

Assessment of resistance factors to second generation anticoagulant rodenticides by BCR-tests in the homozygous anticoagulant resistant strains Y139C and Y139F of the Norway rat

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The Rodenticide Resistance Action Committee (RRAC) is a working group within the framework of CropLife International.

Participating companies are:

BASF

Bayer CropScience AG

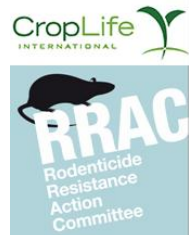
LiphaTech S. A.

Pelgar

Rentokil Initial

Syngenta

ZAPI



RRAC - Objectives

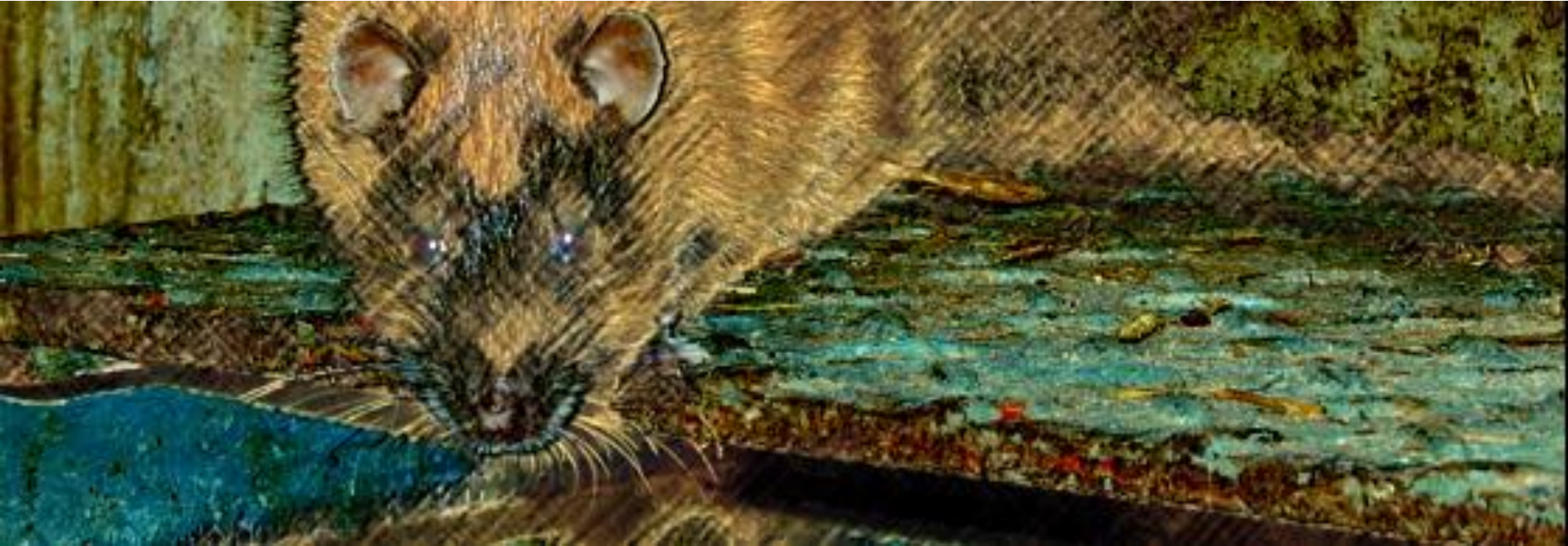
The objective of RRAC is to advise international agencies, government bodies, regulatory bodies and rodenticide users on technical matters relating to rodenticide resistance. It carries out this objective by:

- **Producing information on resistance and the safe and effective use of rodenticide products;**
- **Organizing seminars whereby industry members can meet and exchange ideas with experts from universities, governments and international organizations;**
- **Developing and advocating the use of effective resistance management strategies;**
- **Funding and steering research projects on rodenticide resistance.**

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RRAC – Development + use of BCR resistance test method:



Intro: Research History

RRAC – Development + use of BCR resistance test method:

Field trials in combination with „old“ BCR-tests revealed that tests for different compounds could not be compared.

Therefore

A new BCR test method was developed by Colin Prescott, Univ. Reading/RRAC.

- Introduced 2005 at 5th EVPMC, Budapest
- Published 2007 (Prescott C.V., Buckle A.P., Hussain I., Endepols S. (2007): A standardised BCR-resistance test for all anticoagulant rodenticides. *Int. J. Pest Mgt.* 53 (4), 265-272.)

RRAC – new BCR resistance test applied:

5th EVPMC, Budapest 2005:

- Comparison of BCR-based Resistance-Factors for bromadiolone of the **Y139C** strain (Westphalia) and L120Q (Hampshire).
 - higher RF in Westphalia compared to Hampshire.
- BCR-tests with bromadiolone in relation to practical treatment in Wales (Y139S).
 - lower RF in Wales, with practical control possible.

RRAC – new BCR resistance test applied:

7th EVPMC, Lyon 2009:

Trials with bromadiolone in Westphalia, **Y139C** strain :
BCR-tests and subsequent treatments on livestock farms.

#	Incidence of resistance (2.5 x ED ₅₀)	Bait kg	Survivors
1	34%	10	29%
2	100%	43	107%
3	100%	26	80%
4	37 - 57%	38	31%

Different to outcome of field trials in Wales with Y139S !

RRAC – new BCR resistance test applied:

7th EVPMC, Lyon 2009:

Trials with difenacoum in Westphalia, Y139C strain :
BCR-tests and subsequent treatments on livestock farms.

#	Incidence of resistance (2.5 x ED ₅₀)	Bait kg	Survivors
1	25 - 42%	28	13%
2	14 - 43%	7	40%

BUT: BCR test-results and field trial result were not in line with genotyping!

RRAC – new study



The New Study

New Study: Aim and Method

AIM:

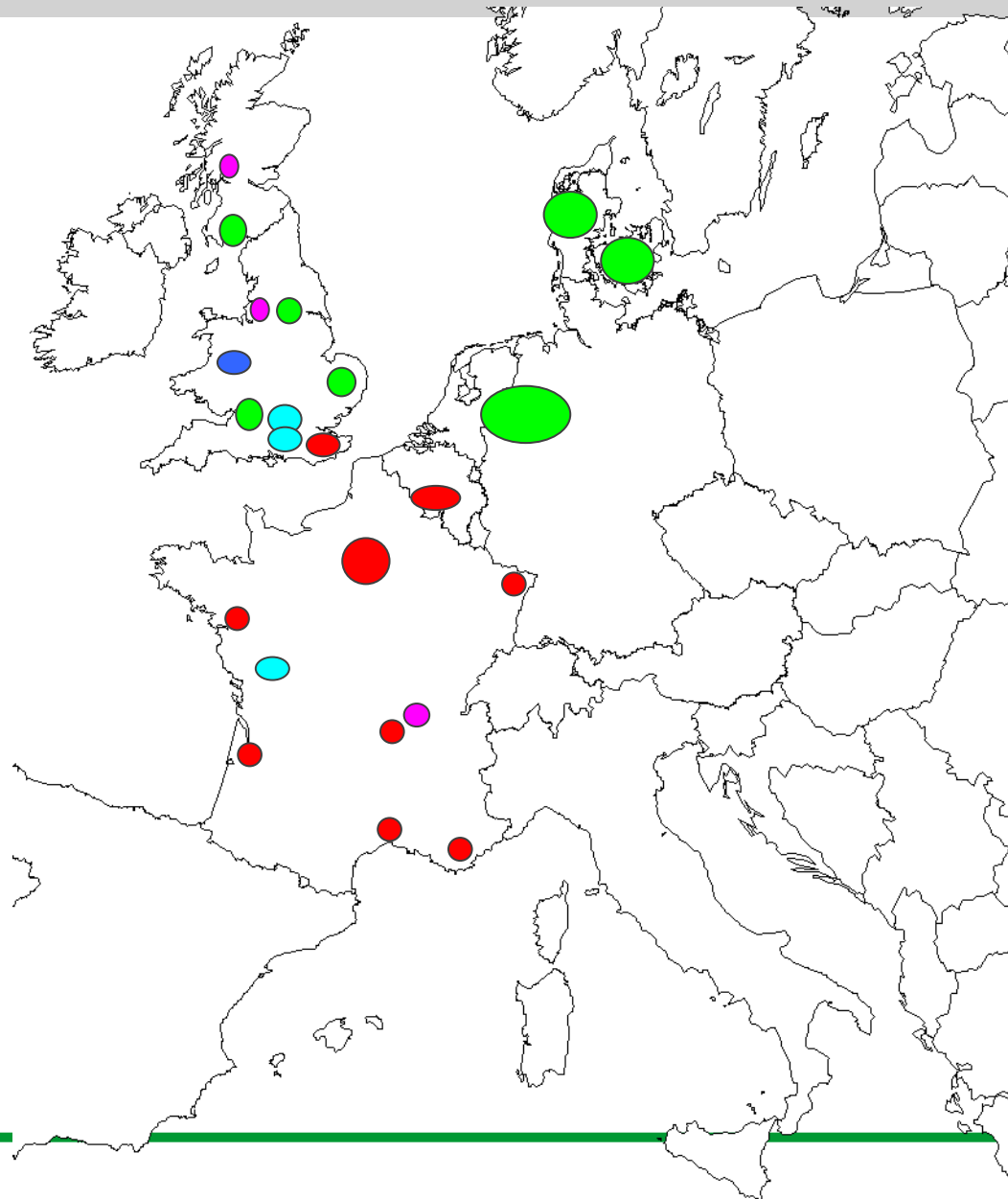
- To investigate the comparative susceptibility to all anticoagulant rodenticides in most common resistant strains of the Norway rat (*Rattus norvegicus*).
- To improve resistance management strategies for all resistant rat strains. Such as to recommend compounds, to validate genotyping.

METHOD:

- Homzygous lab-strains of **Y139C** (Germany) and **Y139F** (France) rats.
- Determine ED₅₀ values for all anticoagulant rodenticides.
- Calculate Resistance Factors.

New study: Resistant rat strains in Europe

- Y139C ●
- Y139F ●
- Y139S ●
- L120Q ●
- L128Q ●



New study: Test Procedure

- 6 adult males and females / strain / compound / dosage.
- Administration of compound, solved in PEG, per gavage.
- After 24 hours, blood sampling.
- Coagulation time determined, Roche HepatoQuick, Amelung coagulometer.
- Threshold for responders at INR = 5.0
- Calculation of ED₅₀ values by Probit analysis.
- Resistance Factors in comparison to baseline (Prescott et al. 2007/RRAC standard)

New study: Results Y139C

- Y139C: Difenacoum

	ED ₅₀ ^s	Multiples of ED ₅₀ ^s x Responder							ED ₅₀	RF
	mg/kg	1.0	1.5	1.7	1.9	2.3	3.0	4.5	mg/kg	
6 m	0.65	0	1	6	6	6	6	-	1.02	1.6
6 f	0.79	0	0	-	-	1	3	6	2.29	2.9

The study is not yet completed!

New study: Results Y139C

Y139C:

ED₅₀s (mg/kg) and Resistance Factors.

	ED ₅₀ ^s Males	ED ₅₀ ^s Females	RF Males	RF Females	
Coumatetralyl	0.36	0.44	42.2	94.1	Endepols et al. 2007
Bromadiolone	0.47	0.62	17.0	15.5	Endepols et al. 2007
Difenacoum	0.65	0.79	1.6	2.9	
Brodifacoum	0.22	0.23		1.5	
Flocoumafen	0.29	0.34			
Difethialone	0.43	0.49			

New study: Results Y139F

Y139F:

ED₅₀s (mg/kg) and Resistance Factors.

	ED ₅₀ ^s Males	ED ₅₀ ^s Females	RF Males	RF Females	
Coumatetralyl	0.36	0.44			
Bromadiolone	0.47	0.62	7.3	9.1	
Difenacoum	0.65	0.79	1.4	ca. 2	
Brodifacoum	0.22	0.23			
Flocoumafen	0.29	0.34			
Difethialone	0.43	0.49	0.9	0.8	

The study is not yet completed!

New study: Results Y139F

Y139F:

ED₅₀s (mg/kg) and Resistance Factors.

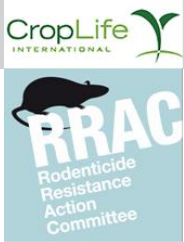
	ED ₅₀ ^s Males	ED ₅₀ ^s Females	RF Males	RF Females	RF in Y139C	
Coumatetralyl	0.36	0.44				
Bromadiolone	0.47	0.62	7.3	9.1	17.0	15.5
Difenacoum	0.65	0.79	1.4	ca. 2	1.6	2.9
Brodifacoum	0.22	0.23				
Flocoumafen	0.29	0.34				
Difethialone	0.43	0.49	0.9	0.8		



Summary and Conclusions

New study: Summary

- The most potent SGARs are effective in the most important resistant rat strains.
- Difenacoum: in Y139C partly effective, in Y139F ?
- The programm will be completed.
- RF-Matrix to be completed as part of resistance management strategy.



THANKS to:

- Engelbert Kampling, Ralf Schlieper und Mechthild Budde for work in the lab.
- BASF and Liphatech for rodenticides.
- VetAgro in Marcy l'Etoile for the Y139F strain

