

# Fungicide resistance in *Botrytis cinerea* in Danish strawberry fields

Bent J. Nielsen

bent.nielsen@agro.au.dk

NORBARAG, Norway 8<sup>th</sup> March 2018

AARHUS UNIVERSITET

Institut for Agroøkologi



# Fungicide resistance in *Botrytis cinerea* in strawberry fields

- Described from several countries (e.g. Germany and Norway)
- First monitoring in Denmark 2015 (Roland Weber and "Gartnerirådgivningen"; 11 fields)
- Monitoring 2017 in 18 fields (Danish Hortprotect project with "Gartnerirådgivningen";)

# Fungicides for *Botrytis* control

Resistance <sup>2)</sup>	FRAC		a.i.	Product
Low-medium	17	SBI III hydroxyanilides	fenhexamid	Teldor
	12	PP phenylpyrol	fludioxonil	Geoxe
Medium	9	AP anilino-pyrimidines	cypredinil	
			mepanipyrim	Frupica
			pyrimethanil	Scala
Medium-high	7	SDHI	boscalid	Signum
High	11	QoI strobilurin	pyraclostrobin	
			azoxystrobin	Amistar 1)

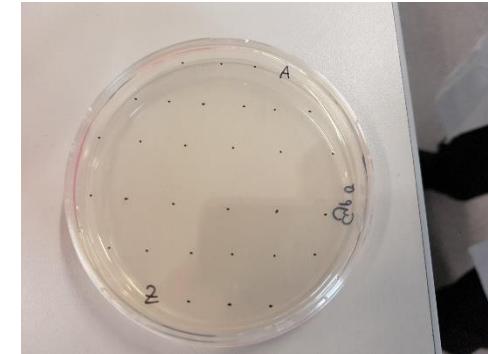
2) Risk of development of resistance, FRAC, 2017

# Collection of strawberries

- 18 fields, 12th june to 30th june 2017
- Sjælland, Fyn og Jylland
- Organic (3) and conventional production (15)
- Planting 2014-2017
- Cv: Fleurette, Sonata, Honneoye , Flair, Elsanta



Foto: Magnus Gammelgård



# Methods

FRAC		a.i.	Test product	Test doses, ppm			
17	SBI III	fenhexamid	Teldor	0	1	50	10 TWA <sup>2)</sup>
12	PP	fludioxonil	Geoxe	0	0,1	1	
9	AP	cyprodinil	Chorus 50 WG <sup>1)</sup>	0	1	10	
7	SDHI	boscalid	Cantus <sup>1)</sup>	0	1	20	
11	strobilurin	trifloxystrobin	Flint <sup>1)</sup>	0	0,1	10	

1) Ikke godkendt i Danmark 2) Vandagar uden næringsstoffer

Spore germination test on PDA  
with two discriminative doses

Classification depending on  
growth:

ss Highly sensitive

s Less sensitive

r Moderately resistant

RR Highly resistant



**Day 1**



**5 fungicides x 2 doses**



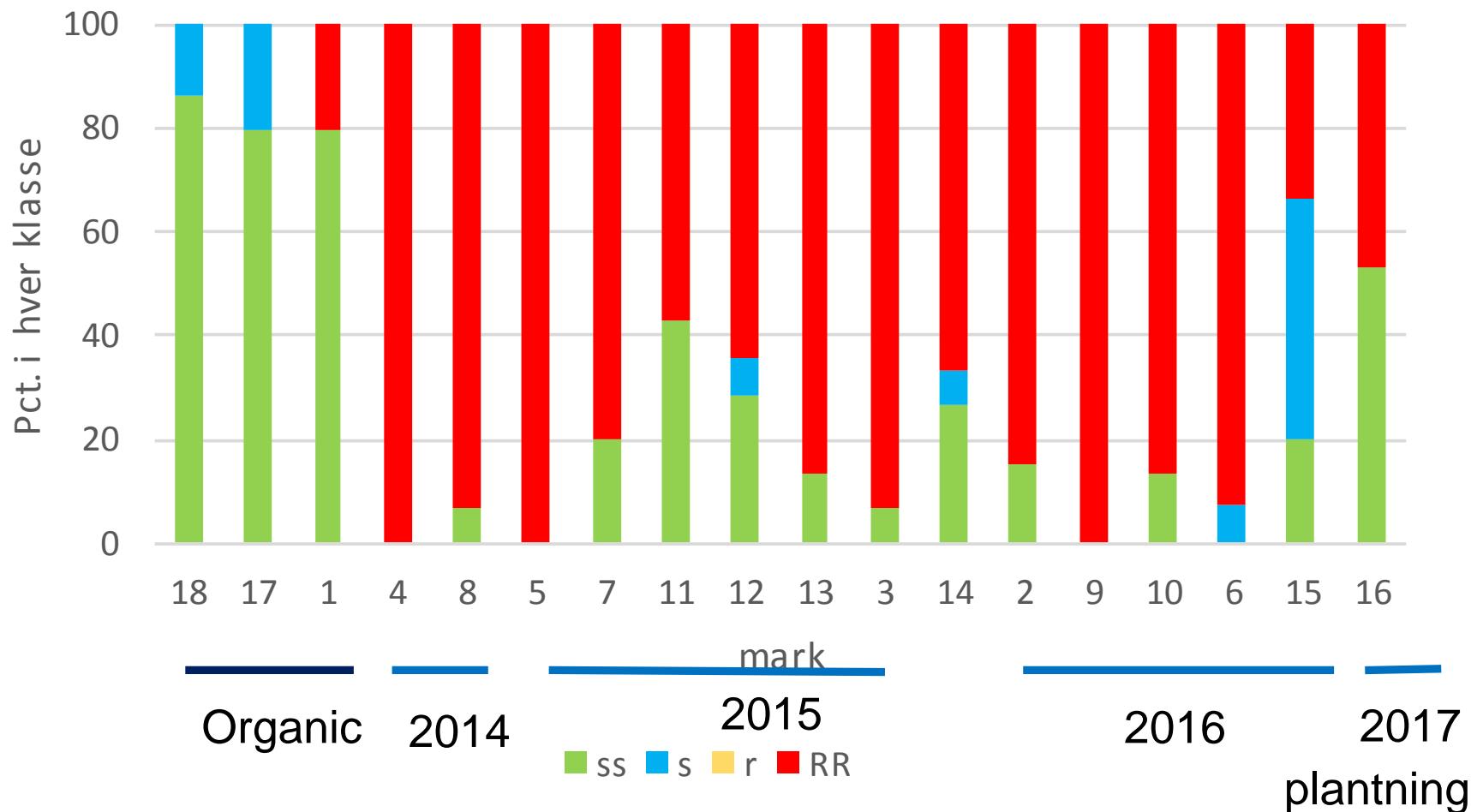
**15 isolates per field**



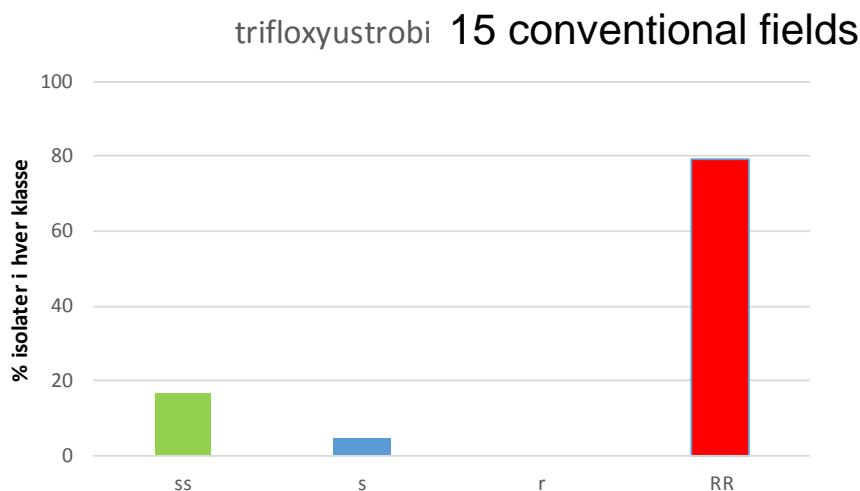
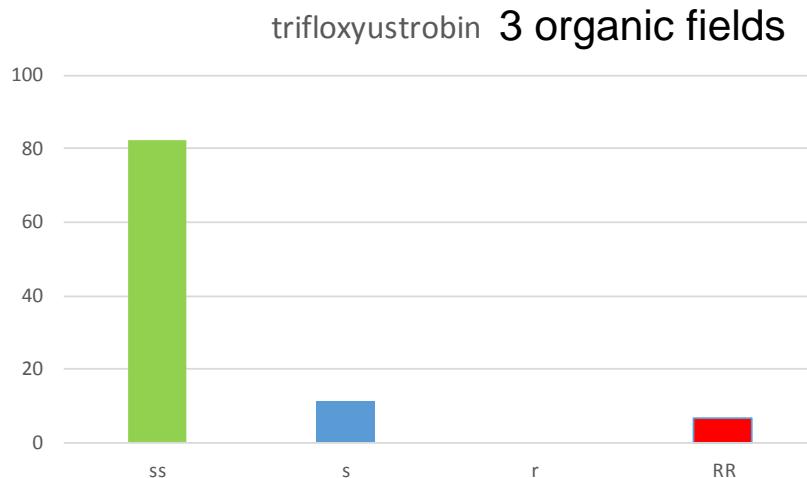
# % distribution i resistance classes

ss	Highly sensitive
s	Less sensitive
r	Moderately resistant
RR	Highly resistant

← fields arranged organic and year of first planting →



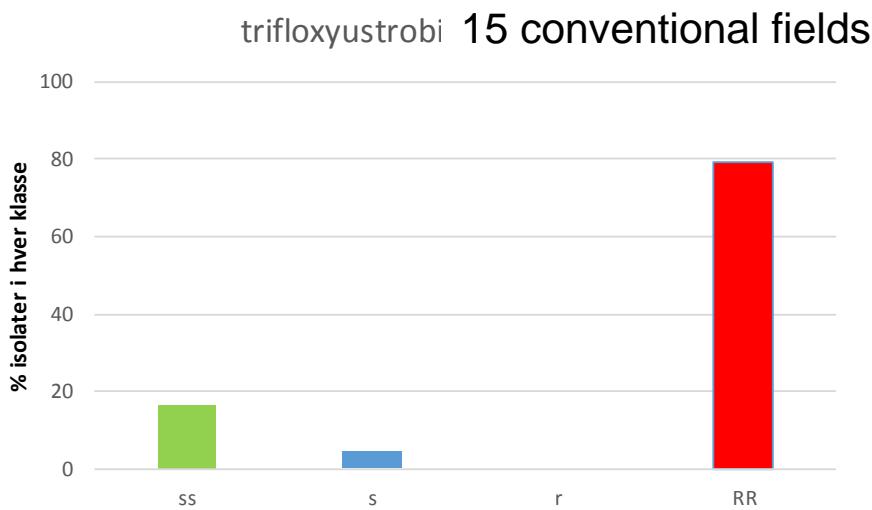
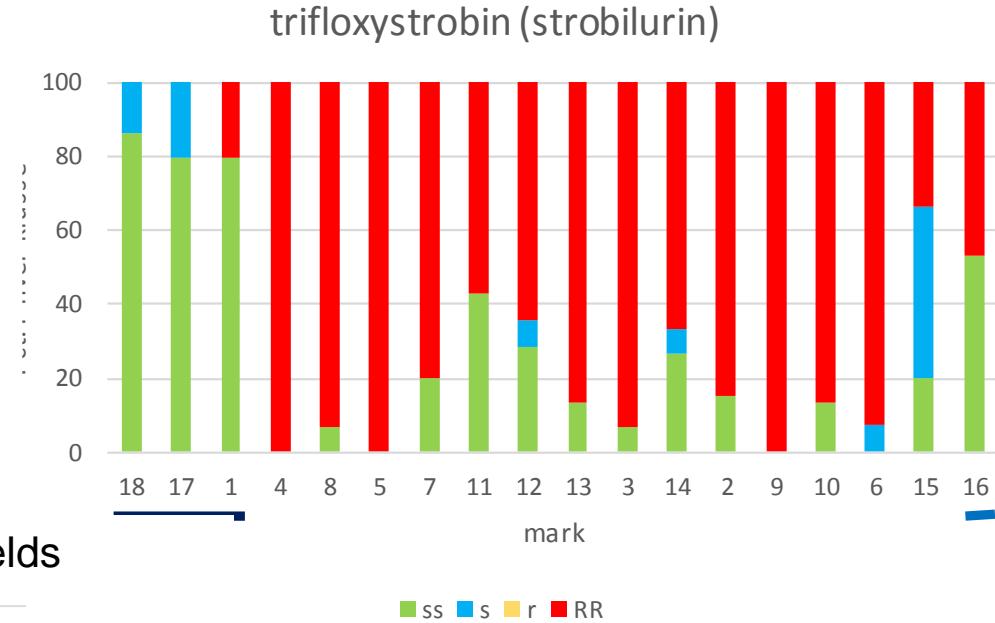
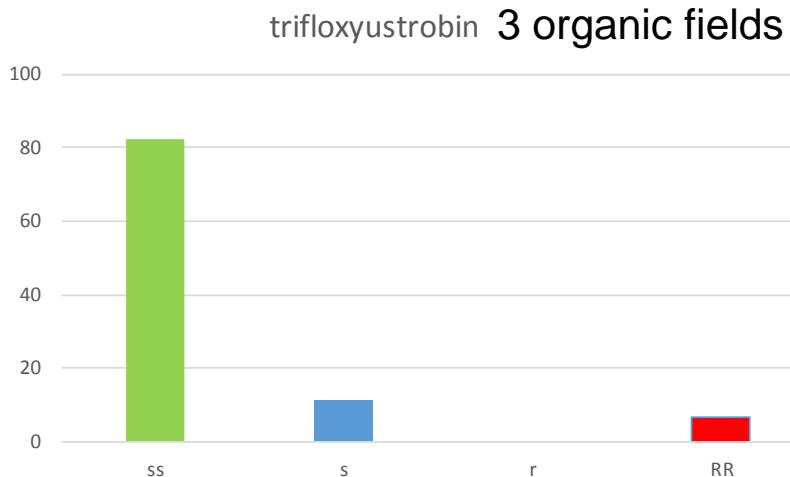
# % distribution in resistance classes. Average 3 organic fields and 15 conventional fields; 15 isolates per field.



ss	Highly sensitive
s	Less sensitive
r	Moderately resistant
RR	Highly resistant

# Results 2017: Strobilurines

Test fungicide: trifloxystrobin



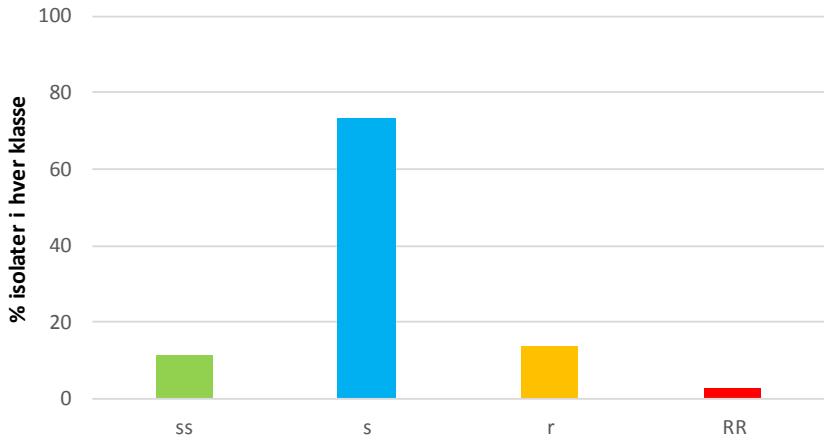
79% of isolates highly resistant

ss	Highly sensitive
s	Less sensitive
r	Moderately resistant
RR	Highly resistant

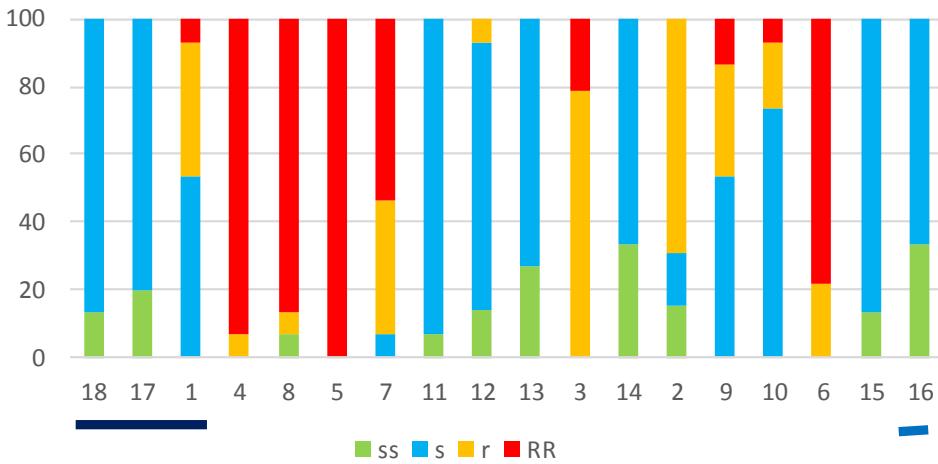
# Results 2017: SDHI

## Test fungicide: boscalid (in Signum)

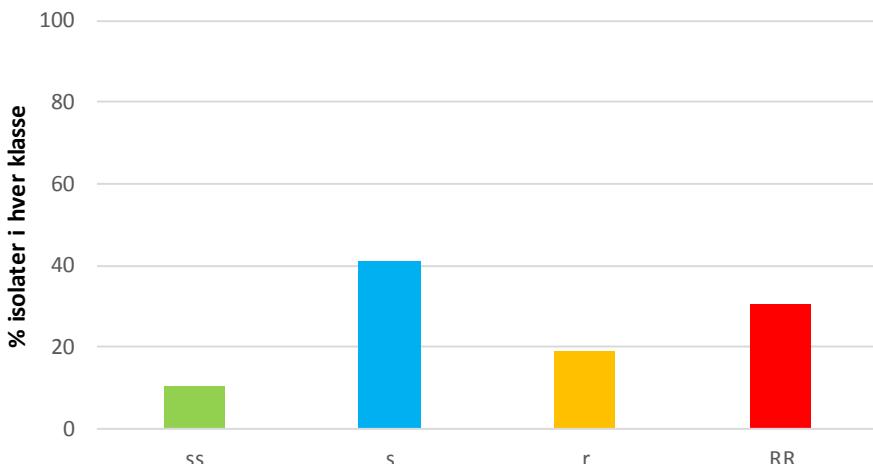
boscalid, 3 organic fields



boscalid



boscalid, 15 conventional fields



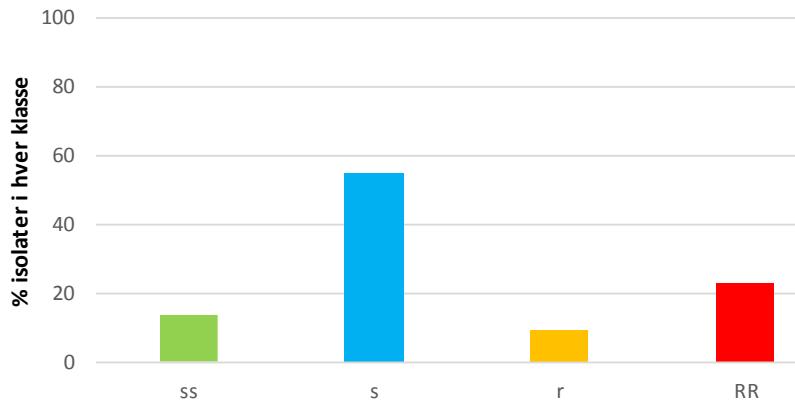
30% of isolates highly resistant  
19% with moderate resistance

ss	Highly sensitive
s	Less sensitive
r	Moderately resistant
RR	Highly resistant

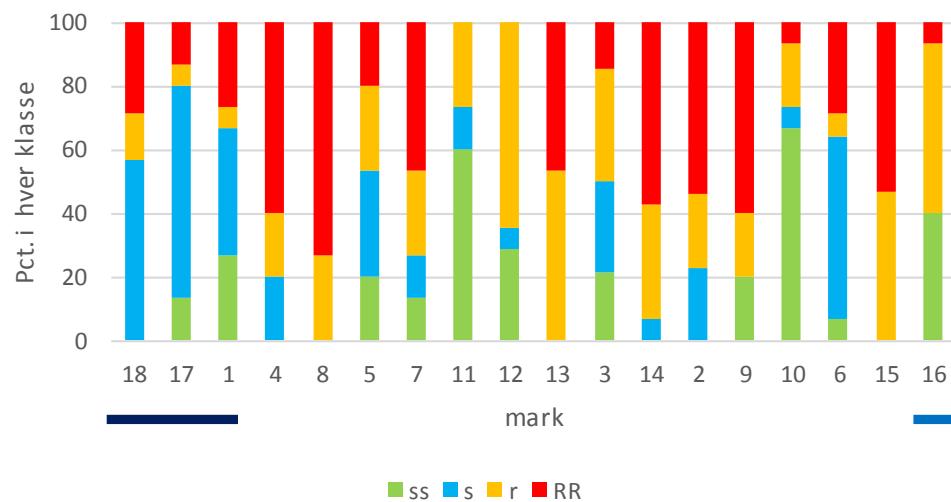
# Results 2017: Anilinopyrimidines

Test fungicide: cyprodinil (in Switch)

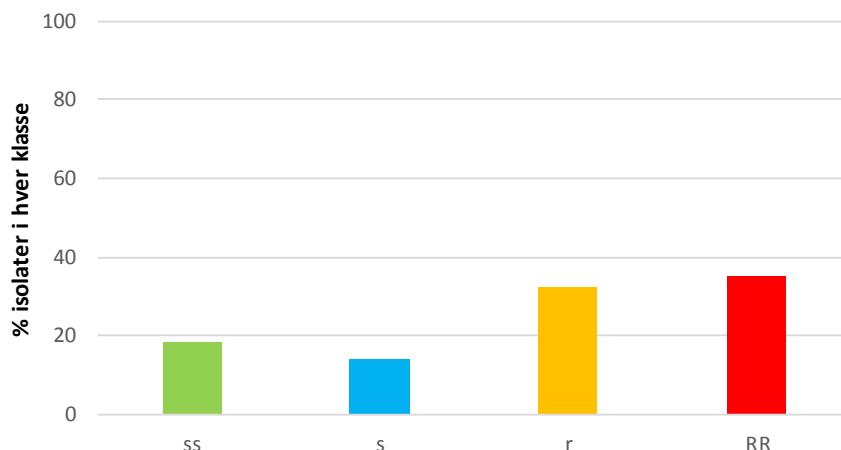
cyprodinil, 3 organic fields



cyprodinil



cypodir 15 conventional fields

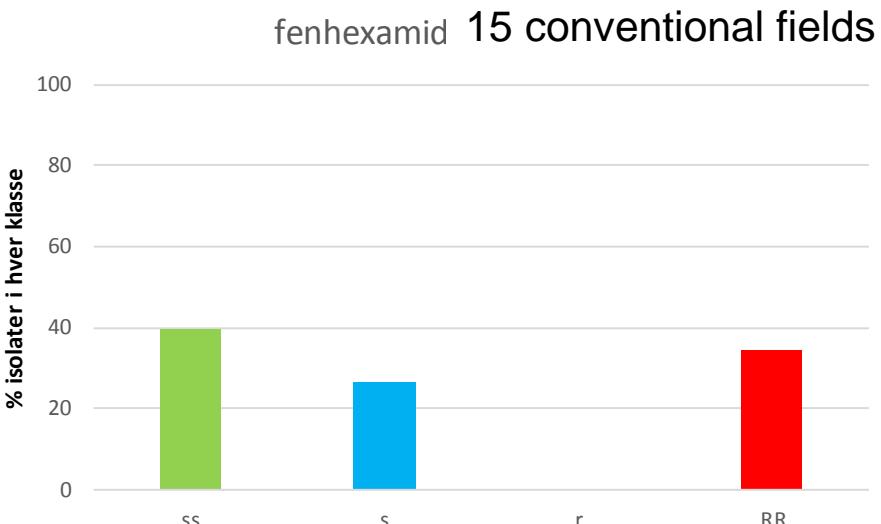
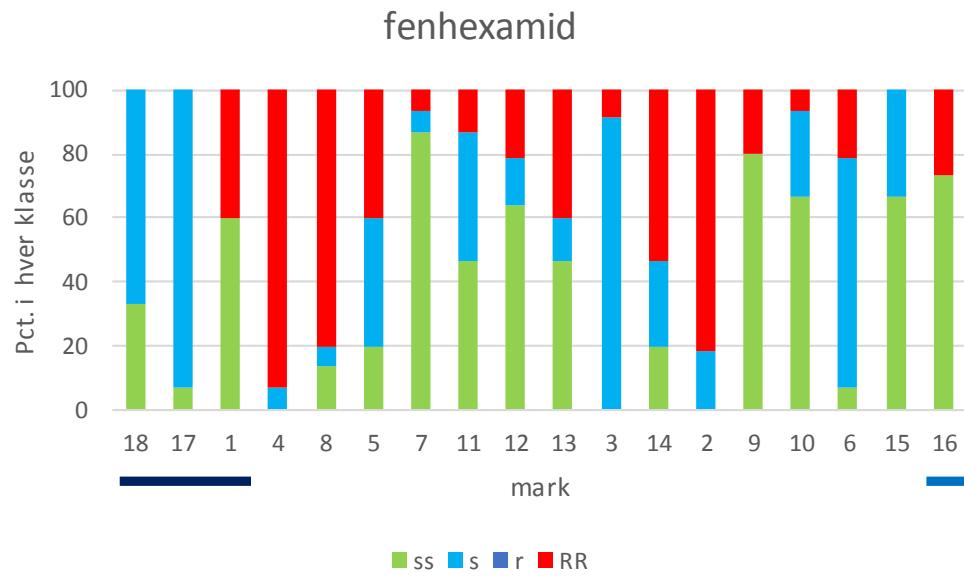
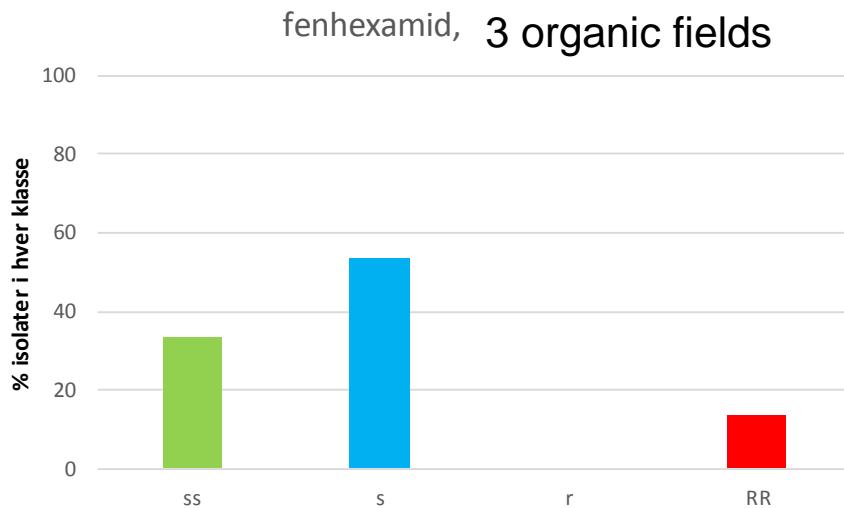


35% of isolates highly resistant  
32% with moderate resistance

ss	Highly sensitive
s	Less sensitive
r	Moderately resistant
RR	Highly resistant

# Results 2017: Hydroxyanilides

Test fungicide: fenhexamid (in Teldor)



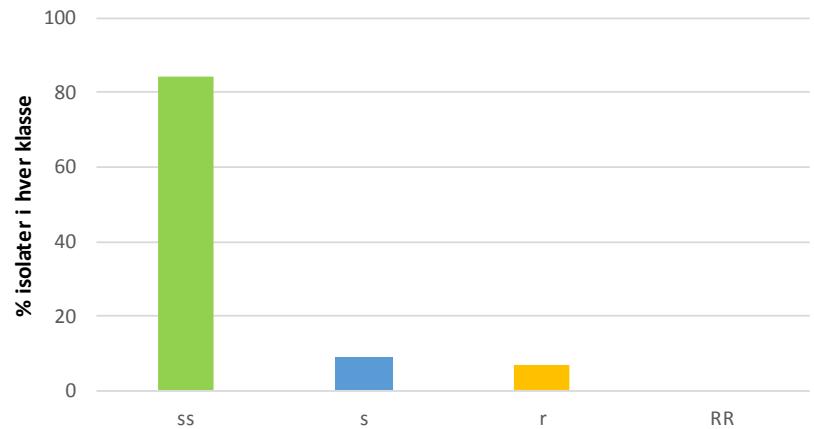
34% of isolates highly resistant

ss	Highly sensitive
s	Less sensitive
r	Moderately resistant
RR	Highly resistant

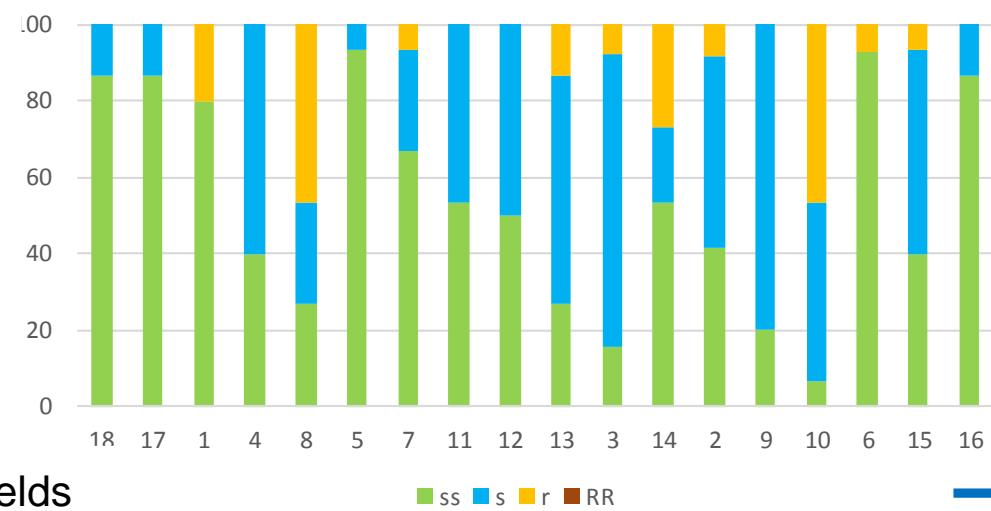
# Results 2017: Phenylpyroles

Test fungicid: fludioxonil (in Geoxe)

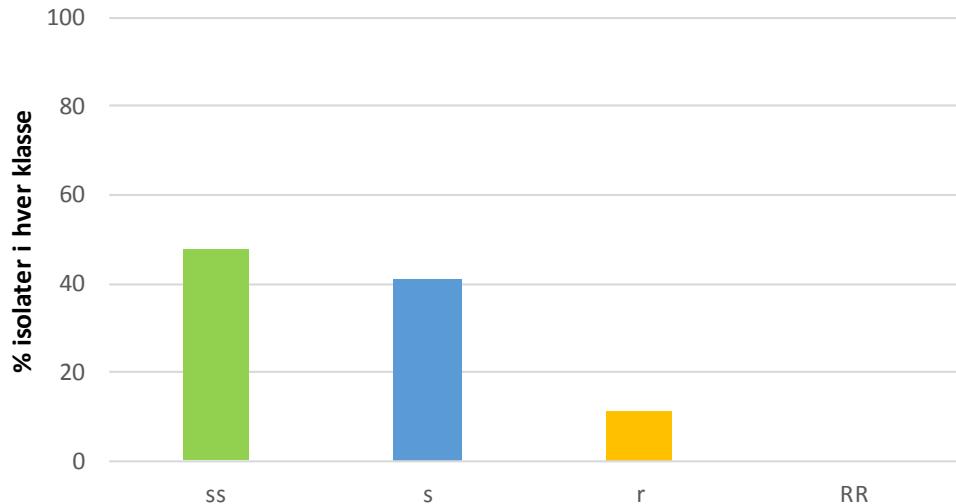
fludioxonil, 3 organic fields



fludioxonil



fludioxonil 15 conventional fields



No highly resistant isolates  
11% with moderate resistance

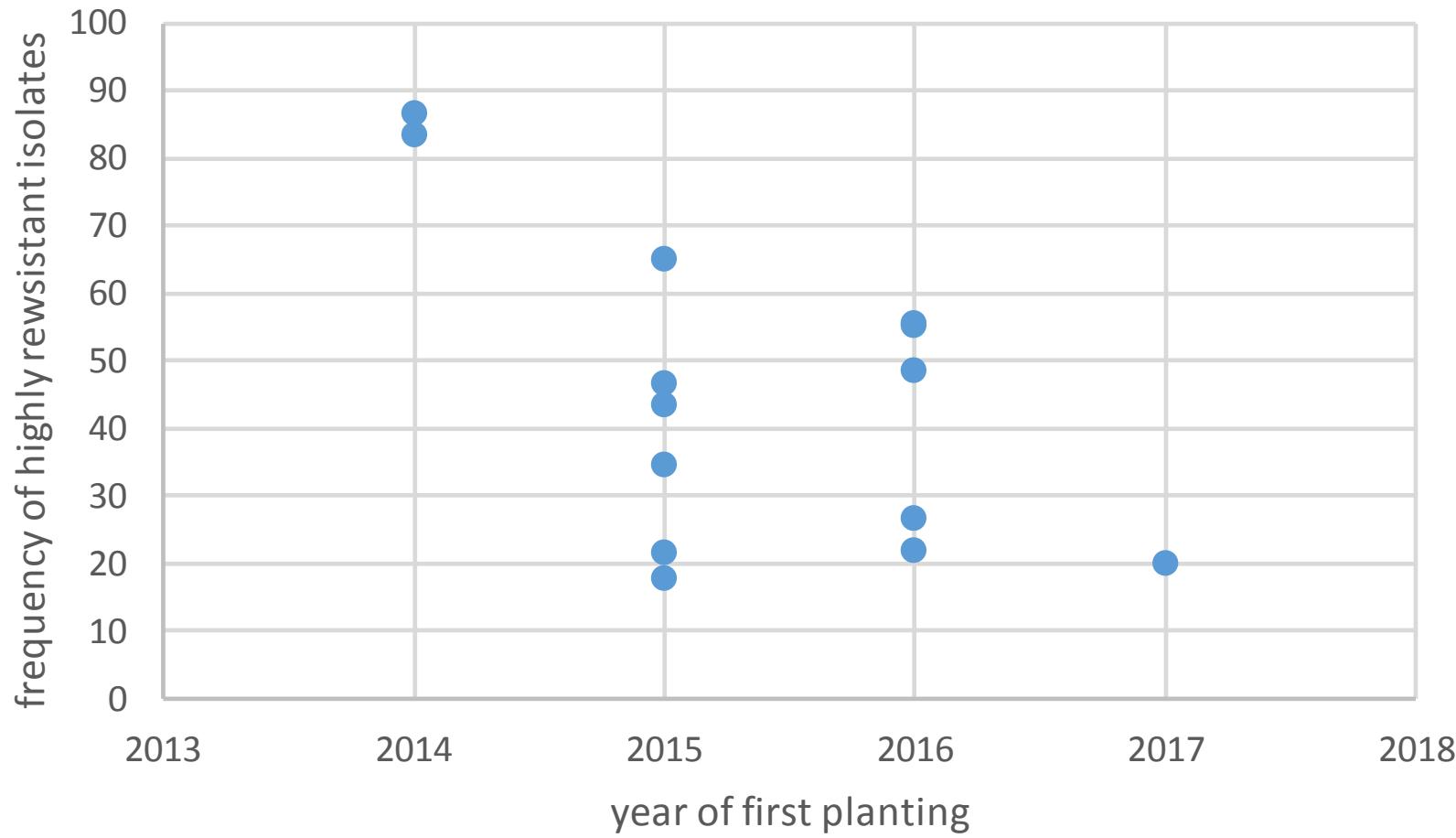
ss	Highly sensitive
s	Less sensitive
r	Moderately resistant
RR	Highly resistant

# Result 2017

Resistenstest 2017, 15 konventionelle marker				% isolater i klasserne			
FRAC		Virksomt stof	Testprodukt	ss	s	r	RR
17	SBI III	fenhexamid	Teldor	39	26	0	34
12	PP	fludioxonil	Geoxe	48	41	11	0
9	AP	cypromidinil	Chorus 50 WG <sup>1)</sup>	18	14	32	35
7	SDHI	boscalid	Cantus <sup>1)</sup>	10	41	19	30
11	strobilurin	trifloxystrobin	Flint <sup>1)</sup>	16	5	0	79

Resistenstest 2017, 3 økologiske marker				% isolater i klasserne			
FRAC		Virksomt stof	Testprodukt	ss	s	r	RR
17	SBI III	fenhexamid	Teldor	33	53	0	13
12	PP	fludioxonil	Geoxe	84	9	7	0
9	AP	cypromidinil	Chorus 50 WG <sup>1)</sup>	13	55	9	23
7	SDHI	boscalid	Cantus <sup>1)</sup>	11	73	13	2
11	strobilurin	trifloxystrobin	Flint <sup>1)</sup>	82	11	0	7

# Age of plants (first planting) and frequency of highly resistant isolates (trifloxystrobin, fenhexamid, boscalid and cyprodinil)



# Conclusions

- Botrytis from 18 fields were tested in 2017
- Large differences between sprayed (conv.) and non-sprayed fields (organic).
- Increased level of resistance in "older" fields (4 – 1 year in same field)
- Very high frequency of resistance to strobilurines
- Relative high frequency of resistance to fenhexamid, cyprodinil and boscalid
- Low high frequency of resistance to fludioxonil. No highly resistant isolates



1