Focus Group IPM for *Brassica*

Major diseases & pests – control strategies, bottlenecks, country spread

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A. MAJOR DISEASES

A.1. Major diseases – oilseed rape

Major oilseed rape diseases and weeds control strategies and bottlenecks (cf. Focus Group report Annex A5.1)							
	Key pest	**Secondary pest**	**No problem**	**Control strategies currently used**	**IPM alternatives**	**Bottlenecks**	**Additional comments**
Fungi							
Plasmodiophora brassicae	All countries			crop rotation and late sowing, liming, resistant varieties, boron	Same as current strategies	resistant varieties may be lower yielding, resistance not stable, land use (much land is rented), monitoring services costly, sampling strategies problematic, conflict between weed management and disease mgmt, no registered fungicides (won't be approved in near future)	Some current control strategies were left out here, should be moved back in from the general table!
Verticilllium longisporum	ES/LV/SE/FR	UK/GE	CH/DK	crop rotation and healthy seed, no minimal tillage, organic matter management	Partial resistance	no good resistance available, no chemicals available	

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Sclerotinia sclerotiorum	UK/CH/DK/	LV/SE/FR/DE		crop rotation, ploughing, remove of infected debris, fungicides, disease forecasting	Biological control, disease forecasting	rotation not easy, no resistant varieties, wide host range, risk for fungicide resistance, biological control is expensive and complicated but can contribute to control in combination with other measures, challenge to develop monitoring and disease forecasting,	Fungicides most important current method; Forecasting system works in UK but leads to many sprays, other forecasting systems are not reliable enough; challenge to have EU-wide initiative to improve forecasting and decision support systems
Leptosphaeria maculans (Phoma lingam)	UK/CH/LV/DK	FR/GE	SE	crop rotation, resistant varieties, remove of infected debris, fungicides	soil tillage, spore trapping	limited range of resistant varieties, farmers prefer minimal tillage; pathogen adaptation to host resistance; no specific resistances left (RLM7 is last one)	
Pyrenopeziza brassicae	UK	DK/FR	GE/CH/LV/SE	resistant varieties, fungicides	soil tillage, rotations and ploughing	fungicide resistance serious problem in UK, limited number of varieties with good resistance, yield penalty, resistance unstable, increased disease pressure means increased spray, farmers prefer minimal tillage	

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Viruses							
Beet western yellows (= Turnip yellows virus)	UK/SE/DK	FR	CH/LV/DE	insecticides to target vector	time of sowing, resistant varieties	neonic ban has increased foliar insecticide use, insect vectors resistant to pyrethroids, resistance could come with yield penalty, only one resistant variety available	
Weeds							
	All countries			herbicides, wide rows	mechanical control	herbicide resistance in grass weeds, in some countries few herbicides registered, mechanical control is more expensive	mechanical weed control can be attractive if you look at savings of seed costs, herbicides and growth regulators

Additional comments:

- We need more work on how to come from monitoring results to recommendations on what the farmer should do in the field, that understanding is missing in many cases.
- Reliable and easy to use forecasting is really needed.

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A.2. Major diseases – *Brassica* vegetables

Most important diseases of Brassica vegetables in Europe (cf. Focus Group report Annex A4.2)									
	Broccoli			Cauliflower			White cabbage		
	Key pest	Secondary pest	No importance	Key pest	Secondary pest	No importance	Key pest	Secondary pest	No importance
Plasmodiophora brassicae	GE/PT/NL/UK/IT/BE	F		GE/NL/UK/PT/IT/BE	F		GE/NL/UK/PT/IT	F/BE	
Hyaloperonospora parasitica (Peronospora parasitica)	PT/FR	GE/NL/UK/BE	IT	GE/PT	NL/UK/F/BE	IT	UK	NL/PT/F/BE	GE/IT
Albugo candida		PT/F	GE/NL/UK/IT/BE		PT/BE	GE/NL/UK/IT/F	NL	PT/BE	GE/UK/IT/F
Phytophthora brassicae		IT	GE/PT/NL/UK/F/BE		IT/F	GE/NL/PT/UK/BE	NL/BE	UK/IT/F	GE/PT
Alternaria brassicae* and *brassicola	PT/NL/BE	GE/UK/IT	F	GE/NL/IT/BE	PT/UK	F	GE/NL/IT/BE	UK/PT	F
Mycosphaerella brassicicola	PT/NL/F/BE	GE/UK/IT		NL/F/BE	GE/PT/UK/IT		NL/PT/F/BE	GE/UK/IT	
Verticillium longisporum			GE/PT/NL/UK/IT/F/BE	GE/IT/BE		NL/PT/UK/F		UK/BE	GE/NL/PT/IT/F
Erysiphe cruciferarum		NL/UK/IT/BE	GE/PT/F	IT	NL/UK/BE	GE/PT/F	IT	GE/NL/UK/BE	PT/F
Sclerotinia sclerotiorum	IT	F/BE	GE/PT/NL/UK		UK/IT/F/BE	GE/NL/PT	IT/BE	GE/UK/F	NL/PT
Rhizoctonia solani		GE/NL/UK/IT/F/BE	PT	B	GE/NL/UK/IT/F	PT	B	GE/NL/UK/IT/F	PT
Leptosphaeria maculans (Phoma lingam)		GE/PT/NL/IT	UK/BE		GE/NL/PT/IT	UK/BE		GE/NL/UK/PT/IT	BE
Pyrenopeziza brassicae		NL/UK	GE/PT/IT/F/BE		NL	PT/UK/GE/IT/F/BE		UK	NL/GE/PT/IT/F/BE
***Stemphylium sp.* (brown spot)**		PT	GE/NL/UK/IT/F/BE		PT	NL/UK/GE/IT/F/BE	PT	UK	NL/GE/IT/F/BE

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Bacteria									
Xanthomonas campestris pv. campestris	NL/BE	GE/PT/UK/IT	F	GE/NL/IT/BE	PT/F		BE	GE/PT/IT	F
***Pectobacterium carotovorum* (soft rot)**		NL/BE	GE/PT/UK/IT/F		NL/UK/BE	GE/PT/IT/F		GE/NL/UK/IT/BE	PT/F
Pseudomonas fluorescens* and *viridiflava	NL/F/BE		GE/PT/UK/IT	BE	GE/IT	PT/UK/F			GE/NL/UK/PT/IT/F/BE
Viruses									
Cauliflower mosaic virus		UK	GE/PT/NL/IT/F/BE		UK	GE/PT/IT/F/BE		UK	GE/NL/PT/IT/F/BE
Turnip mosaic virus		UK	GE/PT/NL/IT/F/BE		UK	GE/PT/IT/F/BE		UK	GE/NL/PT/IT/F/BE
Beet western yellows = Turnip yellows virus		UK	GE/PT/NL/IT/F/BE		UK	GE/PT/IT/F/BE			GE/NL/UK/PT/IT/F/BE

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Major diseases on vegetables, control strategies and bottlenecks (cf. Focus Group report Annex A5.2)				
	Control strategies currently used	**IPM alternatives**	**Bottlenecks**	**Additional comments**
Fungi				
Plasmodiophora brassicae	crop rotation, lime nitrogen, resistant varieties	soil indexing	resistance likely to break down; monitoring may be costly; resistance not stable	
Hyaloperonospora parasitica (Peronospora parasitica)	ventilation, irrigation, fungicides in raising houses, resistance	biofumigant seed meals, vegetable oils	cultural practices in nurseries; new biocontrol products costly and efficacy may be partial (one product under registration)	Low risk definition is not available yet might be a bottleneck for registering biocontrol products
Albugo candida	chemical treatment, resistance	cultural practices	cultural practices not effective, not convenient, resistance only partial and variety choice limited	
Phytophthora brassicae				
Botrytis cinerea				
Alternaria brassicae and brassicola	chemical treatment, resistance, DSS	cultural practices	resistance available?; changing growing practices not convenient; Fungicides are effective and solves problem, should be used in conjunction with forecasting	

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Mycosphaerella brassicicola	fungicides, forecasting, resistance	cultural practices	fungicides are effective and should be used in conjunction with forecasting; resistance only partial; DSS services may be costly	Resistance only partial is not a bottleneck in FR; unknown resistance backgrounds may mean that resistance breaks down sooner: resistance in Brussels sprouts is limited
Verticillium longisporum				
Erysiphe cruciferarum	chemical control, resistance	vegetable oils, biofumigant seed meals	fungicides are effective, limited number of partial resistant varieties; new products only partially effective and require extra effort from grower	
Sclerotinia sclerotiorum	fungicides, rotations, forecasting, Coniothyrium minitans	cultural practices, soil steaming and disinfection	soil steaming and disinfection very expensive, biocontrol extra cost; fungicides need to be used with forecasting; no host resistance; risk of fungicide resistance	
Rhizoctonia solani	rotation and seed treatments with fungicides	biofumigation, biocontrol, glasshouse seedlings	biofumigation and biocontrol expensive	
Leptosphaeria maculans (Phoma lingam)	fungicides	cultural practices, biocontrol	tillage is costly, only partial solution, biocontrol only partial solution at best; fungicides used for other foliar pathogens will have effect on Phoma	

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Pyrenopeziza brassicae	fungicides, resistant varieties	cultural practices	limited information about resistant varieties and variability in pathogen, ploughing is costly; fungicide resistance problems	
Stemphylium sp. **(brown spot)**		cultural practices		
Bacteria				
Xanthomonas campestris pv. campestris	hygiene crop rotation, disease free seed, irrigation control, resistance	soil steaming, hot water seed treatment	resistant varieties unknown or may not be stable (and therefore not suitable for marketing); Soil steaming and hot water treatment very expensive, cultural practices do not solve the problem; very difficult to produce disease free seeds;	
Pectobacterium carotovorum **soft rot**	partial resistance			
Pseudomonas fluorescens **and** ***viridiflava***	cultural practices; partial resistance for broccoli		very difficult to control and only partial resistance	
Viruses				
Cauliflower mosaic virus	aphicides, rotation and removal debris	resistant varieties, destruction of plant material and weeds	cultural practices will constrain growing practices in some situations, resistant varieties limited in availability; destruction extra work for grower and not fully effective	
Turnip mosaic virus				
Beet western yellows = Turnip yellows virus				
Nematodes				
Heterodera schachtii				

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Meloidogyne sp.				
Weeds				
	rotation, false sowing, tillage, mechanical, herbicides		cultural practices not always fit with growing system and only partially effective; mechanical weeding less convenient and more expensive, resistant weeds can be a future problem	

Additional comments:

- Main driver for uptake IPM measures is the loss of pesticides
- Maintaining resistance (resistance breeding) may be a challenge across all Brassica vegetables
- Chemical pesticides will contribute much less in the future in terms of solving current problems
- Areas of many Brassica vegetables so small that they cannot justify registration of pesticides any more
- Challenge to reach high level of reliability of IPM methods
- Tendency for higher delay between treatment and harvest (because of residue issues) - new products needed
- Storage diseases?
- Biocontrol products in field performance? Use in combination with conventional pesticides

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B. Most important pests

B.1. Most important pests – oilseed rape

Most important pests on oilseed rape – control strategies and bottlenecks (cf. Focus Group report Annex A5.3)						
Latin name	**Key pest**	**Secondary pest**	**No problem**	**Control practice currently used**	**IPM alternatives**	**Bottlenecks**
Delia radicum	DK/DE/SE/UK	CH		insecticides, until recently seed treatment	cultural practices, DSS	DSS: species determination difficult, some regions with high competiveness of OSR high losses without chemical control
Pylletreta spp.	SE/LV	DK/IT/GE/UK	CH	insecticides, until recently seed treatment	avoid proximity to Brassica	not possible to avoid proximity to Brassica in arable areas; some regions with high competiveness of OSR, high losses without chemical control
Psylliodes crysocephala	CH/LV/UK/GE	DK/SE		insecticides, until recently seed treatment	avoid proximity to Brassica, yellow traps, vegetable oils, silicate rock dust	yellow traps don't work; vegetable oils are not effective; not possible to avoid Brassica in arable areas; some regions with high competiveness of OSR, high losses without chemical control; pyrethroid resistance
Ceutorhynchus pallidactylus	DK/CH	UK/GE	SE/LV	insecticides	cultural practices, DSS	visual control of oviposition holes are difficult and labour intensive
Ceutorhynchus napi	CH/IT		DK/UK/DE	insecticides	cultural practices, DSS, resistance	visual control of oviposition holes are difficult and labour intensive; more information needed about resistance; in some regions high losses without chemical control

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Ceutorhynchus assimilis			UK/IT	insecticides	cultural practices	insecticides used for other targets may give some control
Dasineura brassica		GE	UK/CH	insecticides	cultural practices	usually side effects of other treatments are sufficient; in regions with high competiveness of OSR high losses without chemical control
***Meligethes auneus* (renamed *Brassicogethes*)**	IT/GE/CH/UK			insecticides	density of rape production, trap crops, DSS, early flowering varieties, silica rock dust	trap crops usually not reliable; DSS: tresholds not linked to yield; silicate rock dust less efficient and more expensive; insecticide resistant beetles; early flowering varieties not reliable and yields may be compromised by late frost
slugs and snails	UK	CH/GE		snail baits, molluscides, methaldehyde, ferric phosphate	cultural practices, biocontrol	biocontrol too expensive and efficacy data lacking in arable situation; ferric phosphate more expensive than metaldehyde, slug problem becoming worse, applications limited; no good tresholds
wild life damage	UK	GE	CH	avoidance of risky areas, pigeon shooting	repellant seed treatment	problem in large fields; pigeon pressure can be very high, shooting cannot cope; nets, fences, shooting, etc. too expensive; repellant seed treatment not available

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B.2. Most important pests – *Brassica* vegetables

Most important pests of *Brassica* vegetables in Europe (cf. Focus Group report Annex A4.4)									
	Broccoli			Cauliflower			White cabbage		
	Key pest	Secondary pest	No importance	Key pest	Secondary pest	No importance	Key pest	Secondary pest	No importance
Nematodes									
Heterodera schachtii		GE/NL/IT/BE/CH	PT/UK/F/CH		GE/IT/CH	PT/UK/F/CH		NL/UK/BE/CH	GE/PT/IT/F/CH
Meloidogyne sp.	IT	NL/BE	GE/PT/UK/F	IT		GE/PT/UK/F/CH	IT	NL/BE	GE/UK/PT/F/CH
Insects									
Delia radicum	All countries			All countries			All countries		
Lepidopteras	All countries			All countries			All countries		
Spodoptera spp.	IT/SP/PT		Other countires	IT/SP/PT		Other countries	IT/SP/PT		Other countries
Myzus persicae			NL/CH/GE		NL/CH/GE		IT	NL/CH/GE	
Brevicoryne brassicae	UK/GE	NL/CH/IT		UK/GE	NL/CH/IT		NL/UK/GE	CH/IT	
Contarinia nasturtii	CH/GE	NL/UK/BE	IT	CH/GE	NL/UK/BE	IT	NL	UK/CH/GE/IT/BE	
Aleyrodes proletella		NL/CH/UK/GE			NL/CH/UK/GE	IT		NL/CH/UK/GE	IT
Thrips tabaci			NL/CH/GE/UK			NL/CH/GE/UK		NL/UK/GE/CH	
Phyllotreta spp.	CH	GE/UK/IT	NL	CH	GE/UK/IT	NL	CH	NL/GE/UK/IT	
Ceutorhynchus		CH/UK	NL/GE/IT		CH/UK	NL/GE/IT		UK	NL/CH/IT/GE
Meligethes		CH/GE/UK	NL		CH/GE/UK	NL			NL/CH/GE/UK
Slugs and snails									
	All countries			All countries			All countries		

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Most important pests on Brassica vegetables – control strategies and bottlenecks (cf. Focus Group report Annex A5.4)				
Insects	**control strategies currently used when problem**	**IPM alternative**	**Bottlenecks**	**Additional comments**
Delia radicum	nets, insecticides, seed treatment, drench treatment, sprays. Monitoring and forecasting	DSS, exclusion fences	problem in organic crops, disperses further than 1 km, conservation control insufficient; DSS has not much impact since most effective treatments are prophylactic; insecticides have side effects on beneficials; few good working insecticides available	Nets used in UK when economics are right. Creates other problems with pests and diseases
Lepidopteras	Insecticide sprays and Bacillus thuringiensis; monitoring	monitoring and DSS	biological control needs precise timing to be effective, biocontrol more expensive and less effective, growers need to be encouraged to use alternatives to pyretrhoids and other broad spectrum insecticides; insecticide resistance in Plutella; Plutella disperses over great distances; OSR is another host	
Myzus persicae	insecticides, seed treatments and sprays; monitoring and forecasting, suction traps, vegetable oils, soaps	reducing N input, suction traps and DSS	insecticide resistance, reduction of natural ennemies, main challenge is insecticide resistance management; reducing N input is not feasible	
Brevicoryne brassicae	insecticides, seed treatments and sprays; monitoring and forecasting, suction traps, vegetable oils, soaps	functional biodiversity	difficult to control with contact insecticides; often heavily parasitized by parasitoids and predators if not disturbed by insecticide use	
Contarinia nasturtii	monitoring, cultural practices, chemicals. Field distance. Seed treatments		expertise required to separate out the midges from other insects in traps; not enough information on control methods and treatment timing	

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Aleyrodes proletella	insecticides, sprays, seed treatments	cultural practices, nets	some insecticides not very effective; exclusion of parasitoids with nets sometimes worsens the situation; resistance to pyrethroids	
Thrips tabaci	tolerance on white and red cabbage, occasionally insecticides, often no control, Spinosad	DSS (French model), tolerant varieties, vegetable oils; spraying techniques	vegetable oils may not be effective, systemic insecticides needed, tolerant varieties not wanted by commercial growers; anything that would help target treatments would be good since difficult to find correct application time and efficacy of insecticides often poor	
Phyllotreta spp.	cultural practices, insecticides, nets	distance to other cabbage fields, silica rock dust	hard to separate fields	
Meligethes auneus	no control or insecticides when in neighbourhood of OSR, nets, DSS	trap crops, nets	trap crops and nets are not worth the extra management cost because sporadic pest; forecasting model of summer flight urgently needed; adults need to be controlled on cauliflower and broccoli; problems with preharvest interval	
Agriotes/Hellula	no control, soil tillage, crop rotation		high incidence in broccoli in monoculture in Spain	
Slugs and snails	molluscicides, cultural practices, monitoring, traps	cultural practices, biocontrol	molluscicides not always effective, metaldehyde perceived to be better than ferric phosphate but contamination issues; biocontrol is expense; traps probably not effective and too expensive for field crops	
Wild life damage	scarers, netting and shooting		nets and fences work but are expensive, birds get used to scary men, shooting can be effective; repellent seed treatment would be good if effective	

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