

FINAL RESULTS OF MONITORING HERBICIDE RESISTANCE IN DENMARK (2013-2015)



Miljøministeriet Miljøstyrelsen DCA report 84 SOLVEJG K. MATHIASSEN OG PER KUDSK





Summary

- Three years monitoring
- A total of 334 seed samples were collected from untreated plots
- 303 samples were tested



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Results

8% of the samples were resistant

- Resistance was most frequent in blackgrass with 30% of samples showing resistance to ACCase- and ALS-inhibitors.
- Fifteen percent of the chickweed samples were resistant to sulfonylureas.
- In ryegrass 15-20% of the samples were resistant to ALS. Surprisingly resistance was found in *L. perenne* as well as *L. multiflorum*.
- Low frequencies of resistance in poppies and mayweed.
- No resistance was found in cornflower and silky bentgrass





Seed sampling (2013-15)

Semi-randomised monitoring – seed sampling from untreated plots in all herbicide trials



Weed species: Blackgrass, ryegrass, silky bentgrass, chickweed, mayweed, cornflower, poppiesAdditional information: GPS coordinates, herbicide history, crop rotation, soil tillage







Seed sampling

2-4 weeks before harvest.

Seeds sampled in 4 untreated plots were mixed to one sample.

Weed species:

- Blackgrass (ALOMY)
- Silky bentgrass (APESV)
- Italian ryegrass (LOLMY)
- Perennial ryegrass (LOLPE)
- Poppies (PAPRH)
- Mayweed (MATIN)
- Chickweed (STEME)
- Cornflower (CENCY)



 Additional information on location (GPS), soil cultivation, crop and herbicide use for three years were recorded.





Herbicides

Black- grass	Silky bentgra ss	Lolium	Poppies	May- weed	Chick- weed	Corn- flower
Fenoxa-	Fenoxa-	Cycloxy-	Tribenu-	Tribenu-	Tribenu-	Tribenu-
prop	prop	dim	ron	ron	ron	ron
Flupyr-	l odosul-	lodosul-	Florasu-	Florasu-	Florasu-	Florasu-
sulfuron	furon	furon	lam	Iam	Iam	Iam
Prosulfo- carb	Prosulfo- carb	Prosulfo- carb				

Doses:

Broadleaves species (expected TSR):10 x ED_{90} of the susceptible population Grass weed species (TSR or NTSR): 3 x ED_{90} of the susceptible population



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Screening tray before herbicide application



3 trays of each population: Untreated, herbicide 1, herbicide 2 2 reference populations (1 susceptible, 1 resistant)



Screening trays after application Chickweed



Susceptible

Resistant





Dose response, tribenuron on chickweed





Results - monitoring

Weed species	No of samples, 2013-15	% resistant samples
Black-grass	28	30
Perennial rye-grass	16	19
Ital. rye-grass	27	15
Chickweed	59	15
Poppies	43	5
Mayweed	92	1
Cornflower	10	0
Silky bentgrass	60	0
Other species	3	0
In total	333	8



Herbicide history



Lack of information for 25% of locations





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Status of herbicide resistance DK June 2016

Weed species	Resistance mechanism	First case	No of locations	
STEME chickweed	ALS TSR	1991	28	
GALTE hemp nettles	ALS TSR	1999	1	
ALOMY Blackgrass	ACCase TSR, NTSR	2001	91	+ 2 i 2016/17
PAPRH poppies	ALS TSR	2003	10	
MATIN mayweed	ALS TSR	2010	19	
LOLMU italian rye- grass	TSR NTSR	2010	33	+ 11 i 2016/17
CHRSE corn marigold	ALS TSR	2010	2	
APESV silky bentgrass	NTSR/ (TSR)	2010	6	
CAPBP shepherd's- purse	ALS TSR	2011	1	



Background

- Pesticide tax introduced as part of the Pesticide Action Plan
- Tax based on potential health and environmental hazards
- Significant differences in prices between pesticide groups
- Less diversity in SoA increased risk of resistance
- Establish a status for resistance for future assessments





Pesticide tax in DK

Herbicide (active ingredient)	Change in costs (%)
Atlantis OD	-22
(Iodosulfuron+mesosulfuron)	
Express ST	-21
(Tribenuron)	
Topik	-18
(Clodinafop)	
Primera Super	-17
(Fenexaprop-P)	
Diflufenican	+6
Starane XL	+3
(Fluroxypyr)	
Glyphosate	+61
Oxitril CM	+90
(Ioxynil+bromoxynil)	
Boxer	+117
(Prosulfocarb)	
Stomp	+121
(Pendimethalin)	
MCPA 750	+133





Application of results

Establishment of a reference level to be used in future surveys

- if spray records show a change in herbicide use pattern
- if resistance level of a specific weed species increases

Number of samples required in future surveys depends on the size of change in resistance level that you wish to detect and the power.





Power analysis, blackgrass



To detect an increase in resistance from 30 to 40%

To detect an increase in resistance from 30 to 50%





Learnt lessons

- Sampling is time consuming
- Very difficult to get spray records from farmers
- Personal contact important (farmers, advisors, companies)



