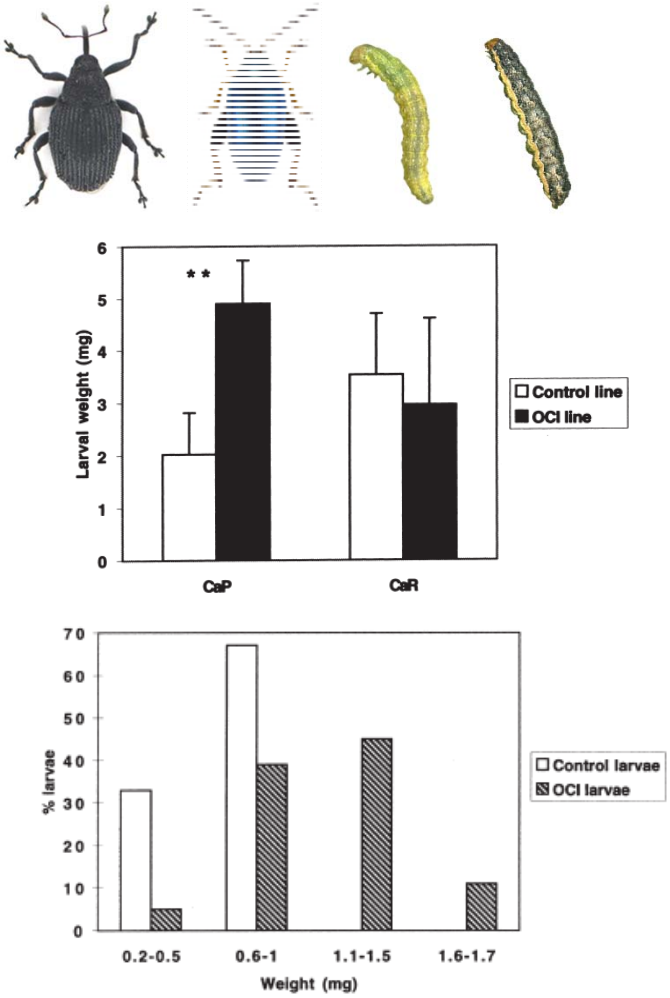
→ Insect availability

BOTTLENECK

Strategy 1: transgenes

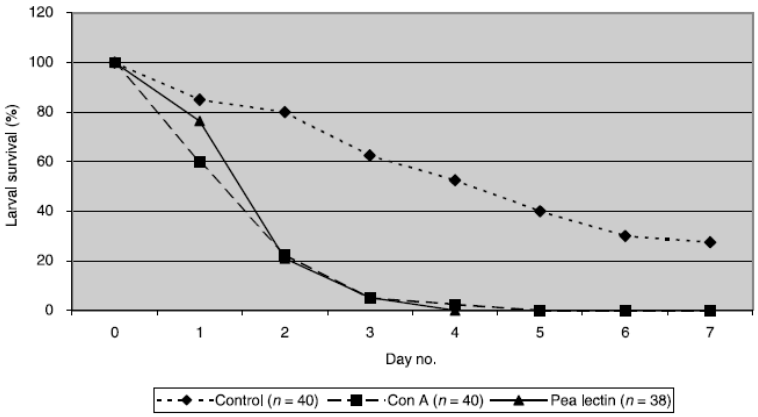


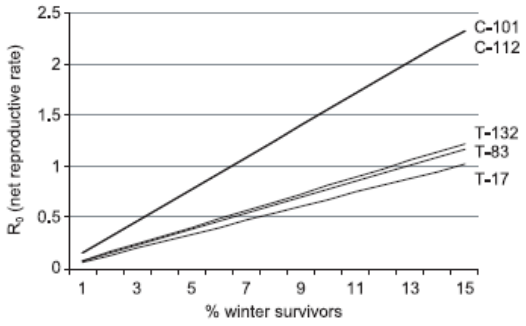
Stewart *et al.* 1996, 1997, Ramachandran *et al.* 1998a,b, Halfhill *et al.* 2001, 2002, Mason *et al.* 2003, Sayyed *et al.* 2003, Schuler *et al.* 2003, 2004, Cerda *et al.* 2006, Le *et al.* 2007, Walker *et al.* 2007, Himanen *et al.* 2008, 2009, Ibrahim *et al.* 2008, Kjaer *et al.* 2010



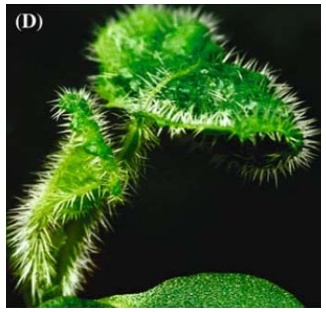
Bonadé-Bottino 1993, Girard *et al.* 1998a,b, Bonadé-Bottino *et al.* 1999, De Leo *et al.* 2001, Ferry *et al.* 2005

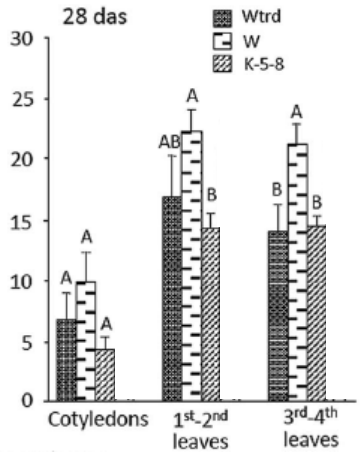
Strategy 1: transgenes

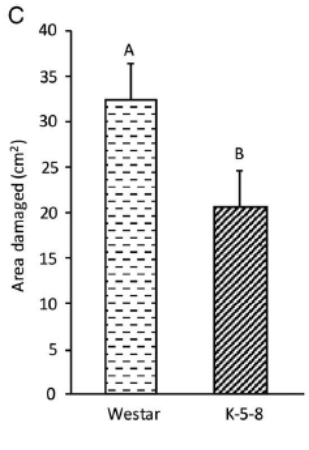




Åhman & Melander 2003, Melander *et al.* 2003, Åhman *et al.* 2006, Lehrman 2007, Lehrman *et al.* 2007, Åhman *et al.* 2009

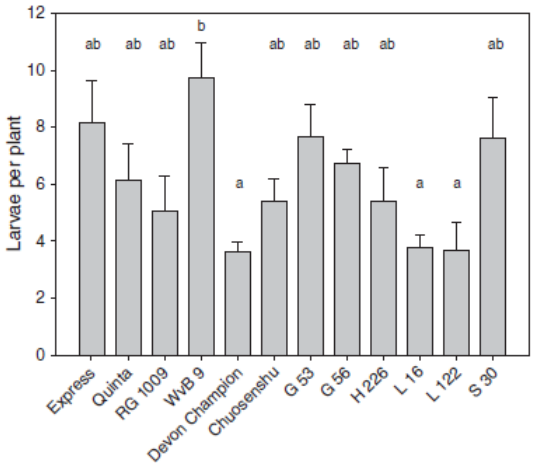




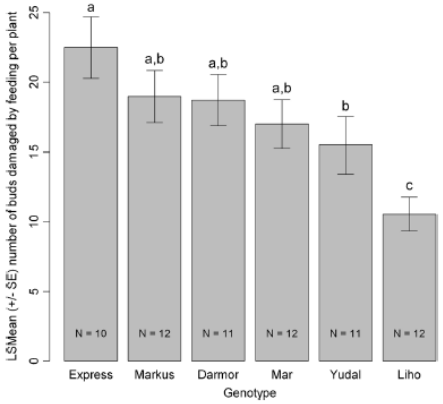


Gruber *et al*. 2006, Soroka *et al.* 2011, Alahakoon *et al.* 2016a,b

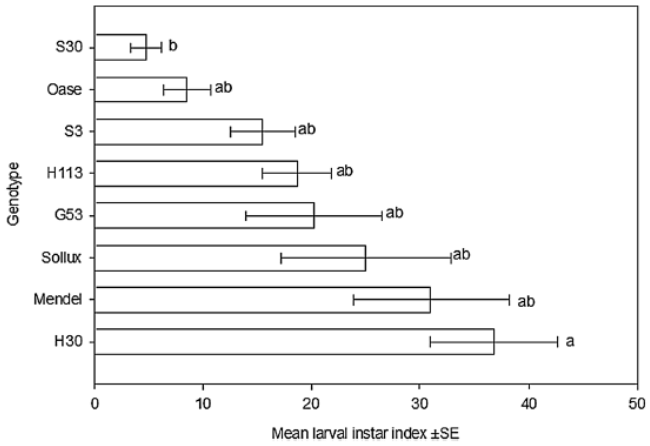
Strategy 2: natural resistance



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



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

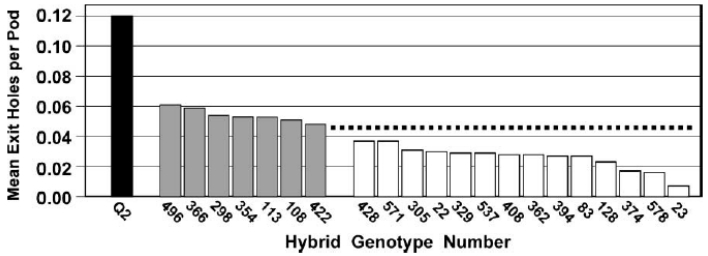


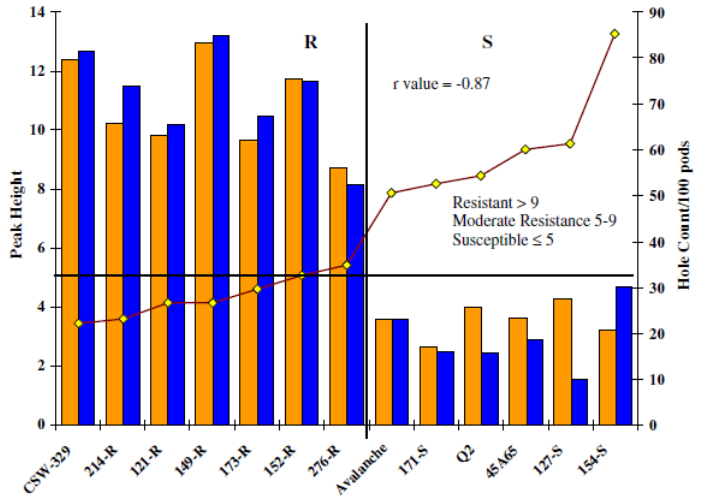
Schäfer-Kösterke *et al.* 2017, Schäfer *et al.* 2017

NOTHING

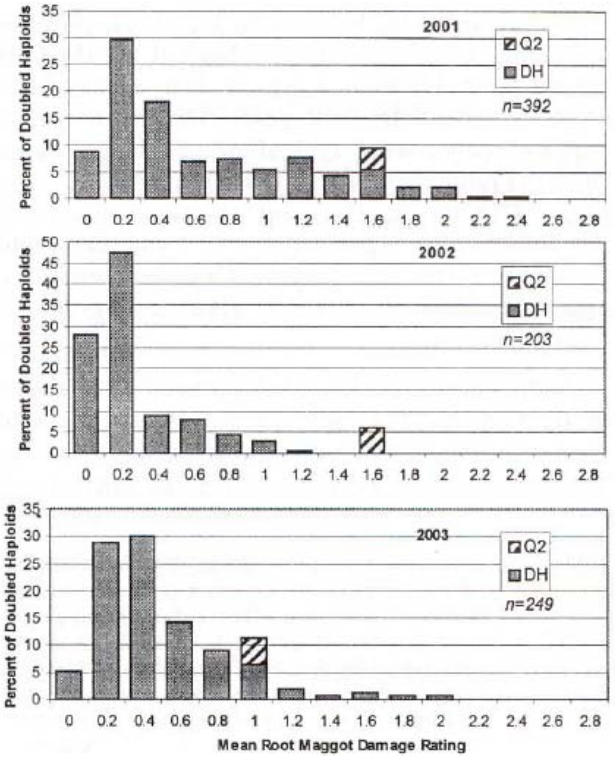
Dosdall *et al.* 1994, unpublished results

Strategy 3: introgression from other *Brassicaceae*



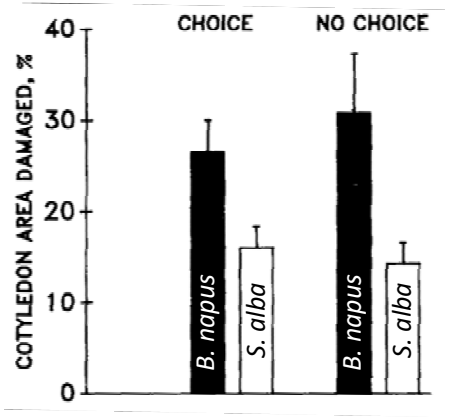


Doucette 1947, Brown *et al.* 1999, Kalischuk & Dosdall 2004, McCaffrey *et al.* 2004, Dosdall & Kott 2006, Ulmer & Dosdall 2006, Cárcamo *et al.* 2007, Shaw *et al.* 2009, Tansey *et al.* 2010a,b,c, Lee *et al.* 2014



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

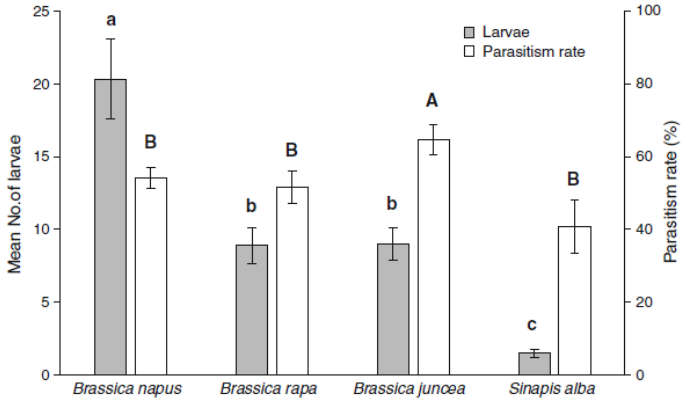
Strategy 3: introgression from other *Brassicaceae*



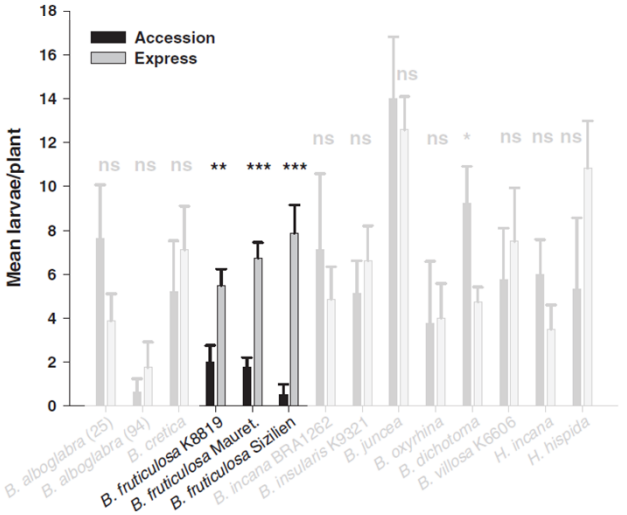
Putnam 1977, Lamb 1980, 1984, Bodnaryk & Lamb 1991, Gavloski *et al.* 2000, Soroka & Grenkow 2013

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

Perspectives

Most transgenic OSR are based on the production of toxins

→ qualitative strategy
→ same problems as with insecticides

Quantitative resistance is likely to be more durable…

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

→ introgression from other brassicaceous species (*S. alba*)
→ resynthetized OSR

Challenge of phenotyping → (bio)marker-assisted selection

Breeding for insect resistance in OSR: is it a dream?

Thank you for your attention

Flea beetles (*Phyllotreta* sp.)

Cabbage stem flea beetle
(*Psylliodes chrysocephala*)

Rape winter stem weevil
(*Ceutorhynchus picitarsis*)

Rape stem weevil
(*Ceutorhynchus napi*)

Cabbage stem weevil
(*Ceutorhynchus pallidatylus*)
(= *C. quadridens*)

Cabbage seed weevil
(*Ceutorhynchus obstrictus*)
(= *C. assimilis*)

Pollen beetle
(*Meligethes aeneus*)
(= *Brassicogethes aeneus*)

Cabbage root fly (= root maggot)
(*Delia radicum*)

Brassica pod midge
(*Dasineura brassicae*)

Turnip sawfly
(*Athalia rosae*)

Bertha armyworm
(*Mamestra configurata*)

Cabbage aphid
(*Brevicoryne brassicae*)

Green peach aphid
(*Myzus persicae*)