



# Country report 2016

## Denmark

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# Activities in DK in 2016

- Test of seed samples from farmers/consultants
- Monitoring project
- Policy support on resistance (DEPA)
- PhD defense – Marielle Babineau 'Microevolution of ALS inhibitor herbicide resistance in loose silky bentgrass (*Apera spica-venti*).'



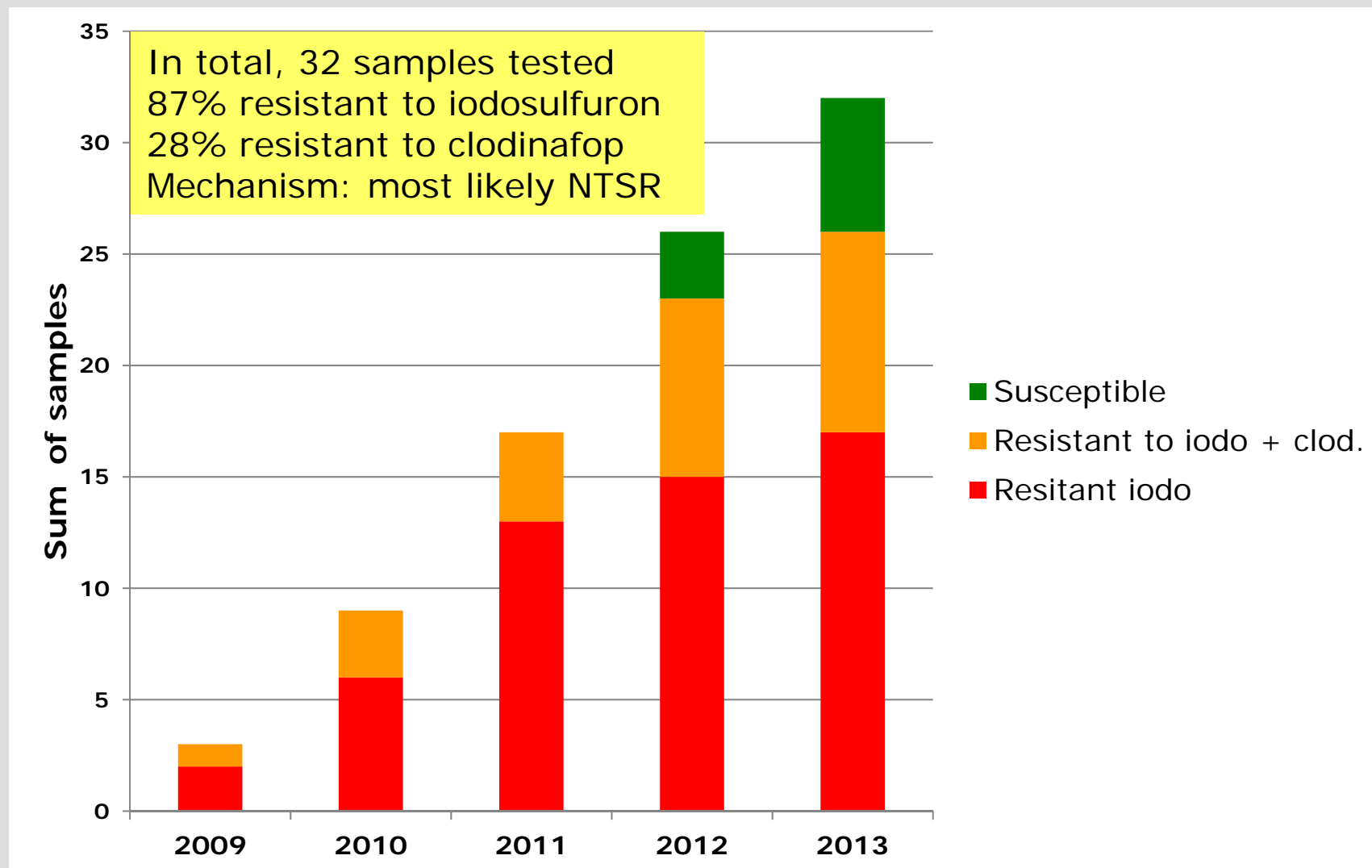
# Resistance test, DK

## (excl. samples for monitoring)

Weed species	No of samples, 2014	No of samples 2015	No of samples 2016
STEME, <i>S. media</i>	0	0	0
ALOMY, <i>A. myosuroides</i>	28 (17)	11 (8)	2 (2)
PAPRH, <i>P. rhoeas</i>	0	0	0
LOLMU, <i>L. multiflorum</i>	16 (5)	7 (6)	12+1 (10 + 1)
MATIN, <i>T. inodorum</i>	3 (2)	0	0
CENCY, <i>C. centaurea</i>	0	0	0
APESV, <i>A. spica-venti</i>	1 (1)	0	3 ?
Other species	2	0	2
In total	50 (25)	18 (14)	20 (13)



# LOLMU, ital. ryegrass





# Perennial ryegrass

## Herbicide Resistant Perennial Ryegrass Globally (*Lolium perenne*)

#	Country	First Year	Situation	Active Ingredients	Site of Action
1	<a href="#">Argentina</a>	2008	Cropland, Soybean, Spring Barley, and Wheat	glyphosate	EPSP synthase inhibitors (G/9)
2	<a href="#">Chile</a>	2001	Cereals	diclofop-propargyl, and diclofop-methyl	ACCase inhibitors (A/1)
3	<a href="#">Germany</a>	2008	Wheat	iodosulfuron-methyl-sodium, pinoxaden, and pyrooxulam	Multiple Resistance: 2 Sites of Action ACCase inhibitors (A/1) ALS inhibitors (B/2)
4	<a href="#">New Zealand</a>	2012	Grapes	glyphosate	EPSP synthase inhibitors (G/9)
5	<a href="#">New Zealand</a>	2015	Grapes	amitrole, glufosinate-ammonium, and glyphosate	Multiple Resistance: 5 Sites of Action Carotenoid biosynthesis (unknown target) (F1/11) EPSP synthase inhibitors (G/9) Glutamine synthase inhibitors (H/10)
6	<a href="#">Portugal</a>	2013	Grapes	glyphosate	EPSP synthase inhibitors (G/9)
7	<a href="#">United States California</a>	1989	Railways, and Roadsides	sulfometuron-methyl	ALS inhibitors (B/2)
8	<a href="#">United States Texas</a>	1989	Roadsides	sulfometuron-methyl	ALS inhibitors (B/2)

60 cases of resistance in LOLMU!

# IPM project – advisory service



Forebyggelse af udvikling fra enkeltplanteniveau til en rajgræsbestand og – evt. resistensudvikling		Valgt tiltag
Tjek årligt alle marker for rajgræs, og aflug/nedvisne alle enkeltplanter af italiensk rajgræs. "0-tolerance".	☆☆☆	
Sædskifte - øge andelen af vårafgrøde (20-30%).	☆☆☆	
Sædskifte - øge andelen af bredbladede afgrøder.	☆☆	
Udnyt afgrødekongurrence: rug bedre end hvede.	☆	
Undlad såning før 15. september.	☆☆	
Aldrig vinterbyg på arealer med ital. rajgræs - det opformerer italiensk rajgræs i sædskiftet.	☆☆	
Skift i valg af ukrudtsmidler / virkemekanismer Brug som udgangspunkt ikke ALS-hæmmere om efteråret – og max 1 middel fra hver gruppe/afgrøde/sæson.  <u>ALS-hæmmere</u> : ex. Lexus, Atlantis OD, Broadway, Monitor, Cossack, Tombo, Ally, Express, Hussar, Primus, Saracen, Zypar, Maister, Safari, Titus, Trimmer, Nuance, Nicanor...  <u>ACCASE-hæmmere (FOP/DIM midler)</u> : ex. Topik, Adimax, Primera Super, Foxtrot, Agil, Focus Ultra	☆☆	
Uden pløjning: altid høj glyfosatdosering lige inden såbedstilberedning.	☆☆☆	
Pløjning på lerjord: glyfosat inden pløjning/ især foragre	☆☆	
Sprøjt med Boxer inden for 10 dage efter såning.	☆☆	
Sprøjteteknik: Sprøjt forageren sidst med jordmidler – og øg dosen i forageren.	☆	
Brug tilstrækkeligt høje doseringer.	☆	

# Resistance test, SE



Weed species	No of samples, 2016
ALOMY, <i>A. myosuroides</i>	22
MATCH, <i>M. recutita</i>	2
APESV	1
In total	25



# Status of herbicide resistance

## DK August 2016

Weed species	Resistance mechanism	First case	No of locations
STEME ( <i>S. media</i> )	ALS TSR	1991	27
GALTE ( <i>G. tetrahit</i> )	ALS TSR	?	1
ALOMY ( <i>A. myosuroides</i> )	ACCase TSR, NTSR	2001	91
PAPRH ( <i>P. rhoeas</i> )	ALS TSR	2003	10
MATIN ( <i>T. inodorum</i> )	ALS TSR	2010	19
LOLMU ( <i>L. multiflorum</i> )	TSR NTSR	2009	33
CHRSE ( <i>C. segetum</i> ) okseøje	ALS TSR	2010	2
APESV ( <i>A. spica-venti</i> )	NTSR/ (TSR)	2010	6
CAPBP ( <i>C. bursa pastoris</i> )	ALS TSR	2011	1





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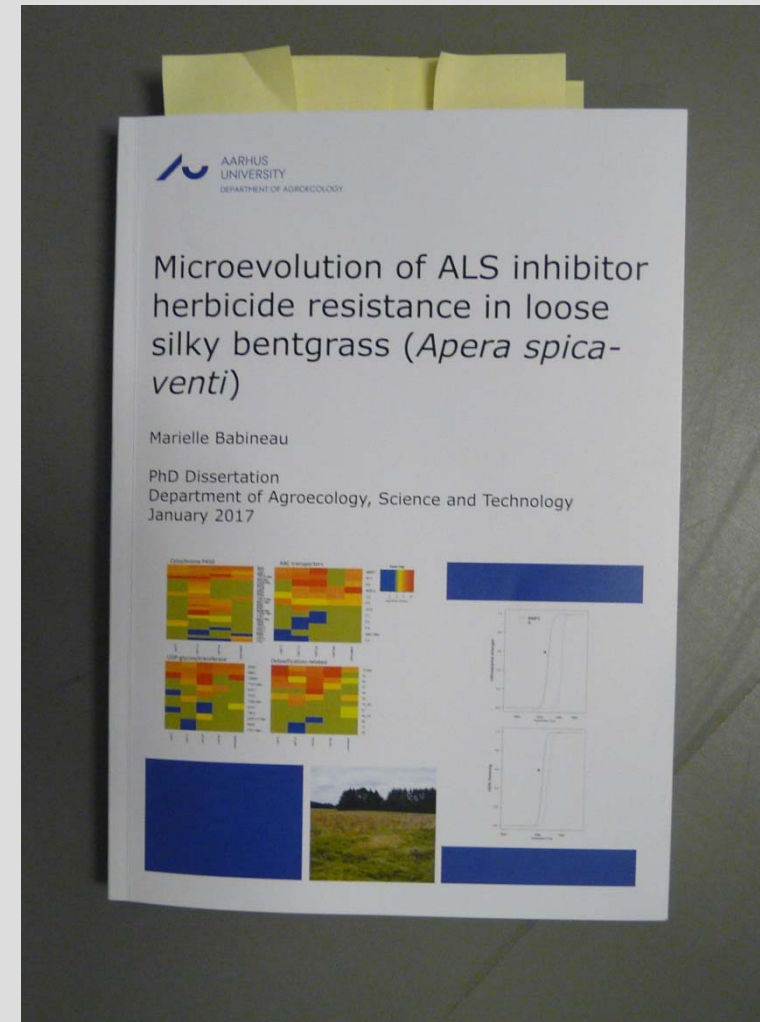
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# Final report on survey on herbicide resistance





# PhD defence - Marielle





# Presentations and papers

Babineau M., Mathiassen SK., Kristensen M., Kudsk P. (2016): Spatial gradient and fitness cost of enhanced metabolism in ALS inhibitor herbicide resistant *Apera spica-venti* populations in Denmark. **7. IWSC, Prague**

Babineau M., Mahmood K., Mathiassen S.K., Kudsk P. and Kristensen M.: *De novo* transcriptome assembly analysis of weed *Apera spica-venti* from seven tissues and growth stages. *BMC Genomics* 2017, 18:128

Babineau M., Mathiassen S.K., Kristensen M., Holst N., Kudsk P.: **Spatial Distribution of ALS Resistance Mechanisms in Neighbouring Populations of *Apera spica-venti*. *Weed Science***

[Mahmood](#) K., [Mathiassen](#) S.K., [Kristensen](#) M. and [Kudsk](#) P. (2016): Multiple Herbicide Resistance in *Lolium multiflorum* and Identification of Conserved Regulatory Elements of Herbicide Resistance Genes. *Frontiers in Plant Science*, 1160, vol. 7.