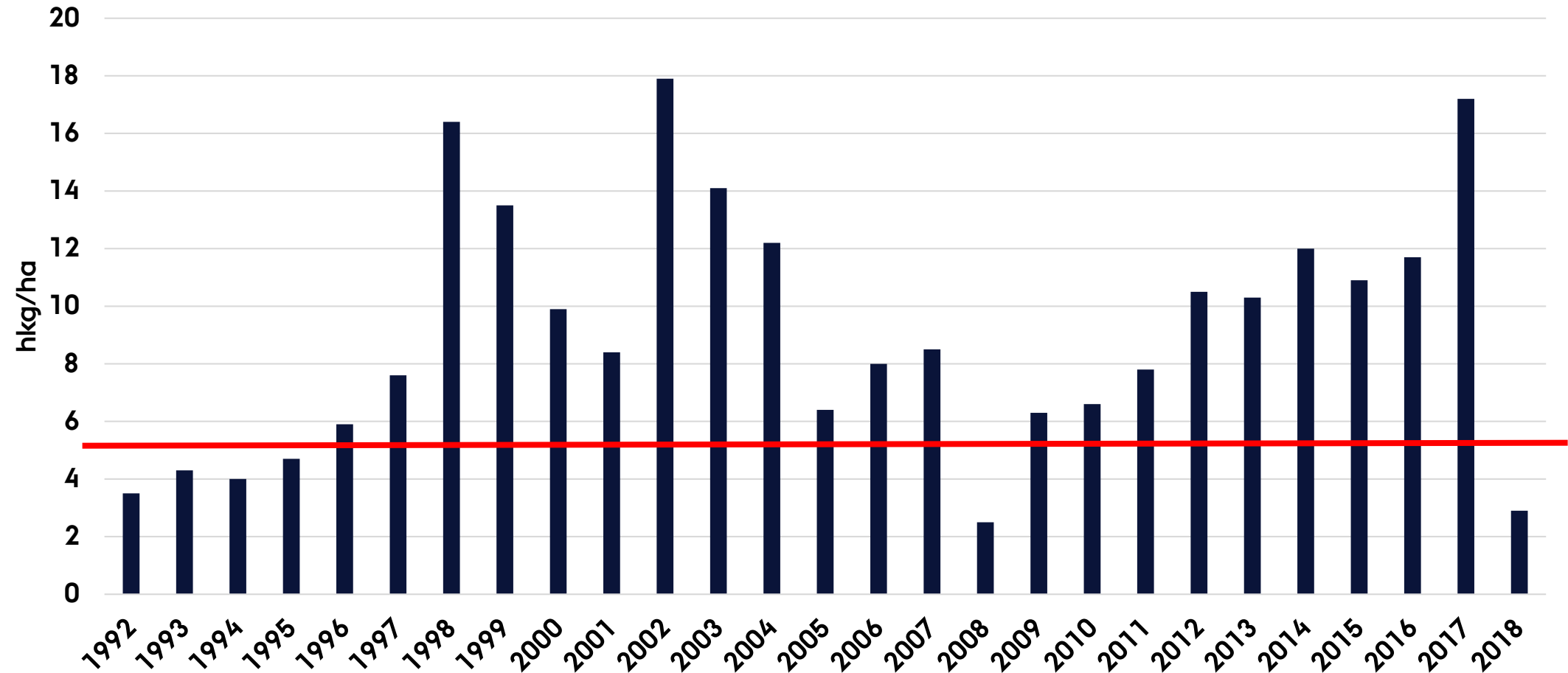


ZYMOSEPTORIA TRITICI – RESISTANCE IN SCANDINAVIA 2018

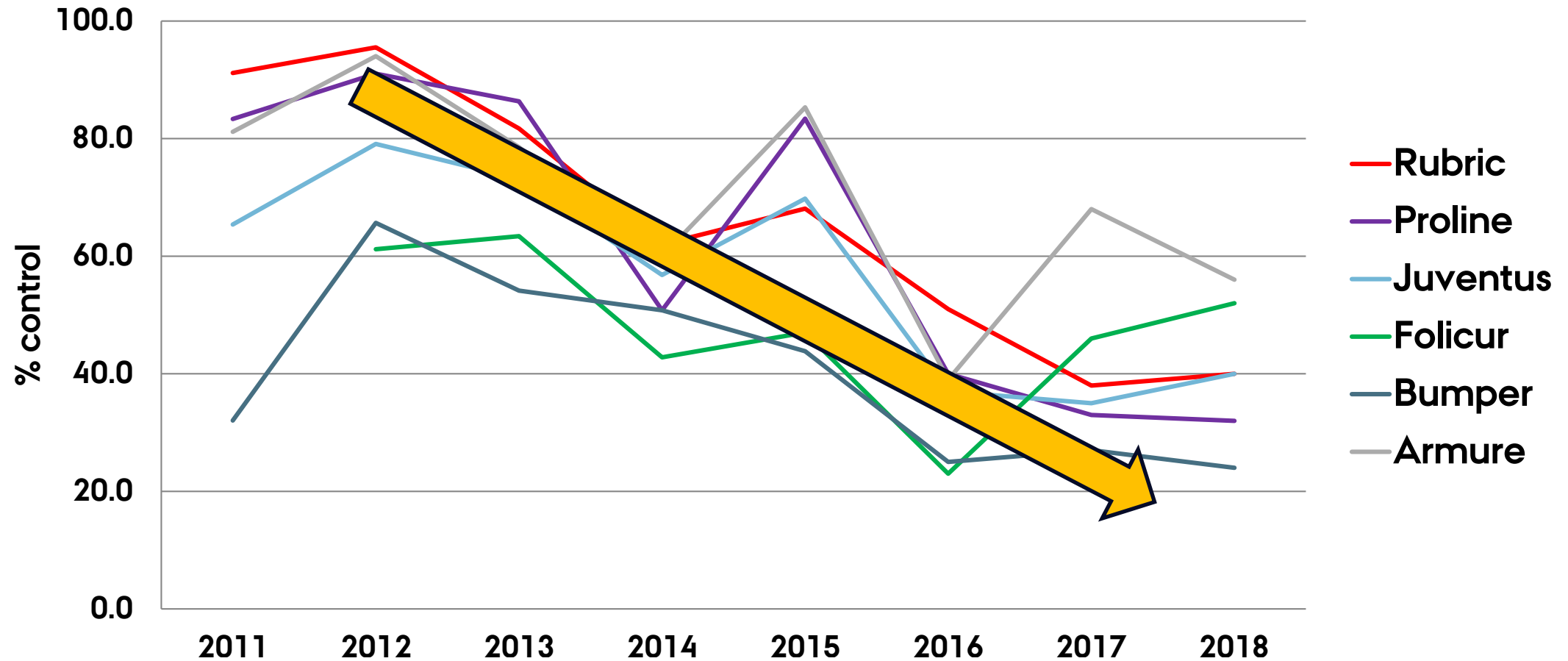
DOES IT ALWAYS PAY TO SPRAY?

Cost for
standard fungicid treatment
ca. 5-6 hkg/ha



FIELD EFFECT OF AZOLES

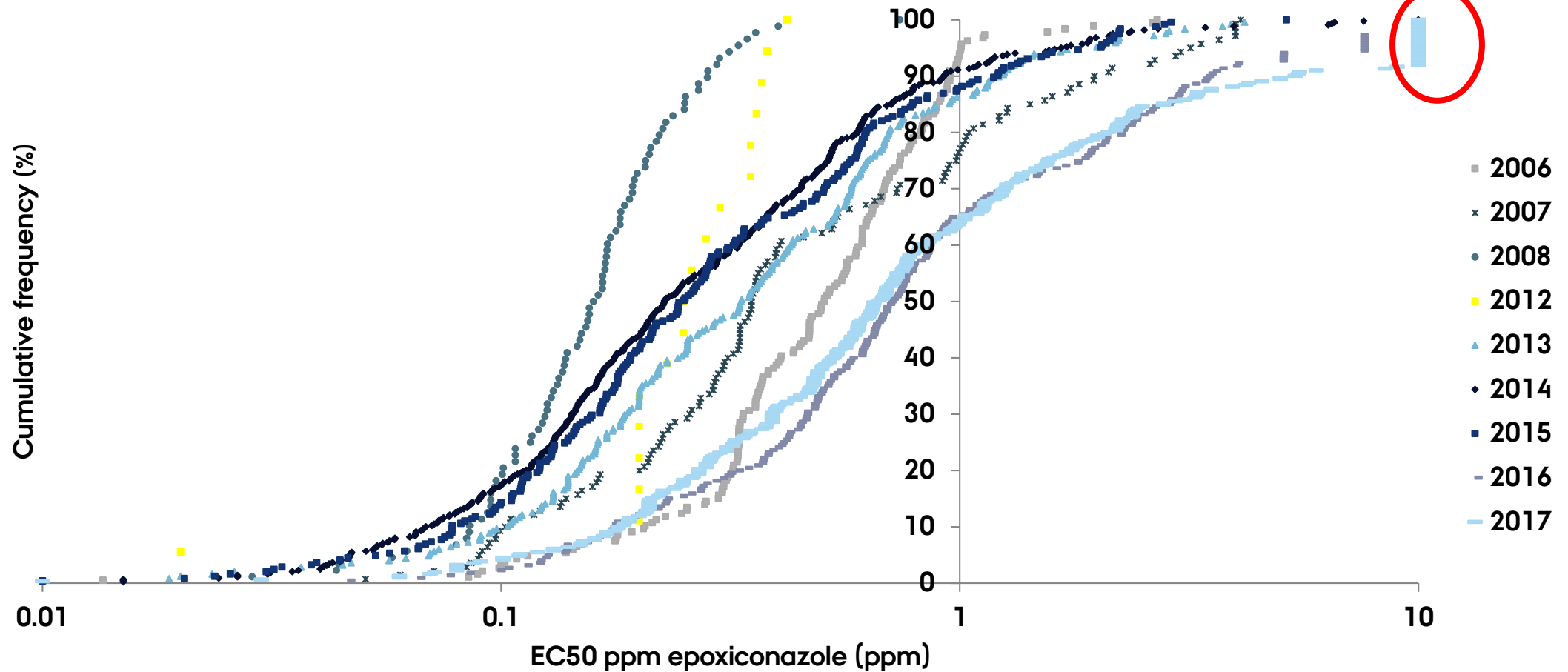
2 x 1/2 dosis at
GS. 32 & 37



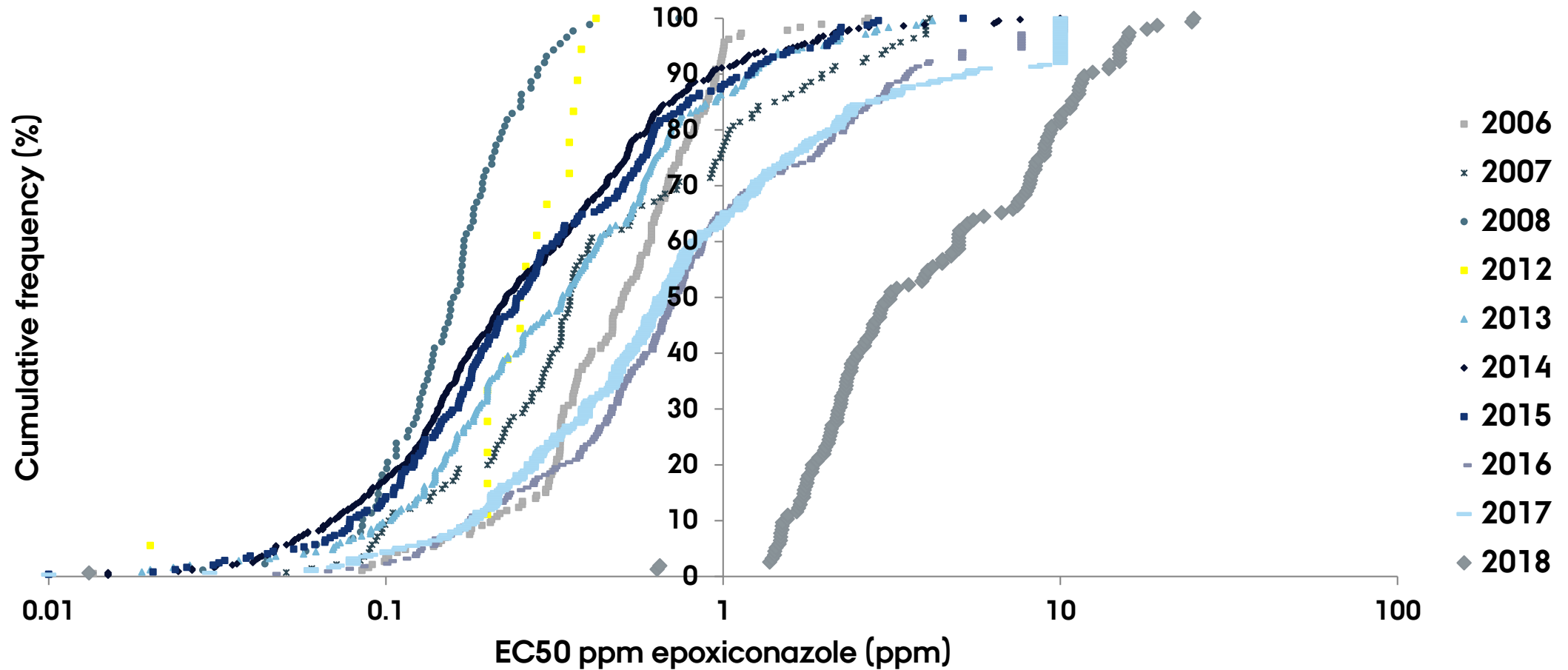
EC50 DENMARK

Year	Epoxiconazole	RF
2005	0.12 (47)	2
2006	0.57 (180)	10
2007	0.77 (140)	13
2008	0.17 (88)	3
2009	0.70 (96)	12
2010	1.40 (54)	23
2011	1.33 (85)	22
2012	0.30 (40)	15
2013	0.36 (133)	18
2014	0.50 (290)	25
2015	0.45 (262)	17
2016	1.39 (220)	66
2017	1.81 (272)	94
2018	5.82 (155)	215
Ref. IPO323	0.02 - 0.03	-

EC50 EPOXICONAZOLE DENMARK



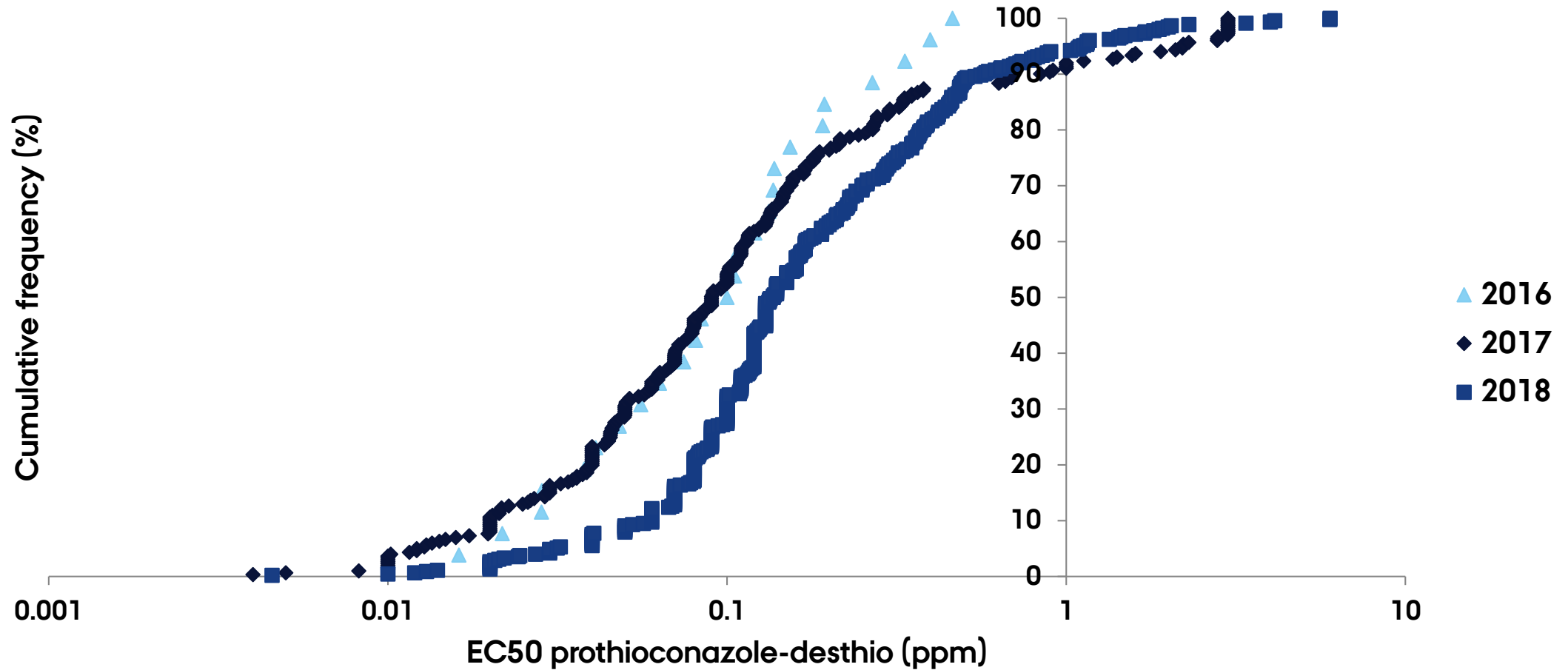
EC50 EPOXICONAZOLE DENMARK



EC50 DENMARK

Year	Epoxiconazole	RF	Prothio-desthio	RF
2005	0.12 (47)	2	-	-
2006	0.57 (180)	10	-	-
2007	0.77 (140)	13	-	-
2008	0.17 (88)	3	-	-
2009	0.70 (96)	12	-	-
2010	1.40 (54)	23	-	-
2011	1.33 (85)	22	-	-
2012	0.30 (40)	15	-	-
2013	0.36 (133)	18	-	-
2014	0.50 (290)	25	-	-
2015	0.45 (262)	17	-	-
2016	1.39 (220)	66	0.13 (26)	17
2017	1.81 (272)	94	0.32 (263)	32
2018	5.82 (155)	215	0.31 (452)	31
Ref. IPO323	0.02 - 0.03	-	0.01	-

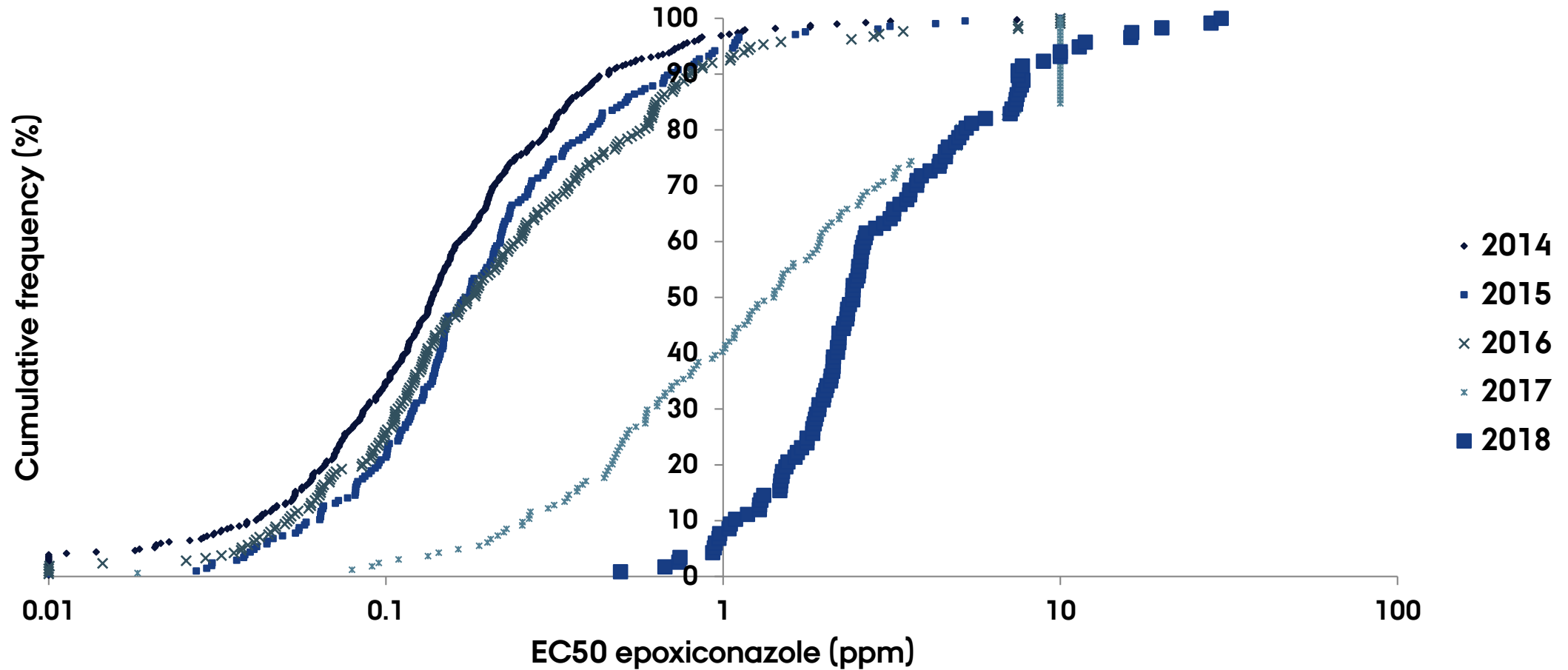
EC50 PROTHIOCONAZOLE-DESTHIO DK



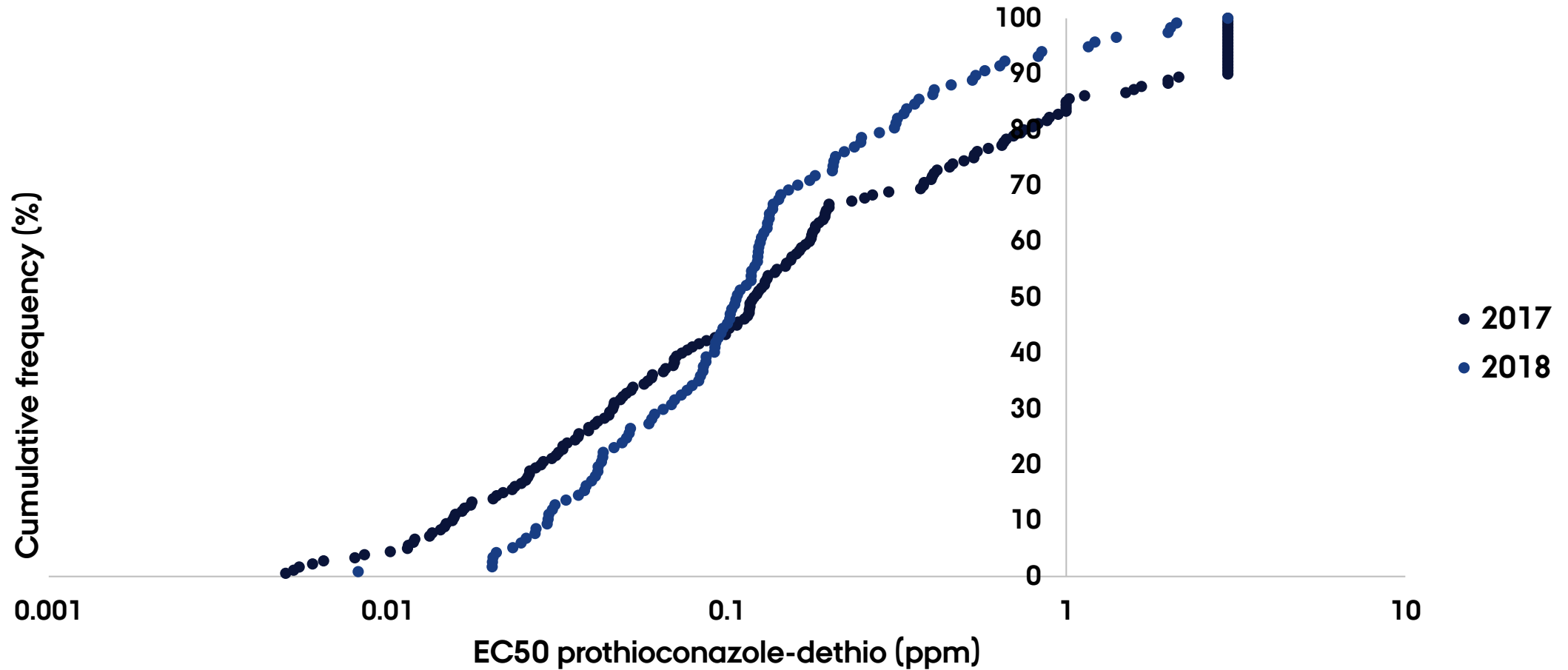
EC50 SWEDEN

Year	Epoxiconazole	RF	Prothioconazole-desthio	RF
2010	0.63 (131)	13	-	-
2011	1.00 (166)	16	-	-
2012	0.36 (211)	18	-	-
2013	0.65 (170)	33	-	-
2014	0.27 (337)	35	-	-
2015	0.33 (227)	12	-	-
2016	0.52 (212)	24	-	-
2017	3.17 (163)	170	0.58 (150)	58
2018	4.53 (127)	181	0.35 (127)	35
Ref. IPO323	0.02 - 0.03	-	0.01	-

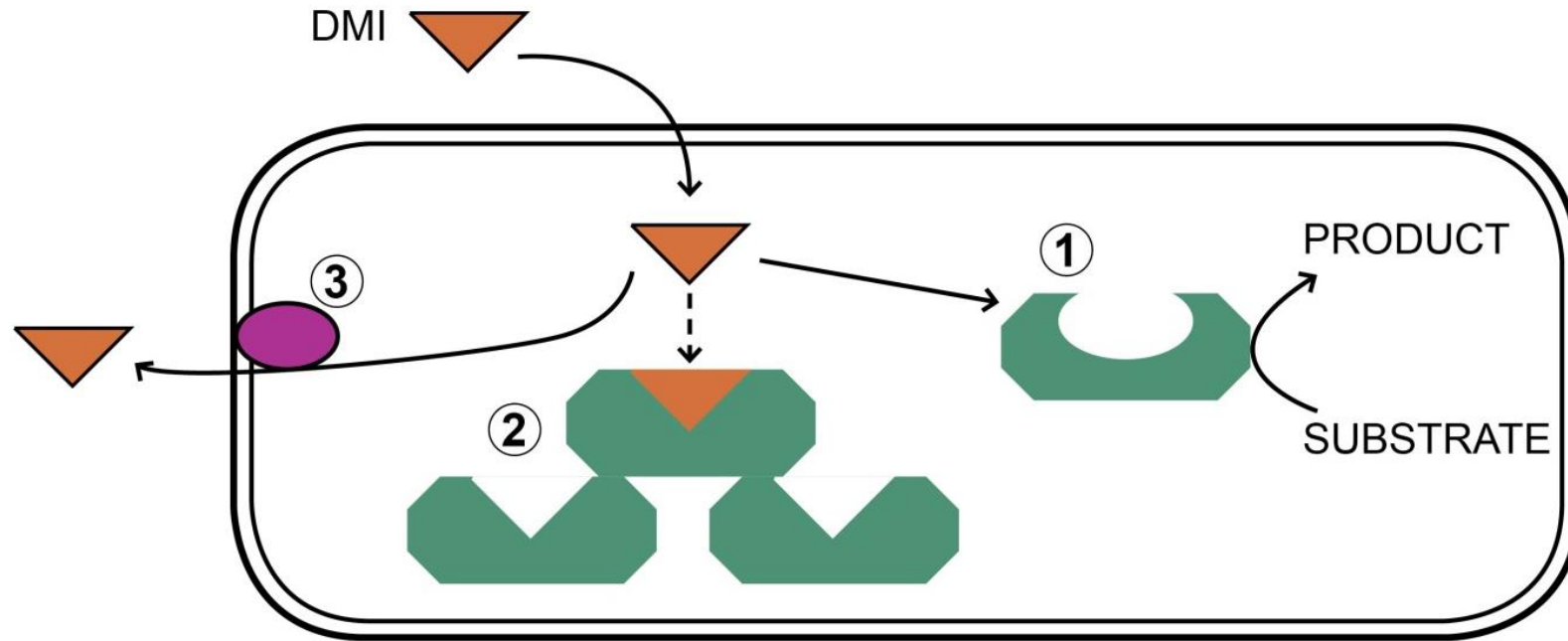
EC50 EPOXICONAZOLE SWEDEN



EC50 PROTHIOCONAZOLE-DESTHIO SWE



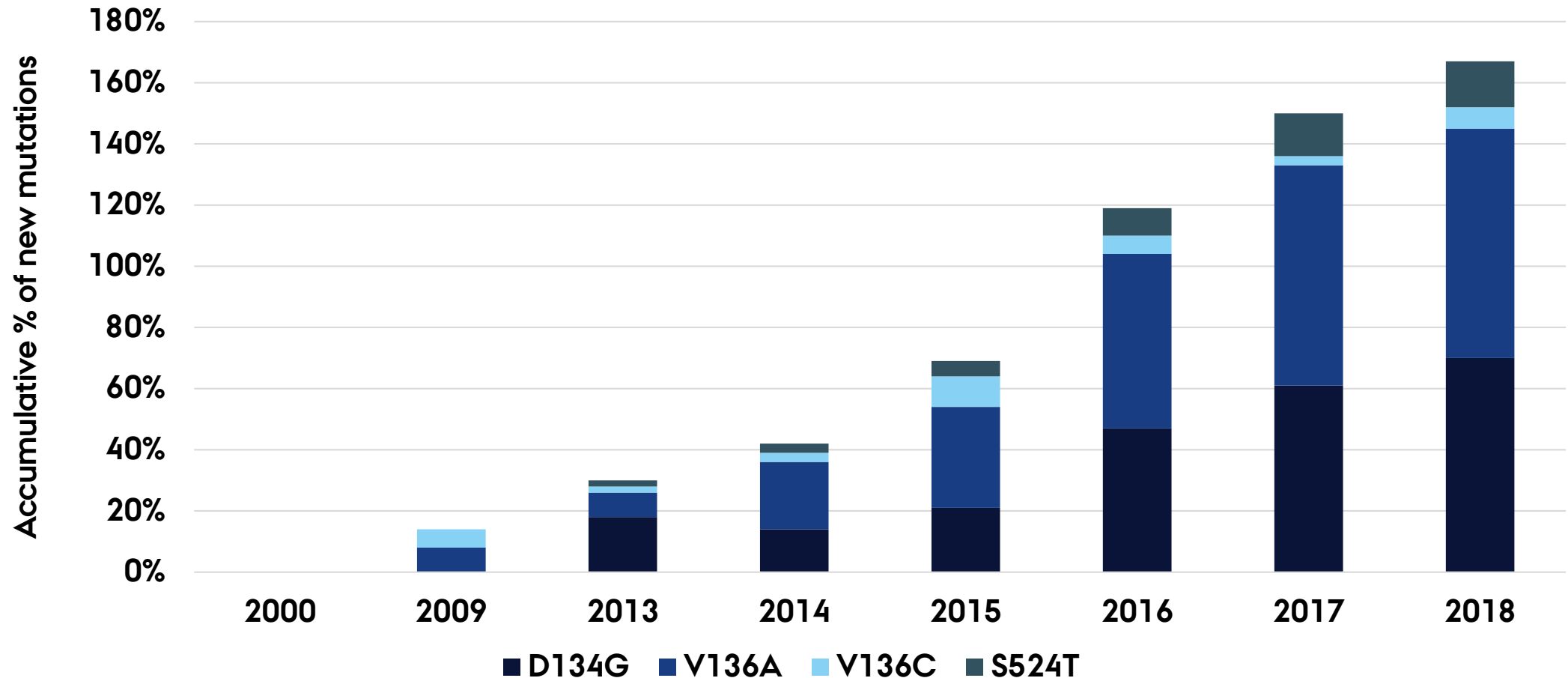
MECHANISMS OF RESISTANCE TO AZOLES



- ① Alteration of the target CYP51 enzyme
- ② Overexpression of CYP51 gene
- ③ Enhanced active efflux

DMI act on the CYP51 enzyme
→ Lanosterol | Ergosterol

DEVELOPMENT OF CYP51 MUTATIONS

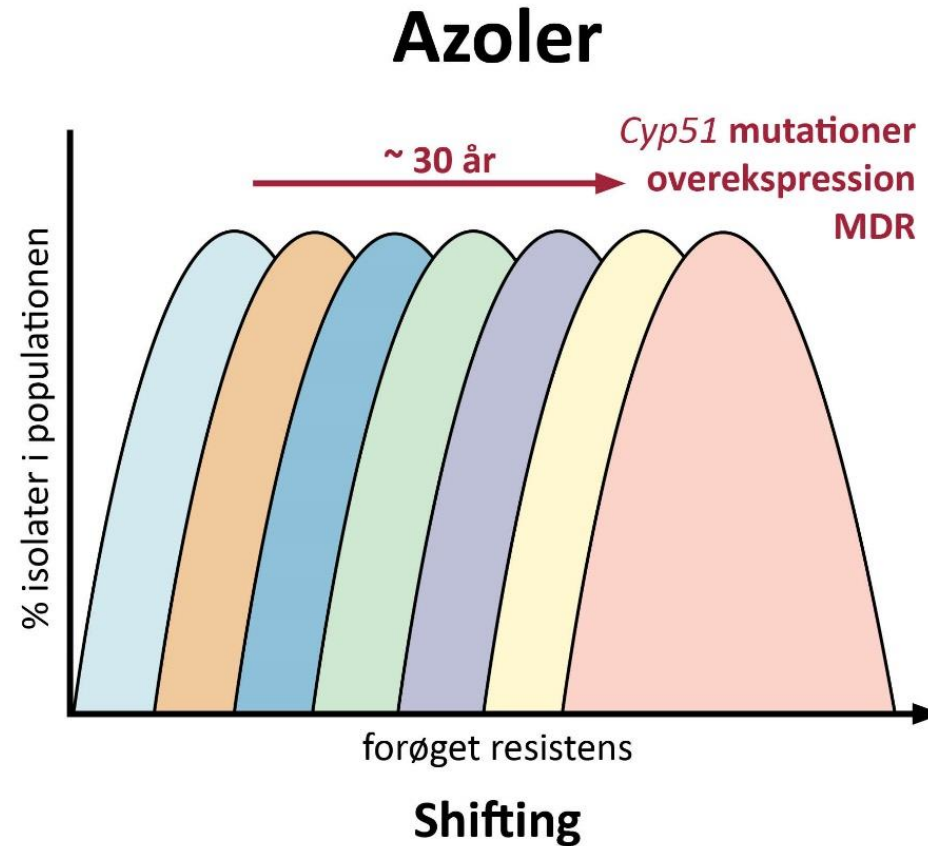


+ CYP51 overexpression (~ 15 %)
+ MDR type I (< 5 %)

CYP51 MUTATION IN NORDEN

	D134G	V136A	V136C	A379G	I381V	S524T
Denmark	60%	70%	5%	20%	95%	8%
Sweden	60%	60%	1%	30%	98%	5%
Finland	30%	30%	0%	30%	88%	0%
Estland	10%	25%	3%	24%	98%	10%
Lithuania	19%	25%	6%	26%	100%	10%
Latvia	50%	25%	0%	25%	99%	0%

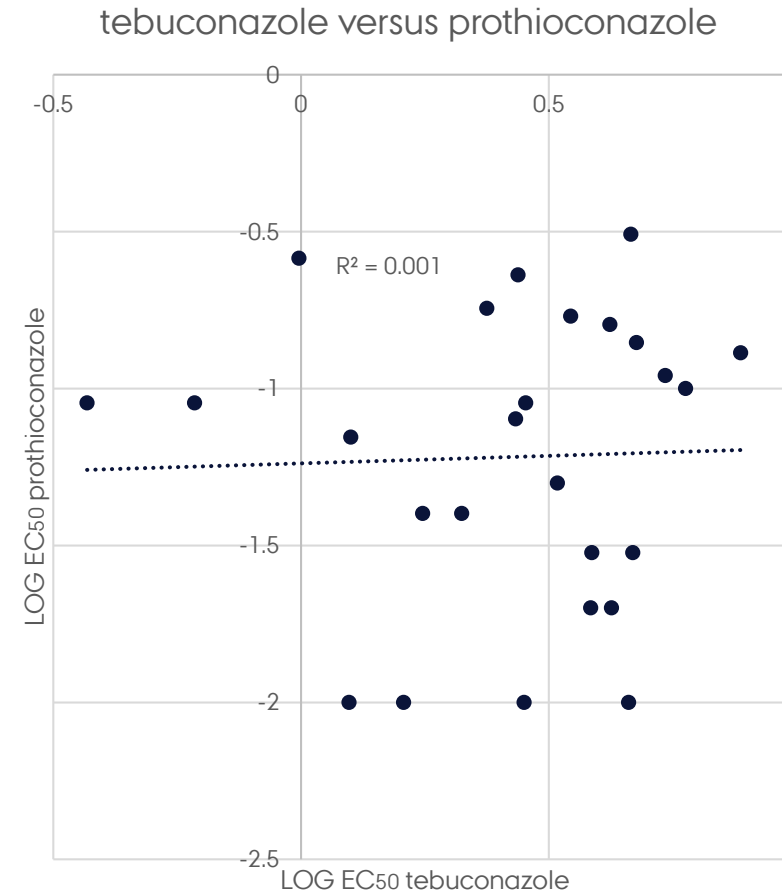
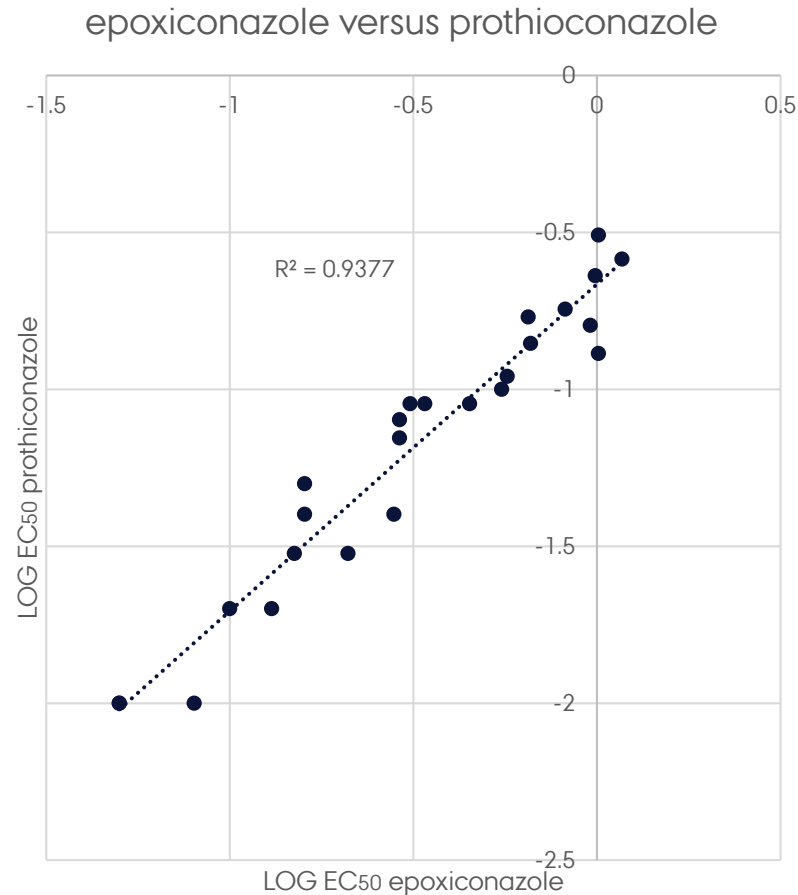
EVOLUTION OF AZOLE RESISTANCE



What comes next?

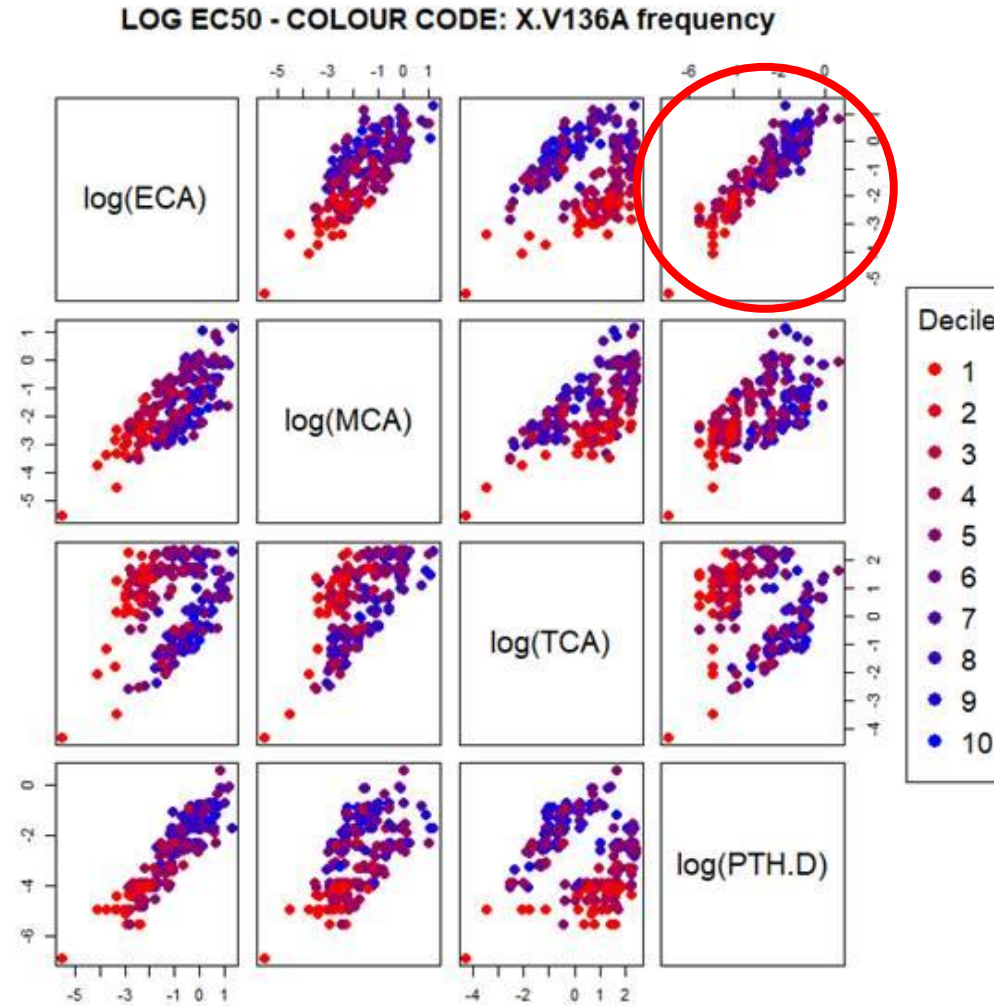
How to learn from it?

NO FULL CROSS-RESISTANCE BETWEEN AZOLES



Link between EC₅₀ values in different countries – Eurowheat – 2015-16

NO FULL CROSS-RESISTANCE BETWEEN AZOLES



SDHIS IN THE NORTH ZONE



	Denmark	Sweden	Finland	Estonia/Latvia/Lithuania
SDHI	boscalid fluopyram	benzovindiflupyr bixafen fluopyram fluxapyroxad	benzovindiflupyr bixafen fluopyram fluxapyroxad	benzovindiflupyr bixafen fluopyram fluxapyroxad penthiopyrad

1. generation vs. 2. generation SDHIs

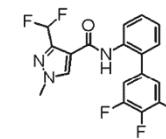
Pyridine carboamides, pyridinyl-ethyl benzoamides, pyrazole-4-carboxamides

New actives launched since 2017 in the entire North Zone but Denmark

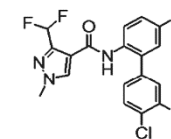
How often should we use the SDHIs?

What is the resistance status?

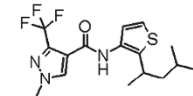
Does seed treatment have any effect?



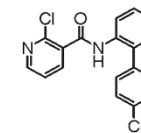
Fluxapyroxad (1)



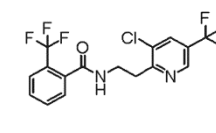
Bixafen (2)



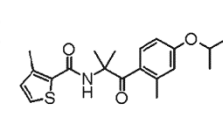
Penthiopyrad (3)



Boscalid (4)

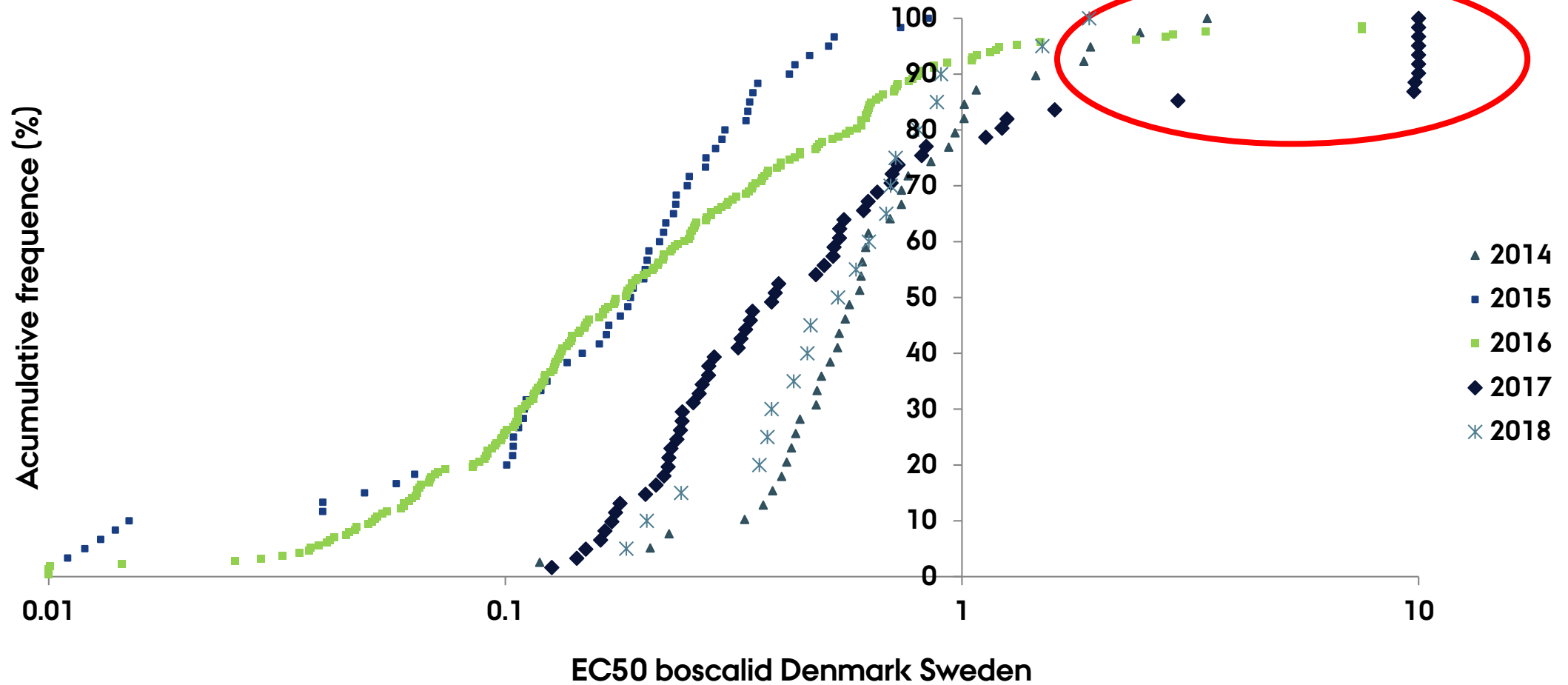


Fluopyram (5)

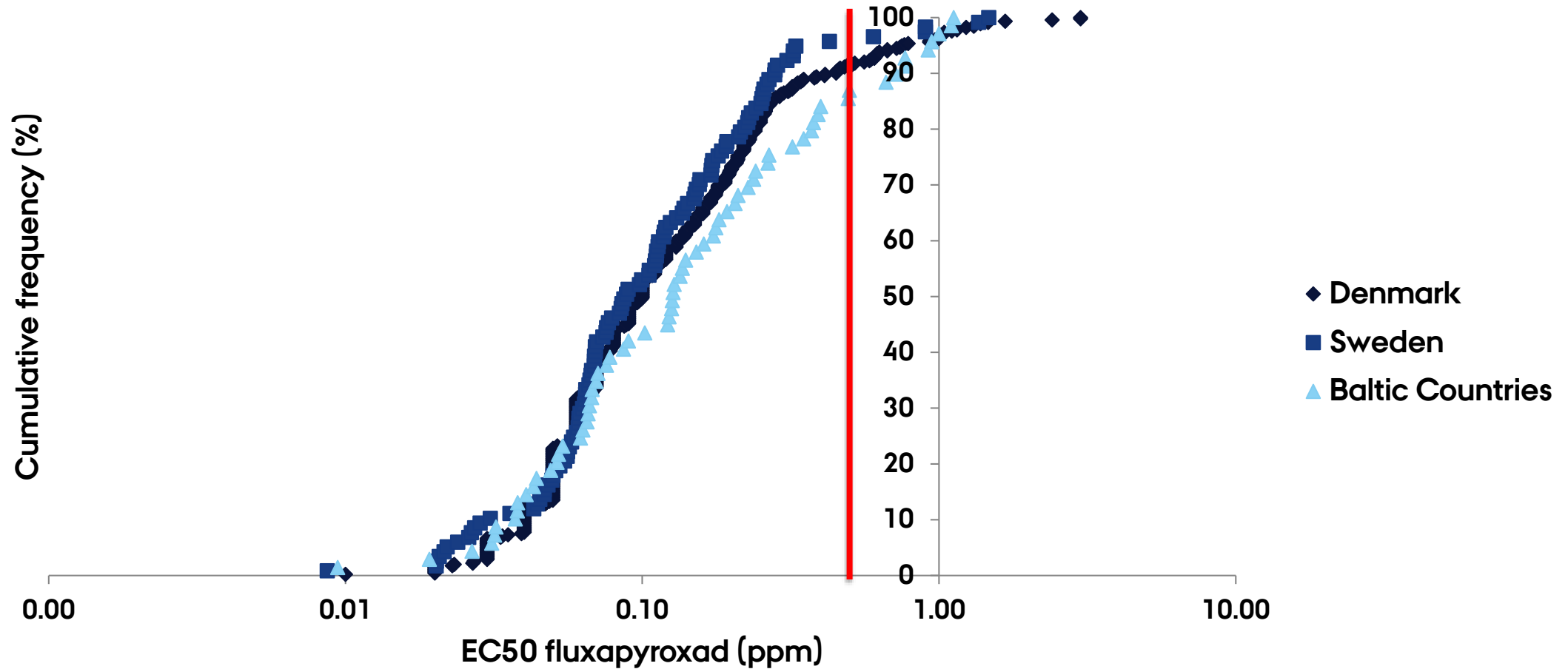


Isfetamid (6)

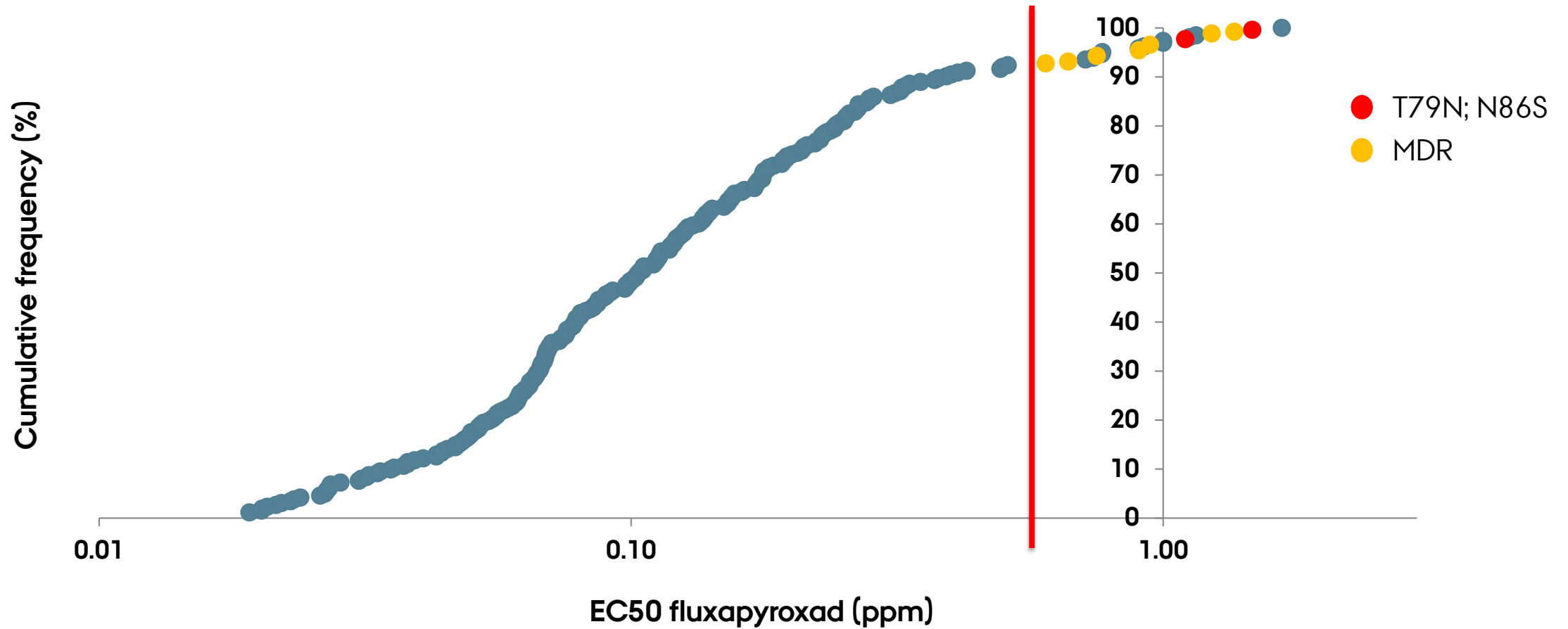
EC50 BOSCALID DENMARK



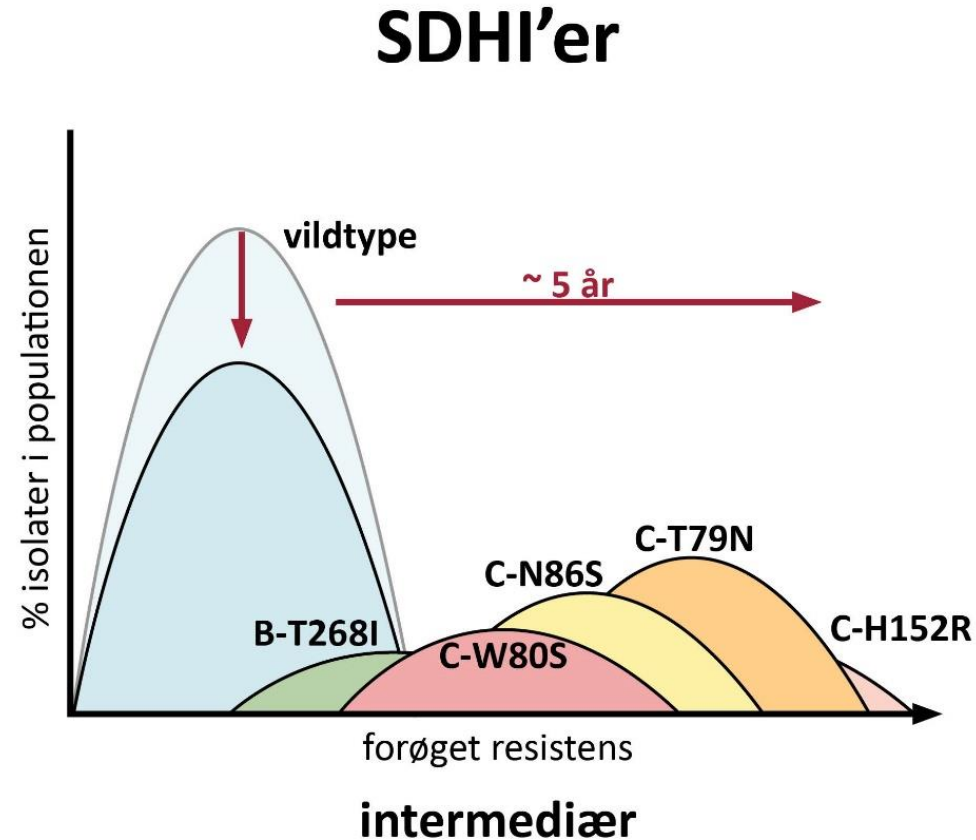
EC50 FLUXAPYROXAD



EC50 FLUXAPYROXAD

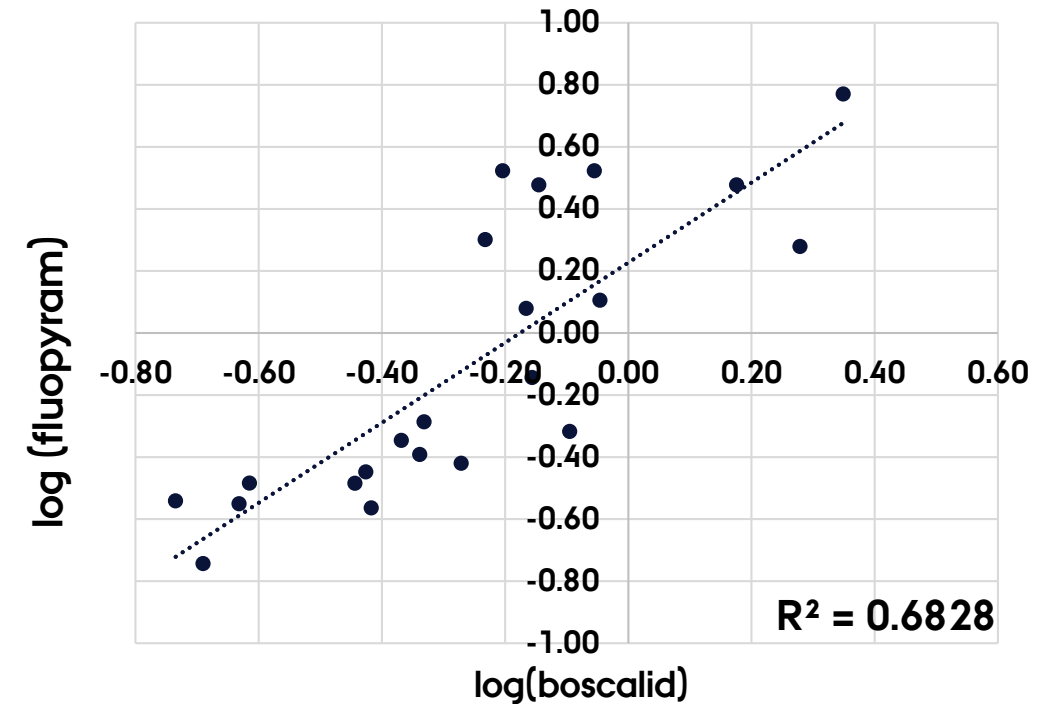
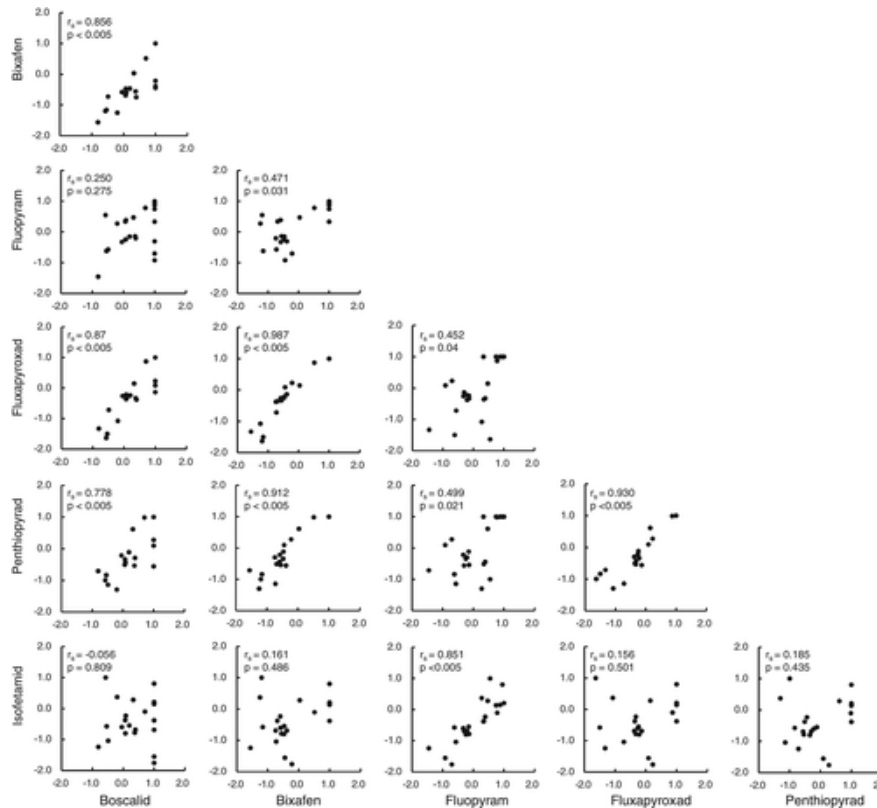


EVOLUTION OF SDHI RESISTANCE



IS THERE CROSS-RESISTANCE AMONG SDHI?

All SDHI fungicides (benzovindiflupyr, bixafen, boscalid, fluopyram, fluxapyroxad, penthiopyrad) belong to the same cross-resistance group.



FIELD FAILURE OF SDHI

—
Untreated



2 x SDHI



First cases of field failure of SDHI-treated plots are observed in Ireland and GB

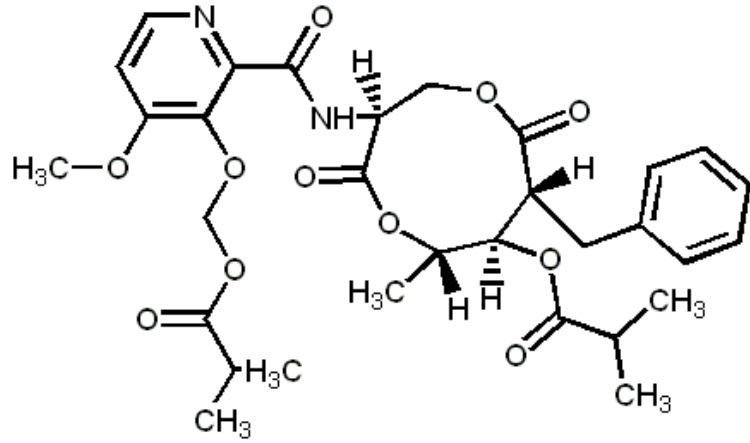
EXAMPLES FOR STB CONTROL IN DK

Vækststadie 32-33	Vækststadie 37- 39	Vækststadie 59-65
	40-50 procent dosis	30-50 procent dosis
0,35 Prosaro	0,5 Propulse + 0,25 Folicur Xpert/Prosaro	0,4 Armure
0,3 Orius	0,8 Viverda	0,4 Proline Xpert /0,4 Prosaro
0,3 Orius	0,75 Propulse	0,4 Armure
0,35 Prosaro	0,75 Viverda	0,3 Prosaro/0,3 Proline Xpert
1,0 Folpan	0,5 Propulse	0,3 Armure
	0,5 Bell + 0,25 Folicur Xpert/Prosaro	0,35 Prosaro
	0,6 - 0,75 Viverda	0,3 Proline Xpert /0,3 Prosaro
	0,6 – 0,75 Viverda	
	0,5 – 0,75 Propulse	

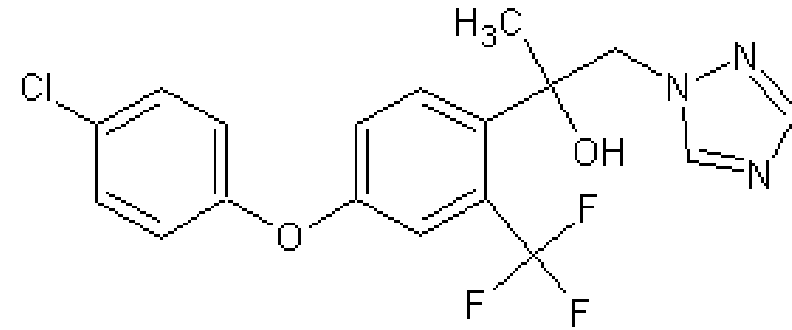
Septoria disease pressure



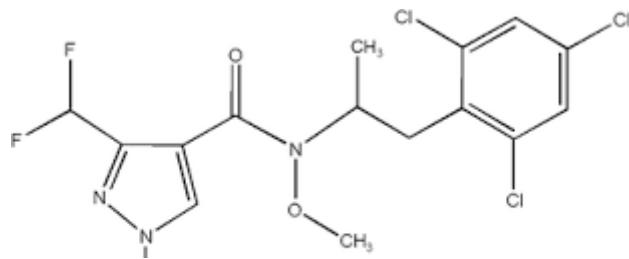
NEW MOLECULES ON THEIR WAY...



Inatreq™ – fenpicoxamid - Corteva



Revysol® - mefentrifluconazole - BASF



Adepidyn™- pydiflumetofen - Syngenta



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