

Rodenticide Resistance Action Committee

Field Trials of Difenacoum against Norway rats carrying the Tyr139Cys anticoagulant resistance mutation in Germany

Alan P. Buckle, Univ. Reading
Nicole Klemann, Consultant
Stefan Endepols, Bayer CropScience

Steered by RRAC: BASF, Bayer CropScience, Liphatech, Rentokil, Sorex, Syngenta, (Pelgar)

Aims

- **Confirm the Resistance Factor (RF) for difenacoum on farms in known resistance Tyr139Cys foci in Muensterland [Tyr139Cys = Y139C]**
- **Establish the effectiveness of difenacoum for the control of Tyr139Cys resistant rats in Muensterland**
- **Examine the relationship between resistance tests (BCR and genotyping) and treatment results**

Methods: Anticoagulant Resistance Testing

Number of field trials :

2 farms

Number of tested rats:

Trial # 1: 17

Trial # 2: 23



Investigation of the incidence and degree of difenacoum resistance on the farms

Trial # 1: **1.0 x ED₅₀** of the CD-strain (0.65 mg/kg males, 0.79 mg/kg females)
 2.5 x ED₅₀ of the CD-strain (1.63 mg/kg males, 1.98 mg/kg females)

Trial # 2: **2.5 x ED₅₀** of the CD-strain (1.63 mg/kg males, 1.98 mg/kg females)

**Genotyping at the Federal Research Centre for Cultivated
Plants (JKI in Muenster, Germany)**

Methods: Field trials

Field trials structure (for protocol details: www.rrac.info):

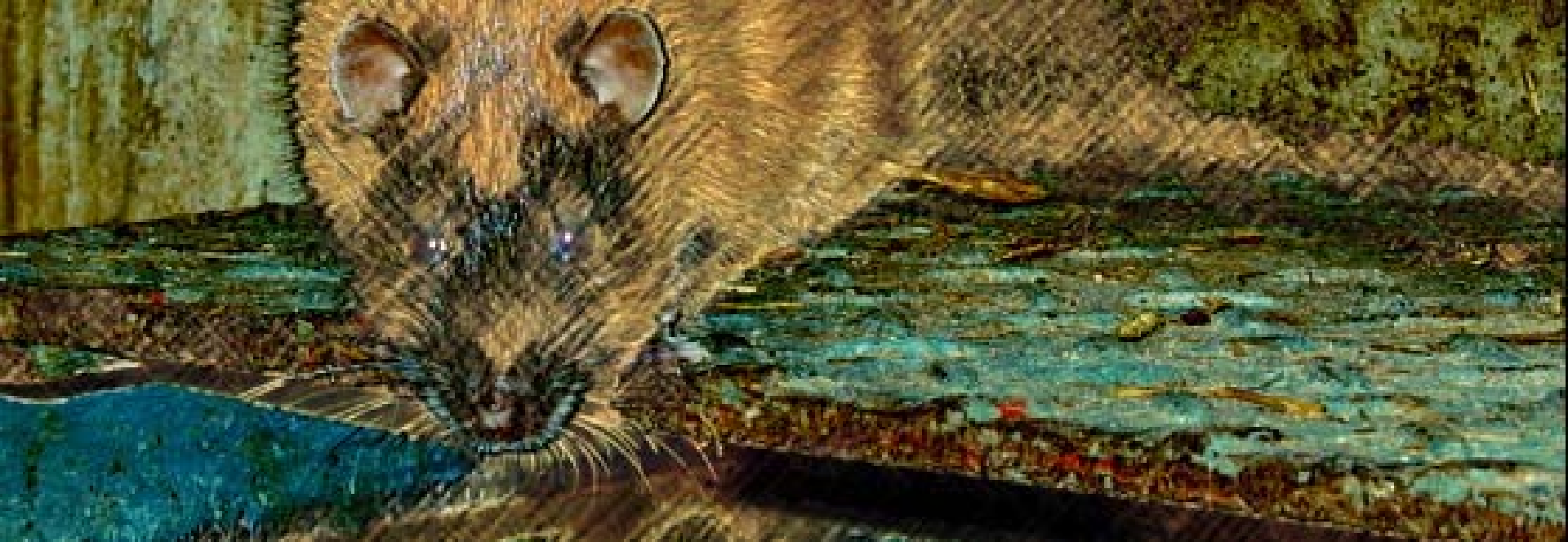
- a) Implementation;**
- b) Pre-baiting census 5 days; 4 days break;**
- c) Baiting period 50 and 43 days; 4 days break;**
- d) Post-baiting census 5 days.**

Census: 1) Consumption of rolled oats,
 2) Tracking plates with sand.

Bait: 0.005% difenacoum wheat bait (Neokil™)

Bait distribution: www.baytool.info (Endepols et al. 2003)

Results



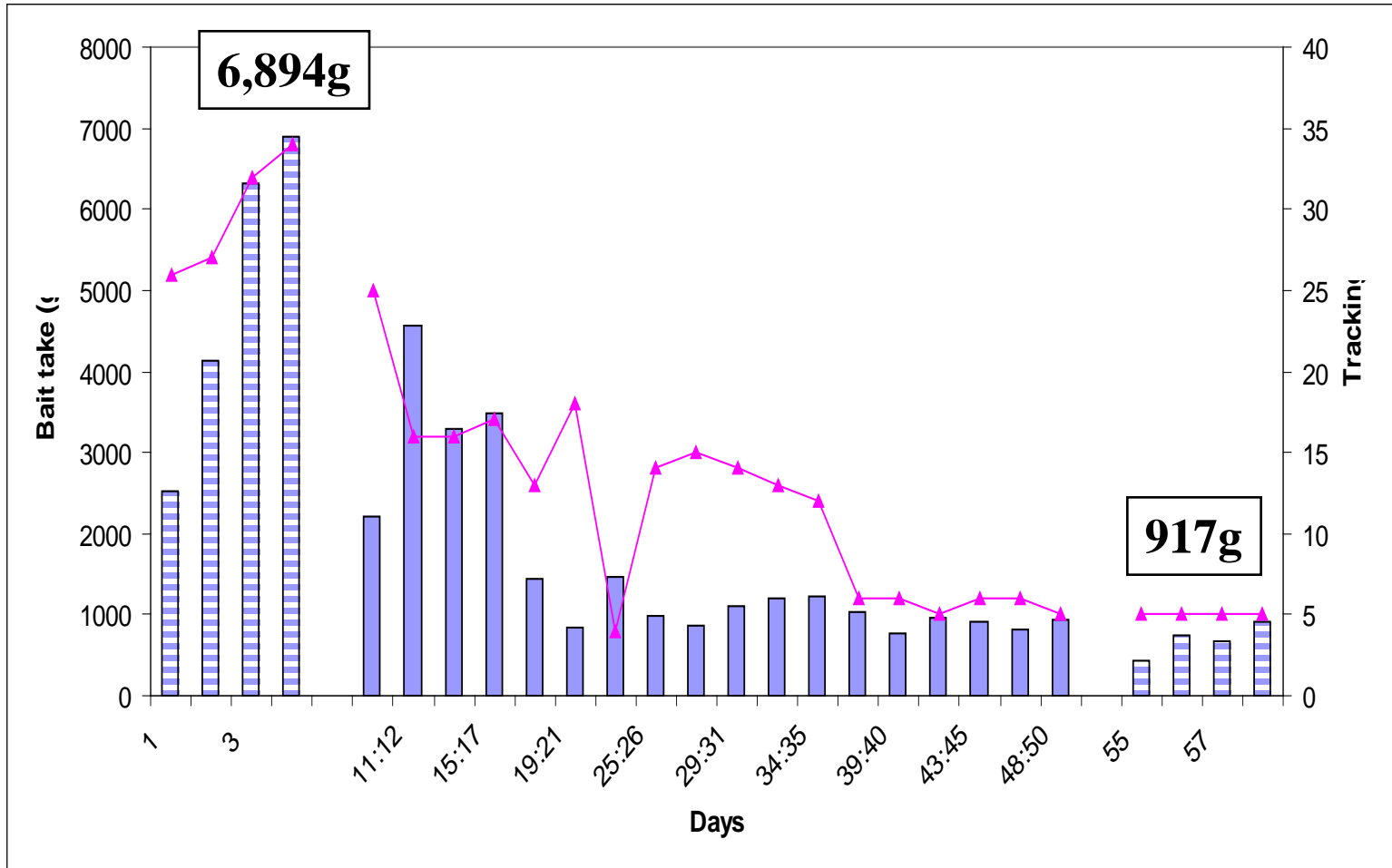
Trial # 1

BCR Testing Results: Trial # 1

Incidence of difenacoum resistance	Degree of resistance 2.5x ED₅₀
min 25% (42%)	3/12 (25%): INR ≤ 5.0 2/12 (17%): INR 5.0-7.0 7/12 (58%): INR >10

- **Difenacoum BCR tests suggest a resistance factor of about 2.5 in this population.**

Field Trial Results : Trial # 1



Bait take (histogram) and tracking score (line). Hatched bars - census bait takes; solid bars - rodenticide bait takes.

Results: Trial # 1

BCR test	Incidence of resistance	Degree of resistance 2.5 x ED₅₀
	42% (min 25%)	3/12 (25%): INR ≤ 5.0 2/12 (17%): INR 5.0-7.0 7/12 (58%): INR >10

Field trial

Bait consumption:	28.10 kg
% survivors	13.3 %

- **The Incidence of Resistance from BCR tests (58-75% susceptible) does not appear to reflect trial success rate (86.7%) very well**

Results



Trial # 2

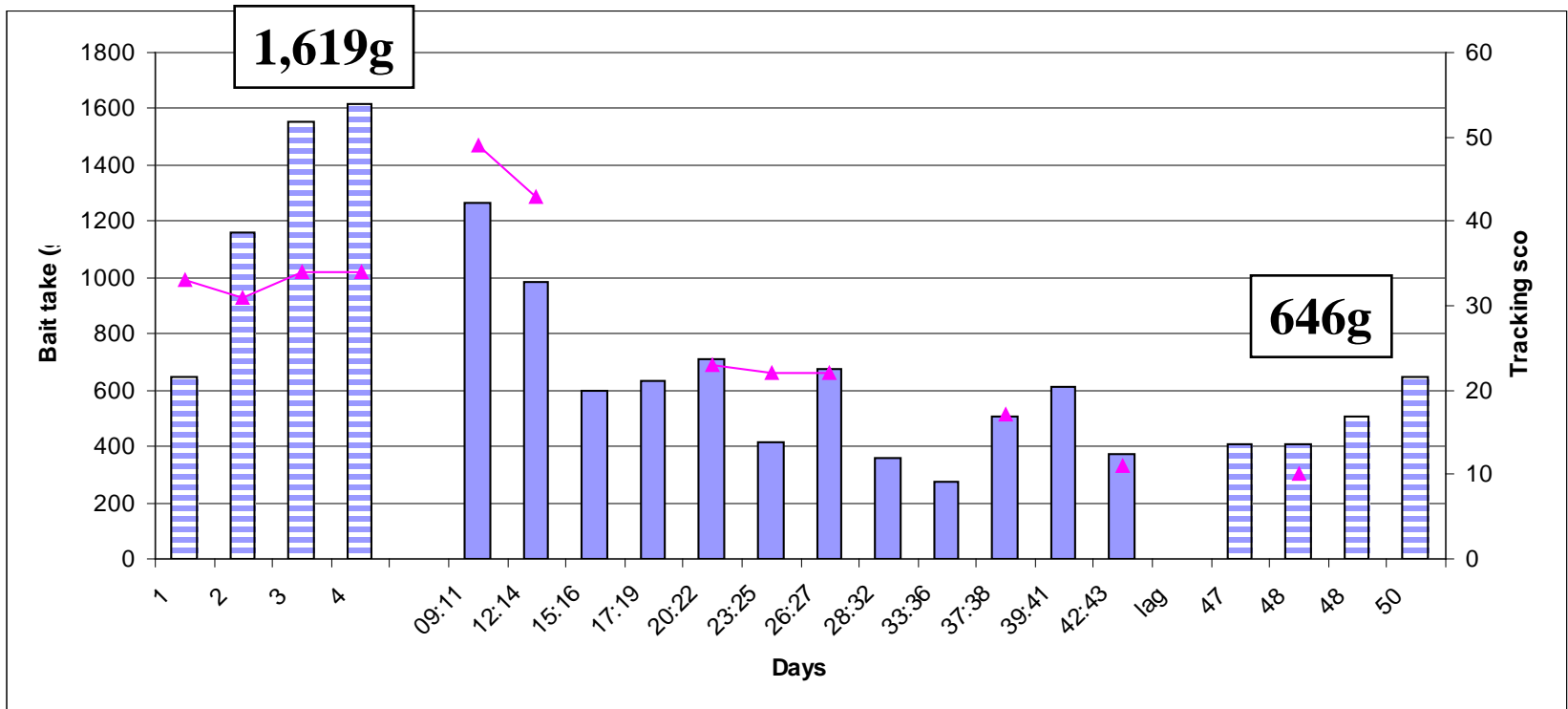
Resistance Testing Results: Trial # 2

BCR test	Incidence of resistance	Degree of resistance 2.5 x ED₅₀
	43% (min 14%)	3/21 (14%): INR ≤ 5.0 9/21 (43%): INR 5.0-10.0 12/21 (57%): INR >10

Genotyping	Incidence of resistance	
	75%	11/20 (55%) homozygous 4/20 (20%) heterozygous wild type 5/20 (25%)

- Agreement between the difenacoum BCR tests (14-43% resistant) and genotyping (75% resistant) is weak. BCR appears to miss some animals carrying Tyr139Cys

Field Trial Results: Trial # 2



Bait take (histogram) and tracking score (line). Hatched bars - census bait takes; solid bars - rodenticide bait takes.

Summary Results: Trial # 2

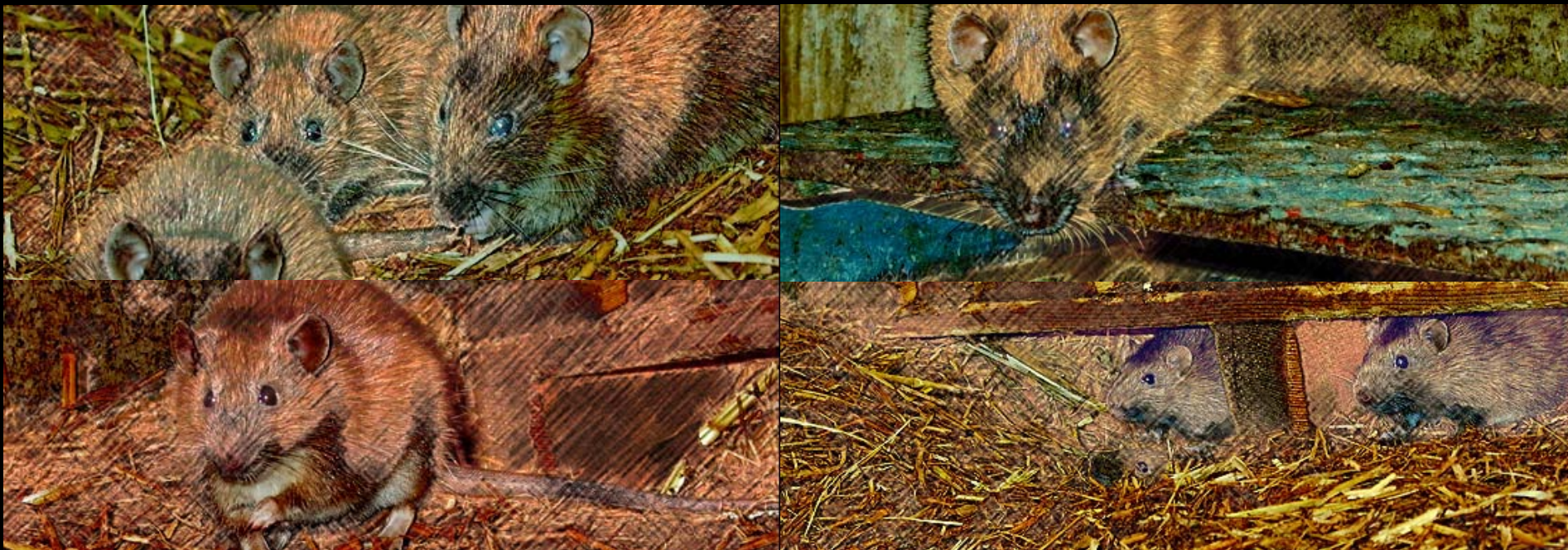
Incidence of resistance	
BCR Testing	Genotyping
14-43%	75%

Field trial

Bait consumption: 7.40 kg

Survivors 39.9 %

- **Difenacoum BCR tests suggest a resistance factor of about 2.5 in this population**
- **Agreement between the difenacoum BCR tests and genotyping is poor**
- **Incidence of resistance by genotyping is not directly reflected in trial outcome**



Conclusions

Conclusions

- **RF is about 2.5 in Tyr139Cys mutation for difenacoum**
- **RF of about 2.5 are not normally associated with control failure but at these sites significant numbers of rats survived the difenacoum treatments**
- **Difenacoum BCR tests underestimated the incidence of resistance**
- **Significant numbers of rats carrying the Tyr139Cys mutation were controlled using 50 ppm difenacoum (heterozygotes ?)**
- **Continued use of difenacoum at these foci would be expected to exacerbate resistance problems in future**
- **Tyr139Cys occurs i.e. Belgium, Denmark, France, Hungary, Netherlands, UK – are results applicable?**

Confirmation of feeding census by tracking census

Index evaluation of tracking plates:

Index	Foot prints
0	No footprints
1	<20%
2	20-40%
3	40-60%
4	60-80%
5	>80%

