EURL-SRM

EURL-FV/-SRM Workshop, October 2022

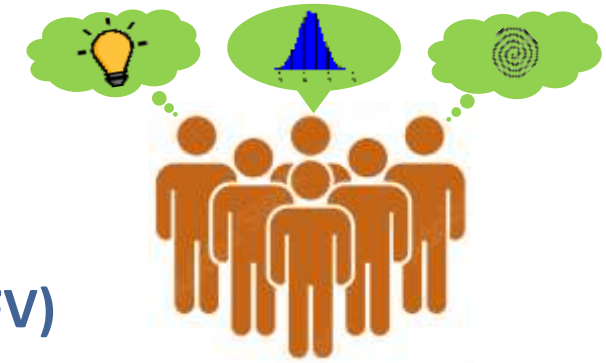
EUPT-SRM17

(Pesticide Residues in Tomato Homogenate) and SRM-News

M. Anastassiades
P. Schreiter
E. Eichhorn
A.-K. Wachtler
A. Lemke
L. Moser
H. Dias
A. Barth
D. Mack
G. Cerchia
I. Sigalov
R. Lötterle
S. Goerlich
C. Ullrich
H. Welzel
D. Stanislavczyk

Photo by aleksandarlittlewolf, www.freepik.com

SELECTION OF COMMODITY & PESTICIDES TO BE SPIKED



COMMODITY & DATE Selection :

AdvG-Meeting decissions:

- Use Tomato as commodity (→ Joining EURL-FV)
- **Start PT towards end of January** (-> publish TPL towards end of Oct.)
- Grow tomatoes in Almería (greenhouse)

Note: finally published early November

Timetable of Sample:

- **Sep.:** Tomato seedlings planted
- **Mid-Dec.:** Pesticides sprayed
- **End of Dec.:** Tomatoes harvested, milled, filled into containers, frozen overnight, shipped to EURL-SRM (27 Dec.)
- **End of Jan.:** Samples shipped to participants

EUPT-SRM17 ORGANISATION

Registration for EUPT-SRM17:

6 Dec. – 31 Dec. 2021

Sample Shipment:

31 Jar. 2022

Results Submission Period:

10* Feb. – 8 March 2022

(*Webtool Opening)

Preliminary Report:

8 April, 2022

EURL-SRM — EU Reference Laboratories for Residues of Pesticides — Single Residue Methods

CALENDAR for the EUPT – SRM17

Tomato Homogenate

(Update on 23/02/2022)

Activity	Dates
Announcement of the EUPT-SRM17 opening of the EUPT-SRM17 Website with links to all relevant documents	05 Nov. 2021
Registration Period for EUPT-SRM17 via "EUPT-Registration Website" Labs classified as "OBLIGED" to participate in the EUPT-SRM17 MUST enter the EUPT-Registration Website and either register OR give explanations for non-participation	06 –31 Dec. 2021, 23:30 h CET*
Dispatch of EUPT-SRM17-Specific Protocol	by 17 Jan. 2022
Shipment of EUPT-SRM17 Test Item	31 Jan. 2022
Confirming Sample Receipt and Acceptance via "EUPT-SRM17 Result Submission Webtool"	From 1 Feb. 2022 onwards
Submission of Results (Pesticide scope, Results, Method Info) via "EUPT-SRM17 Result Submission Webtool"	1 Feb. – 8 Mar. 23:30 h CET
Submission of Additional/Missing Information e.g. Method info on tentatively false negative results via "EUPT-SRM17 Result Submission Webtool"	9 Mar. – 17 Mar. 2022
Dispatch of Preliminary Report containing results as well as preliminary assigned values and z-scores only	Within 3 weeks after the submission deadline
Collection of reasons for underperformance and missing information on methods	Apr. 2022
Dispatch of Final Report	Dec. 2022

* Please make sure to register for the EUPT by the deadline 31 Dec 2021 via "EUPT-Registration Website". Any wish for registration after this deadline or not using the registration website cannot be considered.

REMARK:
Please note that the dates given above may be subject to minor changes. In case of changes importantly affecting the participants, the participants will be informed via e-mail. However, please still check periodically our website for possible updates in case the email does not get through to you.
Contact: eurl-srm@cvuas.bwl.de

The EUPT-SRM Team

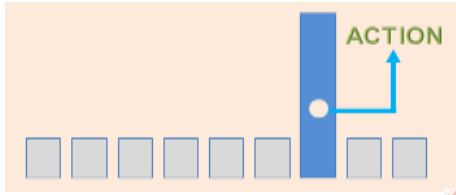
ANALYTE Selection:

Factors considered for INCLUSION IN TARGET PESTICIDES LIST (TPL)…

a) Listing in EU monitoring documents:

- MACP-Regulation (MANDATORY with exceptions):
  - *Mandatory:* Captan, Folpet, Cyromazine, Chlorothalonil, Emamectin, DTCs , …
  - *Optional:* Maleic hydrazide (MACP-incl. decided in 2021), Formetanate (tricky)
- Monitoring Working Document (OPTIONAL):
  - Bifenazate, Diquat, Paraquat, Matrine, Nicotine, Trimesium, Meptyldinocap …

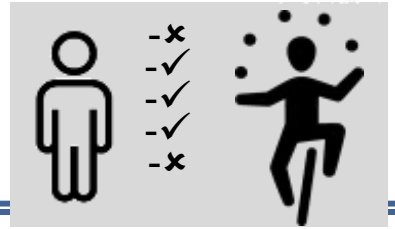
(NOTE: for some WD-compounds, help from EURLs is requested to improve coverage by labs)



b) DTC-Markers (also of toxicological concern): ETU, PTU

c) Relevance to matrix: Specific (tomato) / Matrix Group (high water cont.)

d) Suggestions/Voting by EUPT-Scientific Committee



e) Capacity & Capability of Labs: Keep No. of Methods Moderate

a) EUPT-Scientific Committee (voting for TPL)

Voting for EUPT-SRM17 (Tomato)

Compound Group	COMPOUND	Progr.	EURL-Support needed to increase anal. coverage	Proposed classification if incl. in TPL	Tomato findings avg. 2016/19	Relevance in MACP-commodities (findings reported by EFSA)	General frequency of findings (from W	Approval EU	PT History	Gap (years)	Reasoning for voting for exclusion of compound	Mark with X compounds you think should be excluded from the TPL: hidden names	Sum of neg. votes	EURL-SRM decission	Remarks Reasons for overruling neg. votes (4+) Answers to questions
1-naphthylacetic acid	**1-naphthylacetic acid**	WD	Yes	Optional	none	Aubergines, pears, peaches, strawberries, sweet peppers, cuccumber	0.49% (2017)	approved	never checked in PT	15	HM: less relevant for tomato (LOD*, not found)	x x x X X X X X X X X	11	IN	EURL-Support needed to increase coverage Relevant for many matrices EUPT-gap
2,4-D	**2,4-D (sum)**	MACP		Optional	0.3%	Grapes, citrus, broccoli, caulifowers, sweet peppers, dry beans		approved	SRM04 (opt.; CV*: 22.6) | SRM15 (opt.: CV*: 18.9)	2			0	?	MACP-compound Relevant for many matrices
2,4-D	**2,4-D (free acid)**	MACP		Mandatory	0.3%	grapes, citrus, broccoli, caulifowers, sweet peppers, dry beans		approved	SRM04 (mand.; CV*: 27.5) SRM06 (mand.; CV*: 22.1) SRM07 (mand.; CV*: 27.9) SRM09 (mand.; CV*: 18.7) SRM10 (mand.; CV*: 18.2) SRM12 (mand.; CV*: 13.3) | SRM15 (mand.: CV*: 20.8)	2			0	IN	MACP-compound Relevant for many matrices
2,4-DB	**2,4-DB (sum)**	WD		Optional	none	none	no data in WD	approved	never checked in PT	15	less relevant for tomato (LOD*, not found)	x x x X X X X X X X X	11	OUT	only for cummulative assessment
2,4-DB	**2,4-DB (free acid)**	WD		Optional	none	none	no data in WD	approved	never checked in PT	15	less relevant for tomato (LOD*, not found)	x x x X X X X X X X X	11	OUT	
4-CPA	**4-CPA**	WD	Yes	Optional	none	Aubergines, melons	0.03% (2019)	not approved	never checked in PT	15	HM: not approved, not found	x x X X X X X X X X	9	IN	EURL-Support needed to increase coverage Full EUPT gap
Aminopyralid	**Aminopyralid**	None		Optional	none	Aubergines		approved	never checked in PT	15	less relevant for tomato (LOD*, not found)	x x x X X X X X X X X	11	OUT	
Amitrol	**Amitrol**	WD		Optional	none	none	no data in WD	not approved	never checked in PT	15	not approved, not found	x x x X X X X X X X X	11	OUT	
Abamectin	**Avermectin B1a**	MACP		Mandatory	0.3%	Beans, aubergines, cuccumber, grapes, lettuce, peach, sweet peppers strawberries		approved	B1a: SRM03 (mand.; CV*: 23.4) | SRM05 (mand.; CV*: 24.3) SRM14 (opt., CV*: 30)	3			0	IN	MACP-compound Relevant for many matrices
Abamectin	**Avermectin delta-8,9 isomer of B1a**	MACP		Mandatory	see B1a	see B1a		approved	never checked in PT	15	HU: sensitivity issue (depending on equipment ?) RS: chromatogr: difficulties	X X X X	4	OUT	MACP-compound
Bifenazate	**Bifenazate (sum of bifenazate and bifenazate-diazene expressed as bifenazate)**	WD		Optional	0.9%	Aubergines, sweet peppers, strawberries	0.54% (2019)	approved	SRM12 (opt.; CV*: 22.1) FV-xxxx	5	CF: I suppose the target list should only contain bifenazate-diazene? Bifenazate is not SRM	x	1	IN	Large PT-gap, A: Bifenazate and diazene interconvert, depending on matrix. Caribration is tricky. SRM-method published
Captan	**Captan**	MACP		Mandatory	none	Onions, strawberries, sweet peppers, pears, peas		approved	SRM08 (mand.; CV*: 26.0) SRM12 (mand.; CV*: 28.1) FV: ???	5	less relevant for tomato (LOD*, not found)	X X X	3	IN	MACP-compound; Relevant for many matrices Large PT-gap,
Captan	**THPI**	MACP		Mandatory	none	Onions, strawberries, sweet peppers, pears, peas		approved	SRM12: (opt.; CV*: XXXX%)	6				IN	Forgotten in voting MACP-compound; Relevant for many matrices Large PT-gap,
Captan	**Captan (sum) (sum of captan and THPI, expressed as captan)**	MACP		Optional	none	Onions, strawberries, sweet peppers, pears, peas		approved	Captan (sum) : SRM12: (opt.; CV*: 25.2%)	7				IN	Forgotten in voting MACP-compound; Relevant for many matrices Large PT-gap,
	Carbofuran-part of sum (Sum of														

TPL Evolution

- **TPL-V1: Release on 05.11.21 (following AdvG voting)**
- **Survey:** (11.11. – 19.11.2021), among potential participants
- **TPL-V2: Release on 27.11.21** (reduced no. of analytes considering …
  - Input from survey,
  - Availability of pesticide formulations.
  - Goal: Keep number of methods moderate
- **Call for Registration:** (06.12.2021)
- **TPL-V2a: Release on 07.01.22** (minor changes)
- **TPL-V3: Release on 28.01.22** (corr. of typos; propamocarb was removed)

TARGET PESTICIDES LIST (TPL-V3= Final, page 1):

MANDATORY ANALYTES			
Analytes Name	**Residue definition for the PT and additional remarks**	**MACP/WD**	**MRRL (mg/kg)**
Avermectin B1a	Main component of abamectin; expressed as avermectin B1a	**MACP**	0.01
Captan		**MACP**	0.02
THPI	Tetrahydrophthalimide (degradant of captan), expressed as THPI	**MACP**	0.01
Chlormequat (chloride)	Expressed as chlormequat **chloride salt**	**MACP**	0.01
Chlorothalonil		**MACP**	0.01
Cyromazine		**MACP**	0.02
Dithianon		**MACP**	0.02
Dodine	Expressed as dodine (free base)	**MACP**	0.01
Dithiocarbamates	Determined and expressed as carbon disulphide (CS_2)	**MACP**	0.02
Emamectin B1a	Main component of emamectin; expressed as emamectin B1a (free base)	**MACP**	0.01
Fenbutatin oxide		**MACP**	0.01
Folpet		**MACP**	0.02
Phthalimide	Degradant of Folpet, expressed as phthalimide	**MACP**	0.01
Mepiquat (chloride)	Expressed as mepiquat **chloride salt**	**MACP**	0.01
~~**Propamocarb**~~	~~Expressed as propamocarb (free base)~~	~~**MACP**~~	~~0.01~~
Pymetrozine		**MACP**	0.02
TFNA	Metabolite of flonicamid, expressed as TFNA (free acid)	**MACP**	0.01
TFNG	Metabolite of flonicamid, expressed as TFNG (free acid)	**MACP**	0.01

removed

EURL-SRM

TARGET PESTICIDES LIST (TPL-V3=Final, page 2):

OPTIONAL ANALYTES			
Analytes Name	**Residue definition for the PT and additional remarks**	**MACP/WD**	**MRRL (mg/kg)**
BAC-C12 (chloride)	Benzyldimethyldecylammonium chloride, expressed as **chloride salt**	**WD**	0.02
Bifenazate (sum)	Sum of bifenazate and bifenazate-diazene (expressed as bifenazate)	**WD**	0.03
Chloridazon-desphenyl	Expressed as chloridazon-desphenyl	**WD**	0.02
DDAC-C10 (chloride)	Didecyldimethylammonium chloride, expressed as **chloride salt**	**WD**	0.01
Diquat	Expressed as diquat **dication**	**WD**	0.03
ETU	Ethylene thiourea, degradant of ethylene-bis-dithiocarbamates	**None**	0.01
Formetanate-HCl	Expressed as formetanate **hydrochloride salt**	**MACP**	0.01
Maleic hydrazide	Expressed as maleic-hydrazide (free acid)	**MACP****	0.05
Matrine	Expressed as matrine (free base)	**WD**	0.02
Meptyldinocap		**WD**	0.02
2,4-DNOP	Metabolite of meptyldinocap, expressed as **2,4-DNOP (free phenol)**	**WD**	0.01
Meptyldinocap (sum)	Sum of meptyldinocap and 2,4-DNOP following chemical conversion to 2,4-DNOP (expressed as **meptyldinocap**)	**WD**	0.01
Nicotine	Expressed as nicotine (free base)	**WD**	0.01
Oxymatrine	Expressed as oxymatrine (free base)	**WD (2021)**	0.01
Paraquat	Expressed as paraquat **dication**	**WD**	0.01
PTU	N,N'-(1,2-propylene)thiourea, degradant of propylene-bis-dithiocarbamates	**None**	0.01
Trimesium cation	Expressed as trimesium **cation**	**WD**	0.01

Typo Corrected!

Selection of ANALYTES for SPRAYING & SPIKING …

1. PT-History of compound
   a) How often was it present in previous PTs?
   b) When was the last time it was present?
   c) How was the lab performance in previous PTs?
2. Relevance to Matrix / Matrix Group
3. Availability of pesticide formulations
4. Availability of EURL-method(s) that participants could potentially use
5. Lab capability (considering surveys)
6. Lab requests over time + in survey
7. Lab capacity (**keep number of methods low**)

COMPOUNDS SPRAYED BUT FINALLY EXCLUDED FROM TPL

- **Propamocarb**:

Levels in harvested tomatoes were too high for PT (~2 ppm),

→ **included in EUPT-FV** (harvested later)

- **TFNA and TFNG (degradants of FLONICAMID):**

Levels following flonicamid-treatment were too low,

Decided not to overspike in lab (to keep number of methods low)

→ **Flonicamid (parent) included in EUPT-FV**

COMPOUNDS INCLUDED IN TPL OF EUPT-SRM & EUPT-FV

- **Chlorothalonil**
- **Pymetrozine**

OVERVIEW: COMPOUNDS APPLIED IN FIELD AND LAB

		residues incurred	residues spiked in the lab	Compounds used for spiking in the lab
Captan	COMPULSORY	✓	✓	Captan
THPI		✓	-	
Chlorothalonil		✓	-	
Cyromazine		-	✓	Cyromazine
Dodine		-	✓	Dodine
DTC (CS2)		-	✓	Metiram (CELAFLOR)
Emamectin B1a		✓	✓	Emamectin benzoate
Folpet		✓	✓	Folpet
Phthalimide		✓	✓	Phthalimide
Pymetrozine		✓	-	
Bifenazate	OPTIONAL	✓	-	
Chloridazone-desphenyl		-	✓	Chloridazone-desphenyl
ETU		-	✓	ETU (from Metiram + ETU)
Formetanate-HCl		✓	-	
Maleic hydrazide		-	✓	Maleic hydrazide
Meptyldinocap		-	✓	Meptyldinocap
2,4-DNOP		-	✓	2,4-DNOP (free phenol)
Oxymatrine		-	✓	Oxymatrine

EURL-SRM

Preparation of PT-Item

Shipment of tomato pureé to the EURL in Stuttgart

Tomatoes grown in a greenhouse in Almería.
Harvested → Milled → Placed in freezer overnight → Shipped frozen to EURL-SRM → Stored frozen

Preparation of PT-Item

Homogenate left to partly thaw

Homogenate Spiked
→ Mixing (1h)

Tomato pureé filled into freezer bags

Filled in bags and placed in freezer in flat position (thin plates)

Mixed frozen (ca. 500 g portions at a time)

Bottled and prepared for shipment

Express Shipment to participants

EURL-SRM

HOMOGENEITY TEST

COMPULSORY Compounds

	Captan	Chlorothalonil	Cyromazin	Dithiocarbamates (CS2)	Dodine
Sample	**Concentration [mg/kg]**				
No. 011	0.197 / 0.200	0.173 / 0.177	0.134 / 0.138	0.211 / 0.214	0.110 / 0.113
No. 034	0.192 / 0.182	0.166 / 0.164	0.139 / 0.137	0.218 / 0.222	0.109 / 0.108
No. 050	0.184 / 0.172	0.169 / 0.166	0.146 / 0.138	0.215 / 0.237	0.098 / 0.107
No. 073	0.166 / 0.215	0.165 / 0.160	0.138 / 0.136	0.189 / 0.210	0.111 / 0.112
No. 096	0.168 / 0.217	0.153 / 0.170	0.140 / 0.136	0.211 / 0.214	0.107 / 0.114
No. 112	0.179 / 0.187	0.167 / 0.184	0.135 / 0.134	0.208 / 0.221	0.105 / 0.105
No. 143	0.211 / 0.196	0.173 / 0.171	0.142 / 0.137	0.221 / 0.235	0.106 / 0.112
No. 156	0.162 / 0.210	0.176 / 0.171	0.138 / 0.137	0.210 / 0.217	0.103 / 0.109
No. 183	0.181 / 0.171	0.156 / 0.165	0.135 / 0.134	0.221 / 0.222	0.103 / 0.109
No. 200	0.196 / 0.199	0.169 / 0.168	0.130 / 0.138	0.216 / 0.229	0.111 / 0.108
Mean (AV)	**0.189 (0.174)**	**0.168 (0.151)**	**0.137 (0.154)**	**0.217 (0.187)**	**0.108 (0.100)**
RSD (%)	**4.7**	**3.4**	**1.8**	**3.8**	**2.8**
$S_{sam}^2 < (c)$?	0 < 0.014	1.4E-5 < 0.013	1.3E-6 < 0.010	3.0E-5 < 0.016	2.6E-6 < 0.008
Homogeneity test	**passed**	**passed**	**passed**	**passed**	**passed**

S_{sam}^2: between-samples STD

(c): Check Value (0.3* sigma-PT):

HOMOGENEITY TEST

COMPULSORY Compounds

	Emamectin B1a	Folpet	Phthalimide	Pymetrozine	THPI
Sample	Concentration [mg/kg]				
No. 011	0.049 / 0.051	0.315 / 0.314	0.100 / 0.101	0.179 / 0.196	0.617 / 0.604
No. 034	0.046 / 0.045	0.320 / 0.301	0.103 / 0.091	0.188 / 0.195	0.618 / 0.590
No. 050	0.052 / 0.049	0.277 / 0.323	0.086 / 0.094	0.201 / 0.193	0.648 / 0.628
No. 073	0.048 / 0.049	0.310 / 0.309	0.093 / 0.080	0.196 / 0.193	0.623 / 0.565
No. 096	0.050 / 0.047	0.277 / 0.314	0.083 / 0.091	0.192 / 0.184	0.634 / 0.624
No. 112	0.045 / 0.045	0.301 / 0.303	0.100 / 0.092	0.191 / 0.190	0.640 / 0.582
No. 143	0.048 / 0.048	0.254 / 0.309	0.104 / 0.105	0.197 / 0.196	0.654 / 0.629
No. 156	0.053 / 0.048	0.292 / 0.294	0.100 / 0.092	0.181 / 0.194	0.571 / 0.620
No. 183	0.046 / 0.050	0.285 / 0.308	0.083 / 0.082	0.190 / 0.190	0.633 / 0.569
No. 200	0.049 / 0.045	0.294 / 0.309	0.091 / 0.094	0.189 / 0.192	0.638 / 0.593
Mean (AV)	**0.0482 (0.0461)**	**0.300 (0.249)**	**0.0933 (0.0978)***	**0.191 (0.150)**	**0.614 (0.590)**
RSD (%)	**3.7**	**3.2**	**7.3**	**1.8**	**2.8**
S_{sam}^2 < (c) ?	1.0E-6 < 0.004	0 < 0.023	3.2E-5 < 0.007	0 < 0.014	0 < 0.046
Homogeneity test	**passed**	**passed**	**passed**	**passed**	**passed**

S_{sam}^2: between-samples STD
(c): Check Value (0.3* sigma-PT):

* = Spiking Level
as the AV was too uncertain

EURL-SRM

HOMOGENEITY TEST

OPTIONAL Compounds

	Bifenazate (sum)	Chloridazon-desphenyl	ETU	Formetanate-HCl	Maleic hydrazide
Sample	Concentration [mg/kg]				
No. 011	0.313 / 0.338	0.052 / 0.052	0.057 / 0.053	0.861 / 0.777	0.482 / 0.590
No. 034	0.314 / 0.327	0.049 / 0.056	0.056 / 0.055	0.836 / 0.830	0.514 / 0.595
No. 050	0.316 / 0.324	0.056 / 0.052	0.060 / 0.057	0.852 / 0.844	0.591 / 0.528
No. 073	0.318 / 0.316	0.052 / 0.051	0.050 / 0.054	0.836 / 0.867	0.506 / 0.507
No. 096	0.313 / 0.351	0.055 / 0.052	0.056 / 0.059	0.801 / 0.832	0.494 / 0.555
No. 112	0.290 / 0.323	0.055 / 0.051	0.055 / 0.053	0.861 / 0.833	0.592 / 0.534
No. 143	0.322 / 0.347	0.050 / 0.055	0.060 / 0.060	0.880 / 0.856	0.555 / 0.546
No. 156	0.309 / 0.333	0.055 / 0.058	0.053 / 0.057	0.820 / 0.843	0.458 / 0.539
No. 183	0.302 / 0.322	0.054 / 0.054	0.059 / 0.057	0.838 / 0.818	0.536 / 0.491
No. 200	0.350 / 0.323	0.051 / 0.055	0.057 / 0.063	0.846 / 0.866	0.543 / 0.591
Mean (AV)	**0.323 (0.296)**	**0.0533 (0.0616)**	**0.0566 (0.0629)**	**0.840 (0.873)**	**0.537 (0.544)**
RSD (%)	**3.0**	**2.6**	**4.7**	**2.0**	**4.7**
S_{sam}^2 < (c) ?	0 < 0.024	0 < 0.004	4.3E-6 < 0.004	0 < 0.063	0 < 0.04
Homogeneity test	**passed**	**passed**	**passed**	**passed**	**passed**

S_{sam}^2: between-samples STD

(c): Check Value (0.3* sigma-PT):

OPTIONAL Compounds

	Oxymatrine	2,4-DNOP (free phenol)	Meptyldinocap	Meptyldinocap (sum) calculated	Meptyldinocap (sum) after alk. Hydrolysis
Sample	Concentration [mg/kg]				
No. 011	0.177 / 0.185	0.058 / 0.059	0.100 / 0.099	0.172 / 0.172	0.165 / 0.167
No. 034	0.180 / 0.192	0.057 / 0.055	0.098 / 0.091	0.169 / 0.159	0.154 / 0.167
No. 050	0.205 / 0.190	0.057 / 0.056	0.095 / 0.094	0.165 / 0.162	0.158 / 0.165
No. 073	0.171 / 0.181	0.057 / 0.053	0.098 / 0.094	0.168 / 0.159	0.155 / 0.158
No. 096	0.189 / 0.177	0.054 / 0.056	0.098 / 0.094	0.164 / 0.163	0.164 / 0.167
No. 112	0.187 / 0.190	0.056 / 0.057	0.095 / 0.095	0.164 / 0.165	0.158 / 0.158
No. 143	0.190 / 0.188	0.057 / 0.054	0.097 / 0.094	0.167 / 0.161	0.155 / 0.166
No. 156	0.183 / 0.190	0.058 / 0.058	0.097 / 0.095	0.169 / 0.166	0.157 / 0.164
No. 183	0.191 / 0.184	0.056 / 0.058	0.094 / 0.099	0.163 / 0.170	0.158 / 0.164
No. 200	0.176 / 0.183	0.056 / 0.052	0.092 / 0.093	0.161 / 0.158	0.161 / 0.153
Mean (AV)	**0.185 (0.198)**	**0.056 *(0.056)****	**0.096 *(0.100)****	**0.165 *(0.169)****	**0.161 *(0.169)****
RSD (%)	**3.2**	**2.5**	**1.9**	**1.99**	**1.97**
S_{sam}^2 < (c) ?	1.5E-5 < 0.014	5.6E-7 < 0.004	1.6E-7 < 0.007	3.3E-6 < 0.012	0 < 0.012
Homogeneity test	**passed**	**passed**	**passed**	**passed**	**passed**

S_{sam}^2: between-samples STD
(c): Check Value (0.3* sigma-PT):

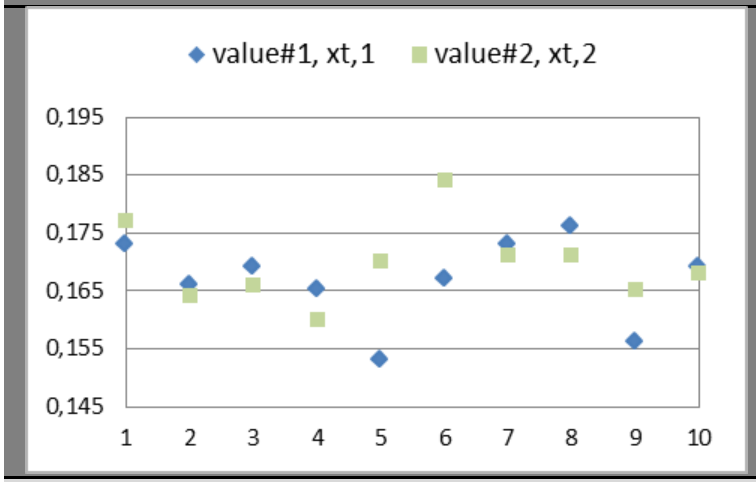
* = Spiking Level.
as AV was too uncertain

EURL-SRM

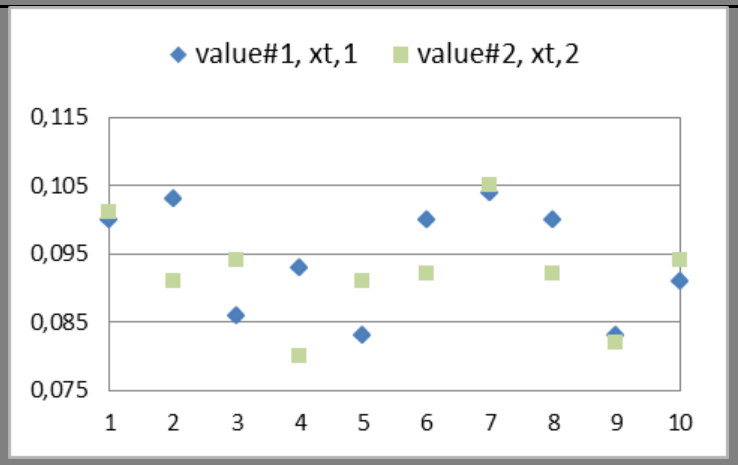
HOMOGENEITY TEST

Distribution of results from 10 bottles (2 portions each), exemplary

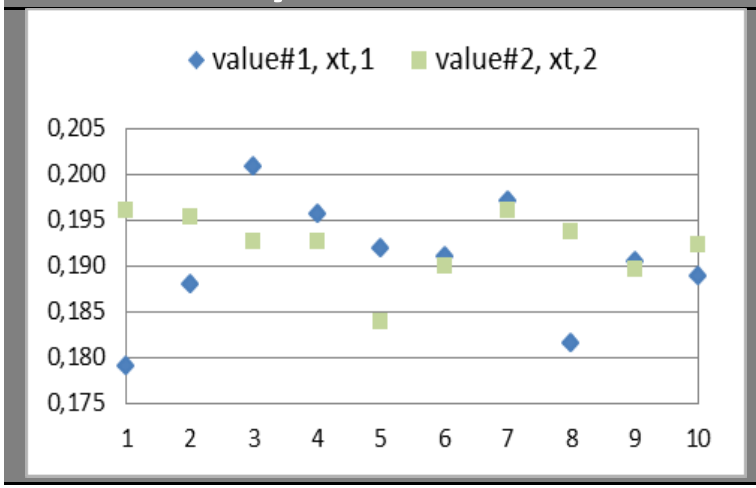
Chlorothalonil



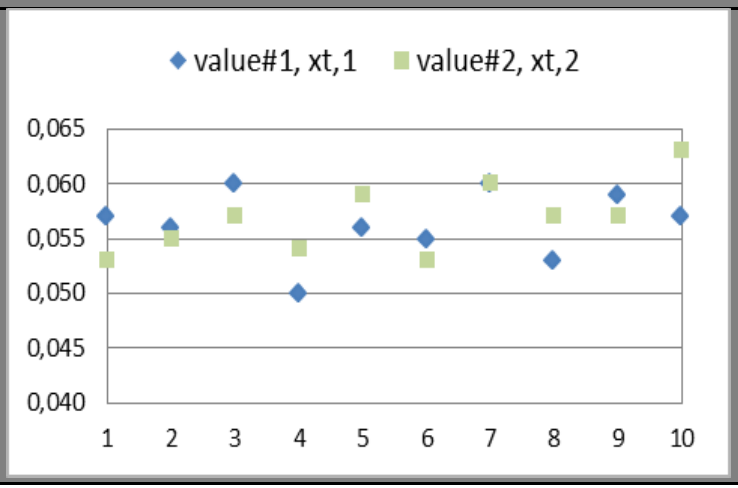
Phthalimide



Pymetrozine



ETU



Axes do not start at zero !!

EURL-SRM STABILITY TEST

COMPULSORY Compounds

	Captan			Chlorothalonil			Cyromazin			Dithiocarbamates (CS2)			Dodine		
Date of extraction	01.03.2022	14.03.2022	07.04.2022	01.03.2022	14.03.2022	07.04.2022	08.03.2022	15.03.2022	13.04.2022	02.02.2022	25.02.2022	11.03.2022	01.03.2022	14.03.2022	07.04.2022
No. 050	0.178	0.174	0.176	0.171	0.159	0.173	0.139	0.127	0.135	0.202	0.215	0.181	0.102	0.098	0.107
No. 096	0.193	0.174	0.181	0.17	0.161	0.168	0.136	0.129	0.134	0.192	0.211	0.219	0.107	0.099	0.105
No. 156	0.186	0.171	0.18	0.174	0.157	0.169	0.135	0.127	0.13	0.215	0.21	0.199	0.107	0.099	0.104
Mean [mg/kg]	**0.186**	**0.173**	**0.179**	**0.172**	**0.159**	**0.170**	**0.136**	**0.128**	**0.133**	**0.203**	**0.212**	**0.200**	**0.106**	**0.099**	**0.106**
% Diviation (vs. 1st Anaylsis)	-	-7.0%	-3.6%	-	-7.5%	-1.1%	-	-6.5%	-2.8%	-	4.3%	-1.7%	-	-6.5%	0.0%
Diff (mean)	-	**0.013**	**0.0067**	-	**0.013**	**0.0018**	-	**0.0088**	**0.0038**	-	**0.0087**	**0.0034**	-	**0.0069**	**0.00**
0.3*FFP-SD		**0.013**	**0.013**		**0.011**	**0.011**		**0.012**	**0.012**		**0.014**	**0.014**		**0.0075**	**0.0075**
Stability test		**passed**	**passed**		**passed**	**passed**		**passed**	**passed**		**passed**	**passed**		**passed**	**passed**

	Emamectine B1a			Folpet			Phthalimid			Pymetrozine			THPI		
Date of extraction	01.03.2022	14.03.2022	07.04.2022	01.03.2022	14.03.2022	07.04.2022	01.03.2022	14.03.2022	07.04.2022	08.03.2022	15.03.2022	13.04.2022	01.03.2022	14.03.2022	07.04.2022
No. 050	0.050	0.052	0.052	0.304	0.285	0.301	0.09	0.088	0.093	0.183	0.174	0.179	0.595	0.608	0.643
No. 096	0.048	0.051	0.053	0.308	0.289	0.294	0.087	0.088	0.089	0.18	0.173	0.184	0.626	0.588	0.638
No. 156	0.051	0.052	0.051	0.309	0.289	0.305	0.096	0.084	0.091	0.18	0.174	0.177	0.596	0.599	0.642
Mean [mg/kg]	**0.050**	**0.052**	**0.052**	**0.307**	**0.287**	**0.300**	**0.091**	**0.086**	**0.091**	**0.181**	**0.174**	**0.180**	**0.606**	**0.598**	**0.641**
% Diviation (vs. 1st Anaylsis)	-	3.6%	3.6%	-	-6.3%	-2.2%	-	-5.1%	-0.4%	-	-3.9%	-0.5%	-	-1.2%	5.9%
Diff (mean)	-	**0.0018**	**0.0018**	-	**0.019**	**0.0068**	-	**0.0047**	**0.0003**	-	**0.0071**	**0.0009**	-	**0.0071**	**0.036**
0.3*FFP-SD		**0.0035**	**0.0035**		**0.019**	**0.019**		**0.0074**	**0.0074**		**0.0113**	**0.011**		**0.044**	**0.044**
Stability test		**passed**	**passed**		**passed**	**passed**		**passed**	**passed**		**passed**	**passed**		**passed**	**passed**

All stability test samples were extracted at the indicated day and measured alltogether at the end.

EURL-SRM STABILITY TEST

OPTIONAL Compounds

	Bifenazate (sum)			Chloridazon-desphenyl			ETU			Formetanate-HCl			Maleic hydrazide		
Date of extraction	01.03.2022	14.03.2022	07.04.2022	08.03.2022	15.03.2022	13.04.2022	08.03.2022	15.03.2022	13.04.2022	01.03.2022	14.03.2022	07.04.2022	08.03.2022	15.03.2022	13.04.2022
No. 050	0.303	0.29	0.315	0.054	0.054	0.056	0.055	0.052	0.055	0.849	0.797	0.823	0.550	0.521	0.514
No. 096	0.305	0.279	0.304	0.052	0.053	0.053	0.058	0.052	0.055	0.819	0.775	0.814	0.536	0.493	0.600
No. 156	0.288	0.271	0.31	0.054	0.053	0.054	0.056	0.055	0.058	0.846	0.762	0.804	0.506	0.488	0.486
Mean [mg/kg]	**0.298**	**0.280**	**0.310**	**0.053**	**0.053**	**0.054**	**0.056**	**0.053**	**0.056**	**0.838**	**0.778**	**0.814**	**0.531**	**0.501**	**0.533**
% Diviation (vs. 1st Anaylsis)	-	-6.3%	3.7%	-	0%	1.9%	-	-5.7%	-0.3%	-	-7.1%	-2.9%	-	-5.7%	0.5%
Diff (mean)	-	**0.02**	**0.01**	-	**0.0**	**0.001**	-	**0.0032**	**0.0002**	-	**0.060**	**0.024**	-	**0.030**	**0.0026**
0.3*FFP-SD		**0.02**	**0.02**		**0.0047**	**0.0047**		**0.0047**	**0.0047**		**0.066**	**0.066**		**0.041**	**0.041**
Stability test		**passed**	**passed**		**passed**	**passed**		**passed**	**passed**		**passed**	**passed**		**passed**	**passed**

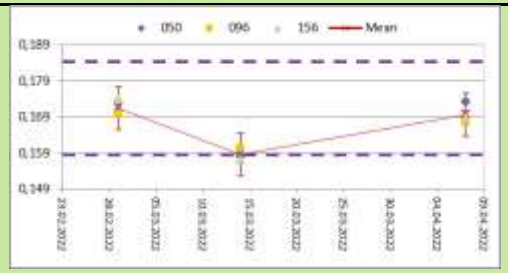
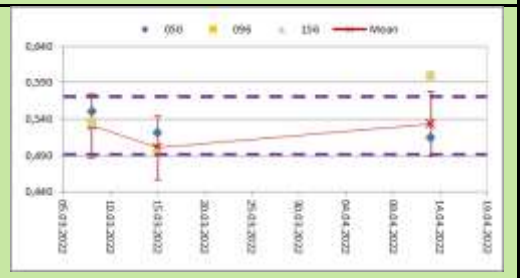
	Oxymatrine			2,4-DNOP (free phenol)			Meptyldinocap			Meptyldinocap (sum) calculated			Meptyldinocap (sum) after alk. Hydrolysis		
Date of extraction	08.03.2022	15.03.2022	13.04.2022	01.03.2022	14.03.2022	07.04.2022	01.03.2022	14.03.2022	07.04.2022	01.03.2022	14.03.2022	07.04.2022	01.03.2022	14.03.2022	07.04.2022
No. 050	0.190	0.174	0.175	0.054	0.051	0.053	0.105	0.107	0.100	0.171	0.168	0.166	0.157	0.160	0.163
No. 096	0.181	0.172	0.180	0.054	0.050	0.052	0.104	0.104	0.098	0.170	0.165	0.162	0.160	0.160	0.163
No. 156	0.181	0.171	0.170	0.055	0.052	0.053	0.106	0.109	0.103	0.173	0.173	0.169	0.161	0.164	0.166
Mean [mg/kg]	**0.184**	**0.172**	**0.175**	**0.054**	**0.051**	**0.053**	**0.105**	**0.106**	**0.100**	**0.171**	**0.168**	**0.165**	**0.159**	**0.161**	**0.164**
% Diviation (vs. 1st Anaylsis)	-	-6.4%	-4.8%	-	-6.5%	-2.8%	-	1.1%	-4.4%	-	-1.8%	-3.6%	-	1.5%	3.1%
Diff (mean)	-	**0.012**	**0.0088**	-	**0.0035**	**0.0015**	-	**0.0012**	**0.0047**	-	**0.003**	**0.0062**	-	**0.0023**	**0.005**
0.3*FFP-SD		**0.015**	**0.015**		**0.0042**	**0.0042**		**0.0075**	**0.0075**		**0.013**	**0.013**		**0.013**	**0.013**
Stability test		**passed**	**passed**		**passed**	**passed**		**passed**	**passed**		**passed**	**passed**		**passed**	**passed**

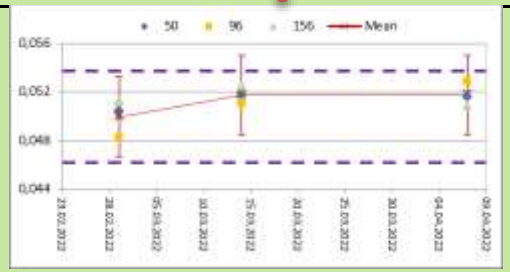
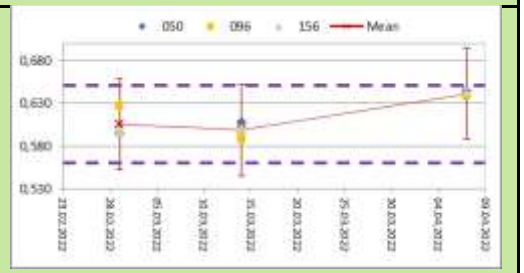
All stability test samples were extracted at the indicated day and measured alltogether at the end.

EURL-SRM STABILITY TEST

Graphic presentation of stability test results:

Mean values within range, individual values partly outside

EXAMPLES	Chlorothalonil	Dithiocarbamates (CS2)	Maleic Hydrazide
	---- limits for acceptable mean values	RSD % of five injections of one sample	
„On the border“ (Mean within range“			

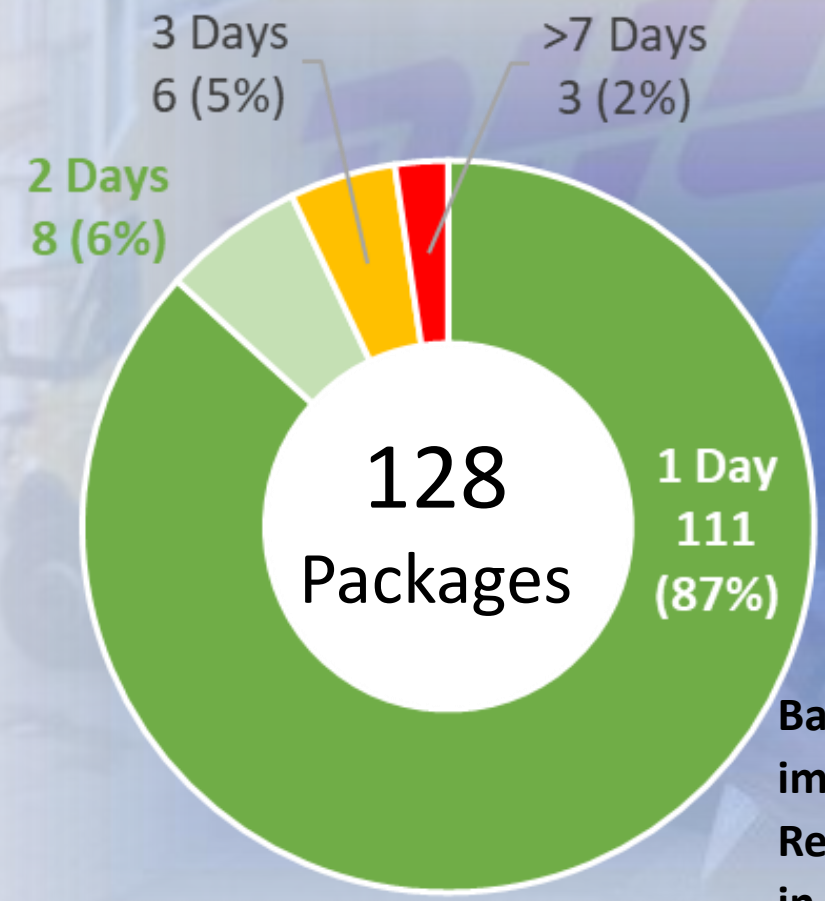
EXAMPLES	Chloridazone-desphenyl	Emamectin B1a	THPI
	---- limits for acceptable mean values	RSD % of five injections of one sample	
all within range			

Fluctuation margin shown in graphs is for orientation (derived from 5-fold injection of one extract)

EURL-SRM

STABILITY DURING SHIPPING

Shipment Duration



- **Within 2 days: 93 %**
- **Within 3 days:**
  - 1 EU remote Location
  - 1 EU Candidate Country
  - 4 to Spain due to thunderstorm (2 days delay at DHL Leipzig)
- **7 and 9 days: EU Candidate and 3rd Countries**
  - TH (7 days): was kept frozen at local DHL
  - RS (7 days): received thawed but cold
  - KR (9 days): received thawed but cold

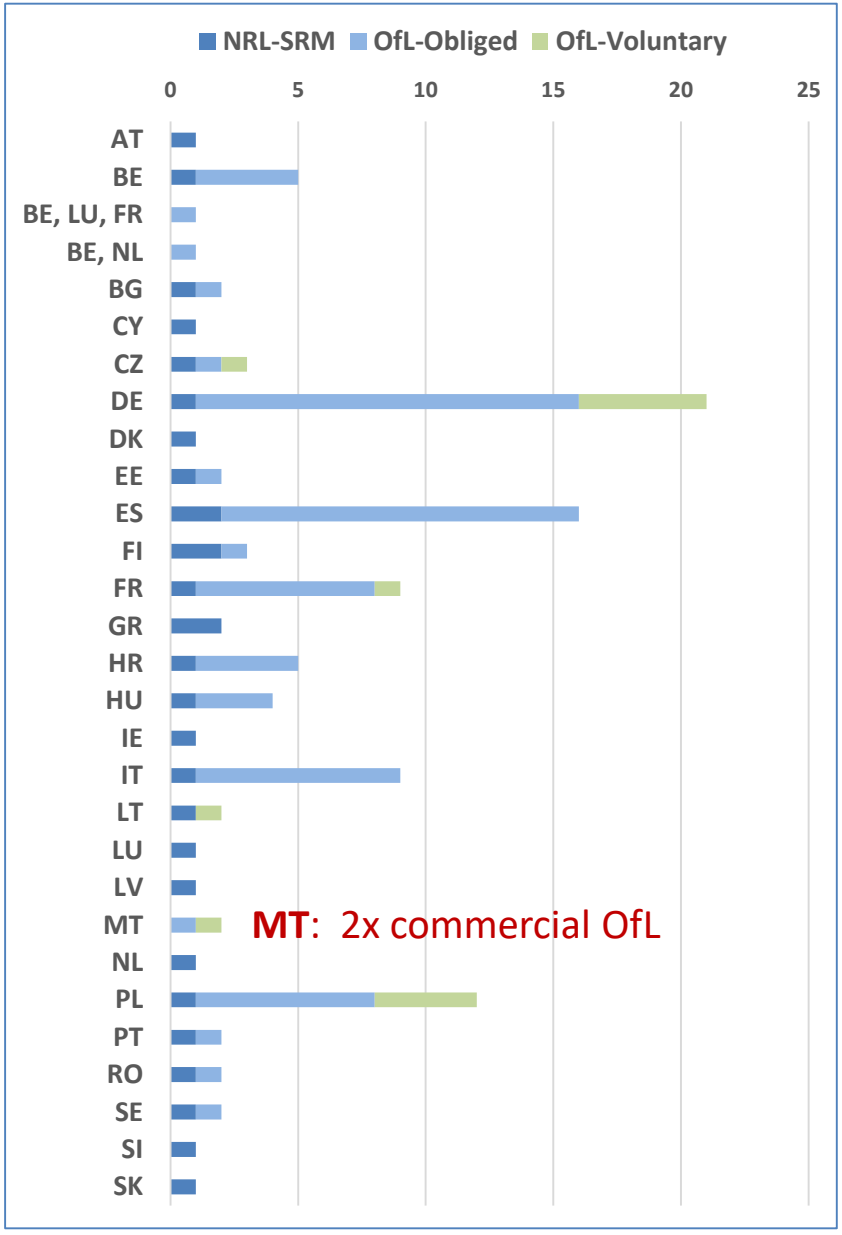
Based on own experiments defrosting had a negative impact on captan and folpet.
Results of labs receiving defrosted material also point in this direction.

EURL-SRM PARTICIPATING LABS / COUNTRIES

	Labs submitting results	Registered WITHOUT submitting results
EU OfLs	114	3*
EFTA OfLs	4	0
3rd Countries + EU Candidates	5	0
SUM	123	3*

*:
2 labs informed during/after SRM17 that none of the target pesticides was within their scope → Excl. from participats list.
1 lab has not given any reasonfor non-participation, even after repeated requests.

EURL-SRM PARTICIPATING LABS / COUNTRIES



EFTA-Countries	Participated in EUPT-SRM17
CH	4
NO	1
EFTA-Total	4

EU Candidate & 3rd countries	Participated in EUPT-SRM17
KR	1
RS	2
TH	1
UK	1
EU Cand. & 3rd C. Total	5

Three labs not submitting results not shown

EURL-SRM

FREQUENCY OF ANALYSIS

COMPULSORY and OPTIONAL Compounds

EU+EFTA

Percentage based on 118 (114 EU + 4 EFTA) labs registered and submitting results

Present in Test Material	No. of Labs Analysed	
Chlorothalonil	103	87%
Pymetrozine	101	86%
DTCs (expr. as CS2)	99	84%
Dodine	96	81%
Cyromazine	92	78%
Emamectin B1a	91	77%
Captan	90	76%
Folpet	90	76%
Phthalimide	83	70%
Formetanate-HCl	81	69%
THPI	80	68%
Bifenazate (sum)	59	50%
Maleic hydrazide	47	40%
Oxymatrine	36	31%
Chloridazon-desphenyl	32	27%
Meptyldinocap	28	24%
ETU	19	16%
Meptyldinocap (sum)	16	14%
2,4-DNOP (free phenol)	15	13%

NOT Present in Test Material	No. of Labs Analysed	
Chlormequat (chloride)	94	80%
Mepiquat (chloride)	93	79%
Avermectin B1a	92	78%
Fenbutatin Oxide	82	69%
Dithianon	78	66%
TFNA	77	65%
TFNG	77	65%
BAC-C12 (chloride)	63	53%
DDAC-C10 (chloride)	63	53%
Matrine	49	42%
Nicotine	47	40%
Diquat (dication)	42	36%
Paraquat (dication)	40	34%
Trimesium (cation)	30	25%
PTU	20	17%

EURL-SRM

FALSE NEGATIVES

COMPULSORY Compounds

EU+EFTA

False Negatives (FN) = 17

	Analyte	MRRL [mg/kg]	AV [mg/kg]	No. of FNs	Lab Code	RL [mg/kg]	Judgement
COMPULSORY	Captan	0.02	0.172	7	3	0.02	FN
					13	0.01	FN
					30	0.02	FR (result < RL and MRRL)
					66	0.5	FN* (RL > AV)
					73	0.02	FN
					106	0.02	FN
					110	0.01	FN
	Chlorothalonil	0.01	0.151	1	61	0.01	FN
	DTCs (expr. as CS2)	0.02	0.187	2	37	0.01	FN
					109	0.02	FN
	Folpet	0.02	0.249	1	13	0.01	FN
	Phthalimide	0.01	0.098	5	20	0.01	FN
					44	0.01	FN
					71	0.01	FN
					92	0.01	FN
					104	0.01	FN
	Pymetrozine	0.02	0.150	1	49	0.02	FN

False Reporting

Lab-Feedback: Measurement problems
Extended time where material was not frozen

Lab-Feedback: Mainly measurement problems

EURL-SRM

FALSE NEGATIVES

OPTIONAL Compounds

EU+EFTA

False Negatives (FN) = 20

	Analyte	MRRL [mg/kg]	AV [mg/kg]	No. of FNs	Lab Code	RL [mg/kg]	Judgement
OPTIONAL	Chloridazon-desphenyl	0.02	0.061	8	3	0.02	FN
					30	0.02	FN
					41	0.01	FR (result < RL and MRRL)
					45	0.01	FN
					99	0.01	FN
					110	0.01	FN
					114	0.02	FN
					120	0.01	FN
	ETU	0.01	*0.063*	1	12	0.01	FN
	Formetanate-HCl	0.01	0.873	5	4	0.01	FN
					12	0.01	FN
					71	0.01	FN
					112	0.01	FN
					113	0.01	FN
	Maleic hydrazide	0.05	0.544	1	109	0.05	FN
	2,4-DNOP (free phenol)	0.01	*0.056*	2	10	0.01	FN
					112	0.01	FN
	Meptyldinocap	0.02	*0.100*	3	10	0.02	FN
					30	0.02	FN
					50	0.02	FN

False Reporting

Lab-Feedback: Trascription errors, misinter-pretation of results, mismatching of analytes

Lab-Feedback: Mainly measurement problems and reporting errors

EURL-SRM

FALSE POSITIVES

EU+EFTA

COMPULSORY Compounds

False Positives (FP) = None !

OPTIONAL Compounds

False Positives (FP) = 4

Compound	MRRL [mg/kg]	Lab Code	RL [mg/kg]	Results [mg/kg]	Judgement
BAC-C12 (chloride)	0.02	75	0.02	0.68	FP
DDAC-C10 (chloride)	0.01	75	0.01	0.099	FP
Matrine	0.02	102	0.02	0.029	FP
Paraquat (dication)	0.01	74	0.01	0.92	FP

RESULTS OVERVIEW

COMPULSORY Compounds

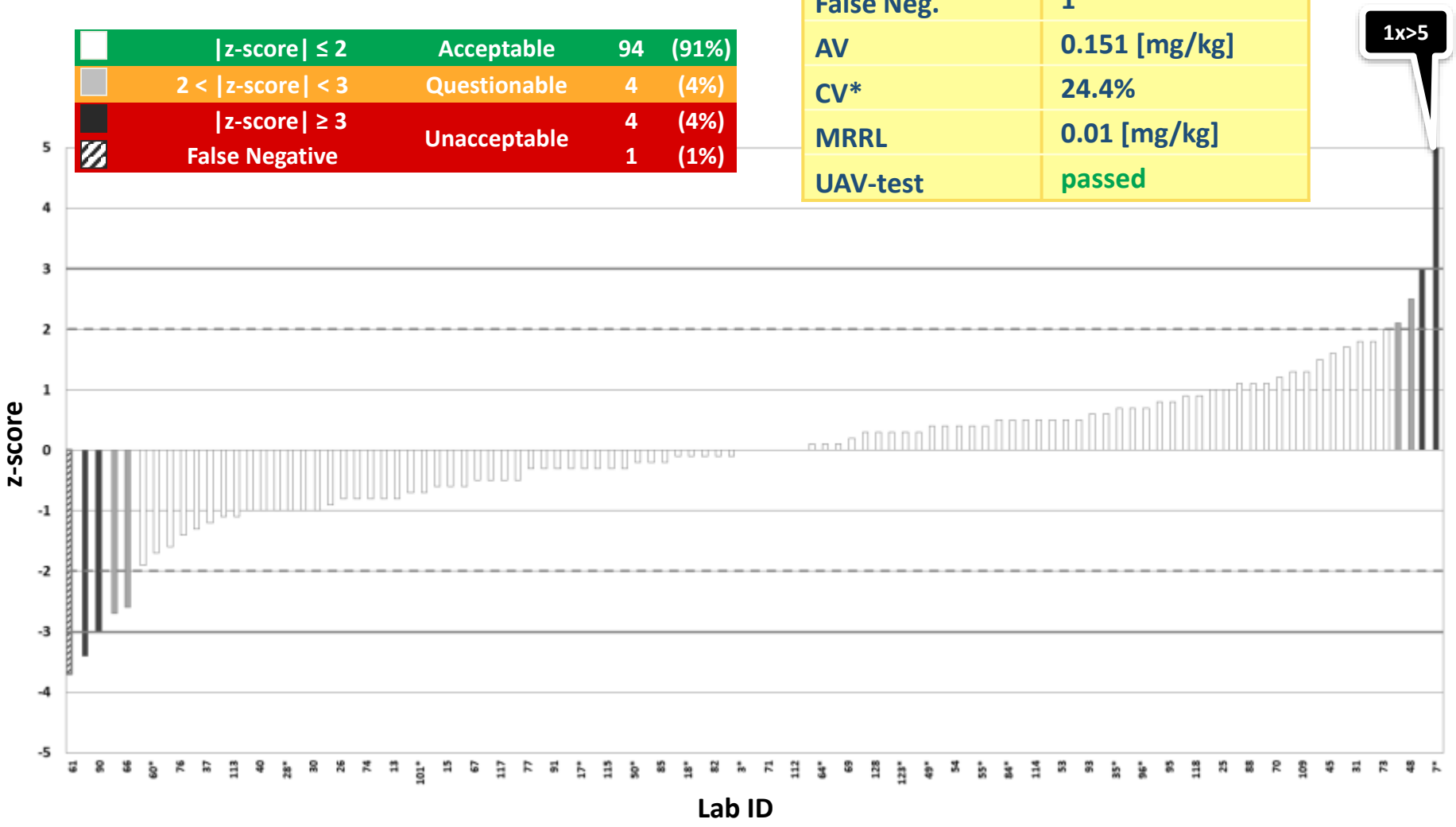
EURL-SRM

CHLOROTHALONIL

Chlorothalonil

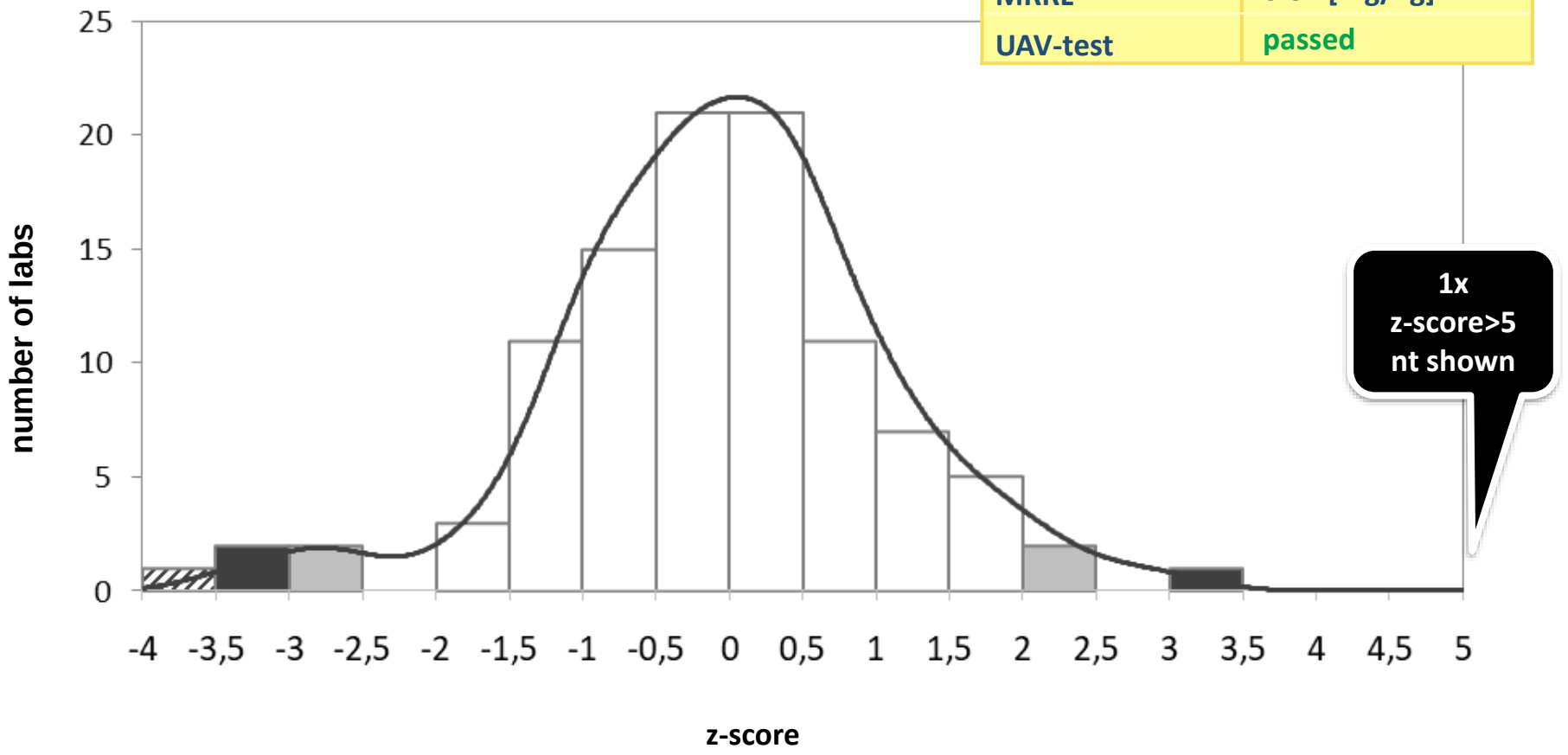
|z-score| ≤ 2	Acceptable	94	(91%)
2 < |z-score| < 3	Questionable	4	(4%)
|z-score| ≥ 3	Unacceptable	4	(4%)
False Negative		1	(1%)

Results	102
False Neg.	1
AV	0.151 [mg/kg]
CV*	24.4%
MRRL	0.01 [mg/kg]
UAV-test	passed



Chlorothalonil

Results	102
False Neg.	1
AV	0.151 [mg/kg]
CV*	24.4%
MRRL	0.01 [mg/kg]
UAV-test	passed



EURL-SRM

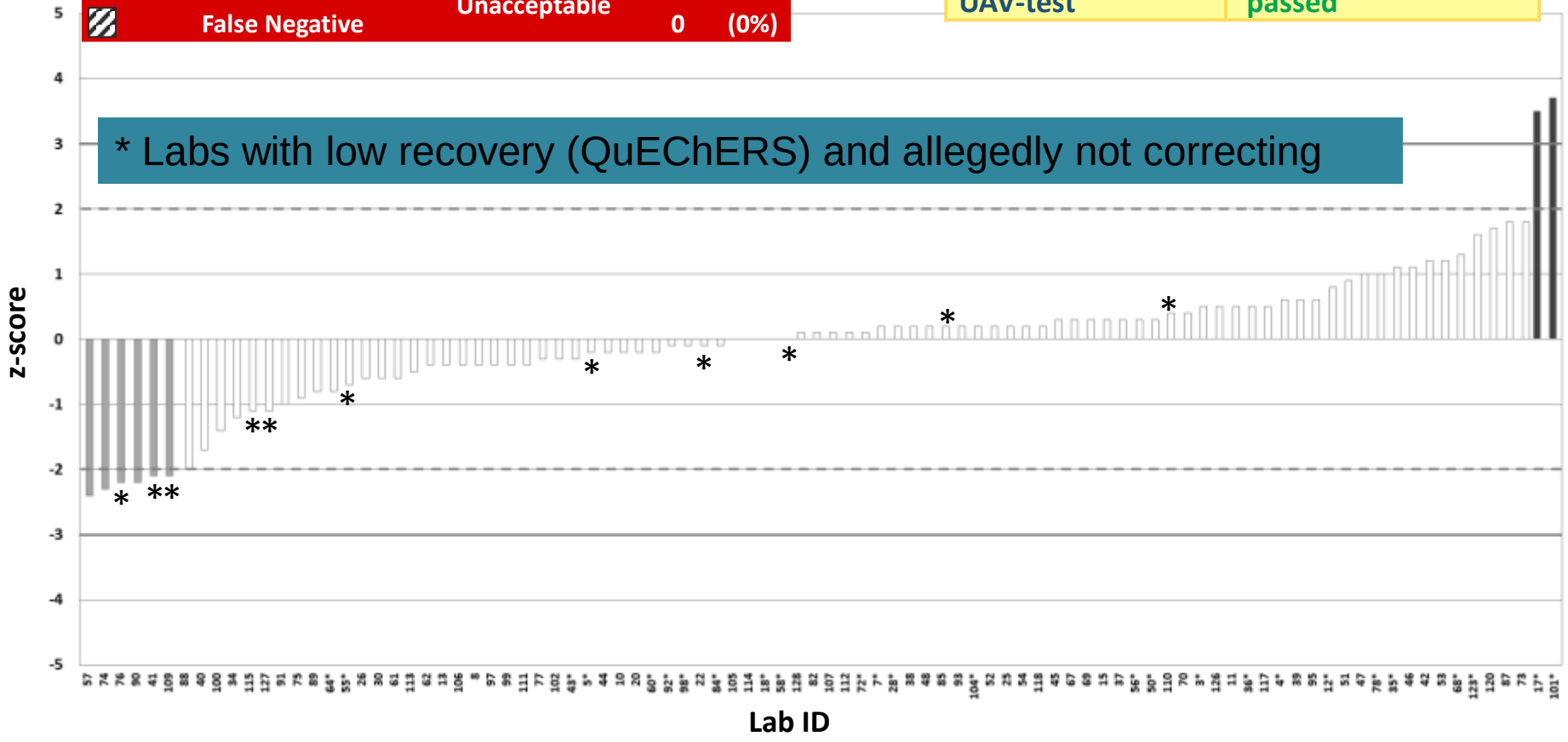
CYROMAZINE

Cyromazine

|z-score| ≤ 2	Acceptable	84	(91%)
2 < |z-score| < 3	Questionable	6	(7%)
|z-score| ≥ 3	Unacceptable	2	(2%)
False Negative		0	(0%)

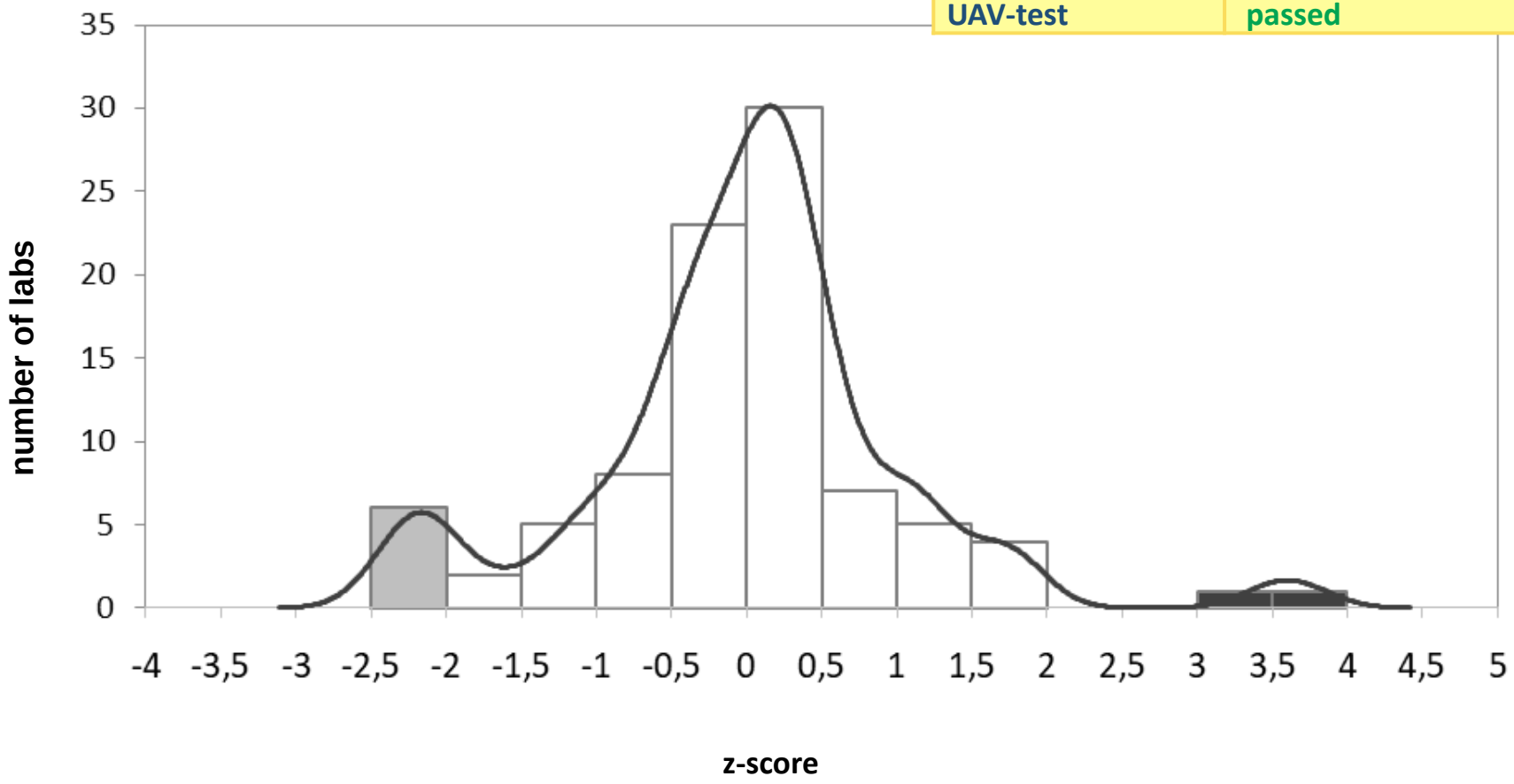
Results	92
False Neg.	0
AV	0.154 [mg/kg]
CV*	20.3%
MRRL	0.02 [mg/kg]
UAV-test	passed

* Labs with low recovery (QuEChERS) and allegedly not correcting



Cyromazine

Results	92
False Neg.	0
AV	0.154 [mg/kg]
CV*	20.3%
MRRL	0.02 [mg/kg]
UAV-test	passed



EURL-SRM

IMPACT OF ILIS

Cyromazine:

Cyromazine	Whole Population	Matching ILIS	No matching ILIS
No. Numerical results	92	19	73
No. FNs	0	0	0
No. Outliers °	0	0	0
AV [mg/kg]	**0.154**	**0.161**	**0.152**
CV* [%]	**20.3**	**9.9**	**23.5**
UAV [mg/kg]	0.0041	0.0046	0.0053
Tolerance [mg/kg]	0.0116	0.0121	0.0114
	passed	passed	passed

Cyromazine: impact of Matching ILIS

Cyromazine	Matching ILIS
No. Numerical results	19
No. FNs	0
No. Outliers °	0
AV [mg/kg]	**0.161**
CV* [%]	**9.9**
UAV [mg/kg]	0.0046
Tolerance [mg/kg]	0.0121
	passed

Method	N
QuEChERS	4
QuPPe	15

Calibration Approach	
Procedural	1
StAdd-SP	2
StAdd-EA	1
MM	11
MB	0
SB_	4

Additional measure for correction for recovery

Cyromazine: Overview

Calibr. Approach	N	SUM
Procedural	14	23
StAdd-SP	9	
StAdd-EA	3	50 (27x QuEChERS 23x QuPPe)
MM	28	
MB	6	
SB	13	
SUM	73	

Also correcting for recovery (via Calibration Approach)

thereof ...
17x correcting for recov. via Recovery Factor (thereof 14x QuEChERS) ↓

and ...
33x NOT corr. for recov. (thereof ... 19x QuPPe and 12x QuEChERS)

Cyromazine	Whole Population	Matching ILIS	No matching ILIS
No. Numerical results	92	19	73
No. FNs	0	0	0
No. Outliers °	0	0	0
AV [mg/kg]	0.154	0.161	0.152
CV* [%]	20.3	9.9	23.5

	QuEChERS Rec.	Z-Score
1	44 %	-1,43
2	31 %	-0,81
3	61 %	-0,47
4	45 %	-0,36
5	44 %	0,16
6	49 %	0,16
7	51 %	0,23
8	52 %	0,31
9	50 %	0,31
10	40 %	1,12
11	36 %	1,19
12	32 %	1,58
13	30 %	1,74
14	34 %	3,53
	AVG: 43 %	AVG: 0.29

Summed-up:
64% of labs used an approach correcting results for recovery

Cyromazine: Impact of ILIS (cont.)

Cyromazine	No matching ILIS
No. Numerical results	73
No. FNs	0
No. Outliers °	0
AV [mg/kg]	**0.152**
CV* [%]	**23.5**
UAV [mg/kg]	0.0053
Tolerance [mg/kg]	0.0114
	passed

Cyromazine	QuEChERS no matching ILIS no RecCorr
No. Numerical results	12
No. FNs	0
No. Outliers °	0
AV [mg/kg]	**0.119**
CV* [%]	**47.4**
UAV [mg/kg]	0.0203
Tolerance [mg/kg]	0.0089
	failed

NO CORRECTION FOR RECOVERY

- **Neither via matching ILIS**
- **Nor via recovery factor** (QuEChERS recovery typically ~ 40%)
- **Nor via calibration, i.e. …**
  - NOT based on standard(s) prepared in PURE SOLVENT
  - NOT based on Standard(s) prepared in MATRIX Extract

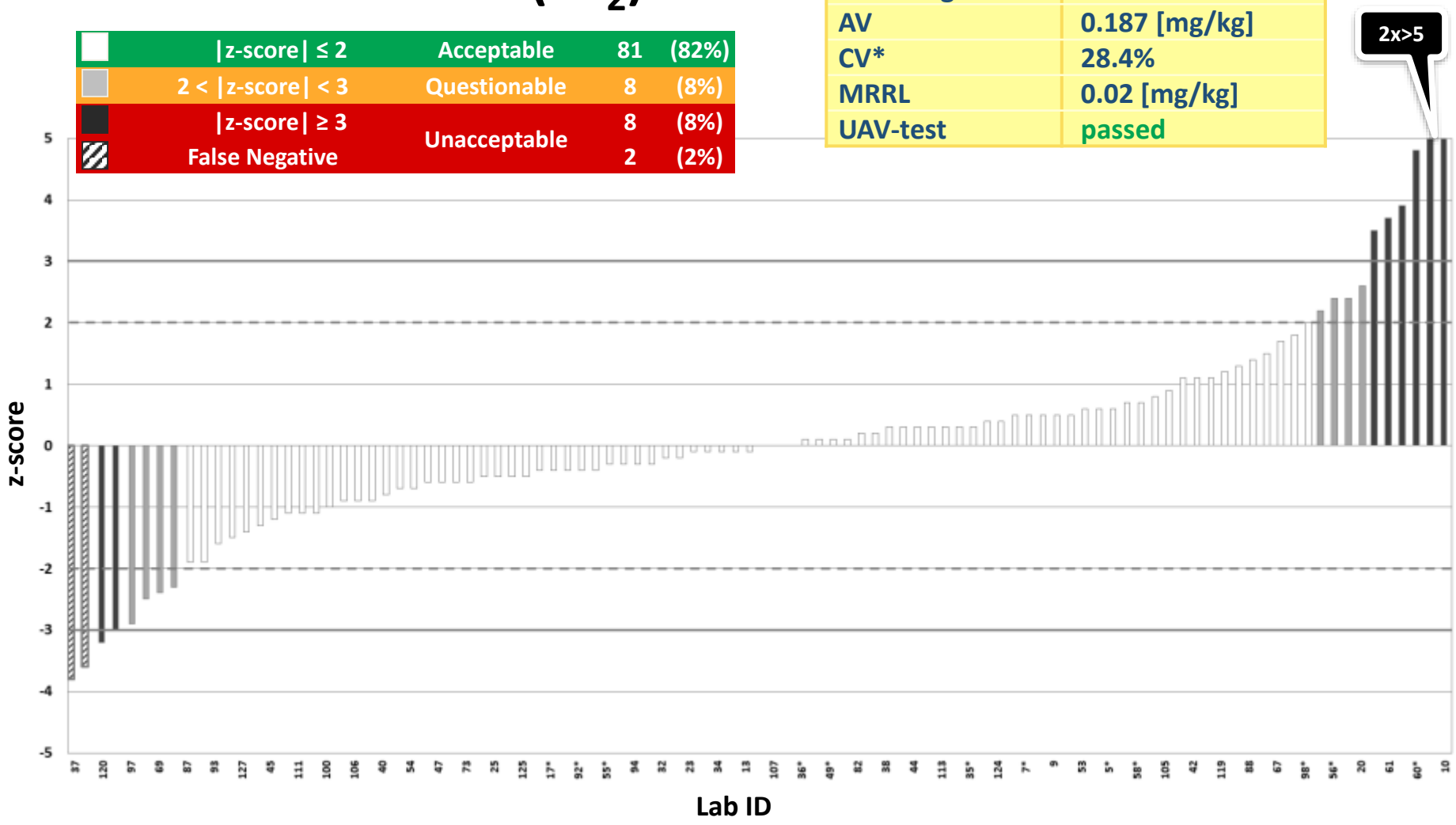
EURL-SRM

DITHIOCARBAMATES (CS_2)

Dithiocarbamates (CS_2)

|z-score| ≤ 2	Acceptable	81	(82%)
2 < |z-score| < 3	Questionable	8	(8%)
|z-score| ≥ 3	Unacceptable	8	(8%)
False Negative		2	(2%)

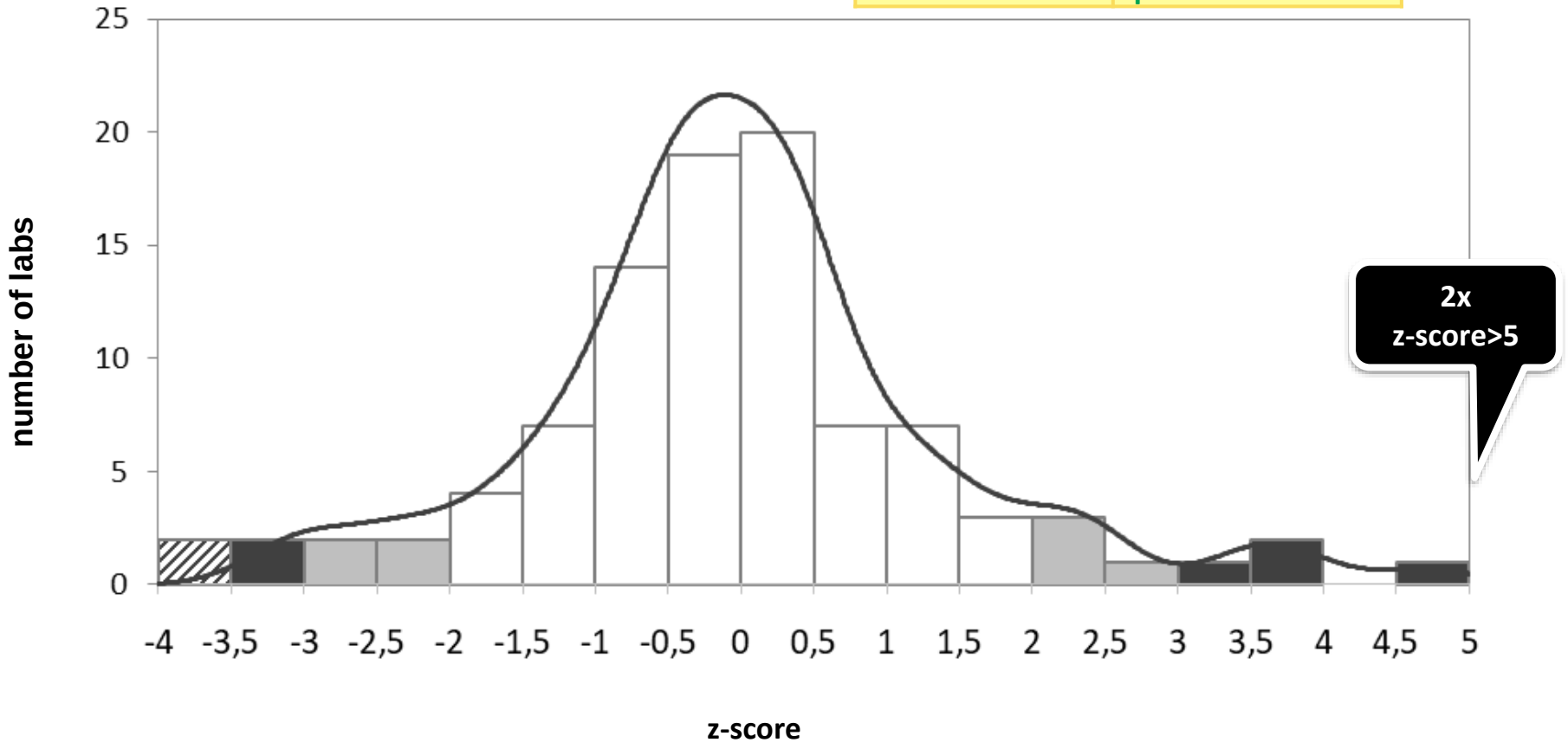
Results	97
False Neg.	2
AV	0.187 [mg/kg]
CV*	28.4%
MRRL	0.02 [mg/kg]
UAV-test	passed



DITHIOCARBAMATES (CS_2)

Dithiocarbamates (CS_2)

Results	97
False Neg.	2
AV	0.187 [mg/kg]
CV*	28.4%
MRRL	0.02 [mg/kg]
UAV-test	passed



Dithiocarbamates (CS_2)

Comparison of Methods

Dithiocarbamates (expr. as CS2)	All Results	HS + SPME	LLP	Spectrophoto-metric
No. Numerical results	97	32	42	18
No. FNs	2	2	0	0
No. Outliers °	2	1	1	0
AV [mg/kg]	**0.187**	**0.205**	**0.183**	**0.175**
CV* [%]	**28.4**	**31.8**	**31.1**	**20.0**
UAV [mg/kg]	0.0068	0.0147	0.0111	0.0103
Tolerance [mg/kg]	0.014	0.0154	0.0137	0.0131
	passed	**passed**	**passed**	**passed**

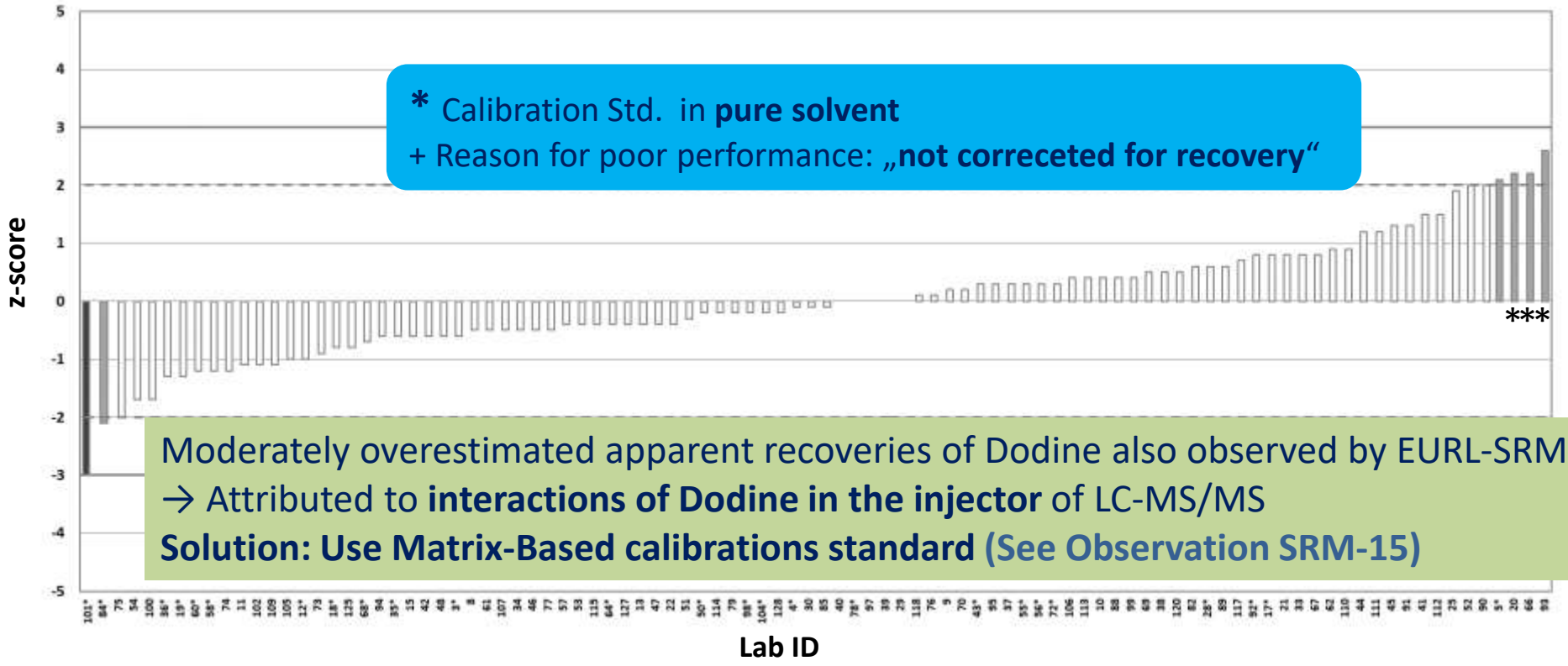
EURL-SRM

DODINE

Dodine

|z-score| ≤ 2	Acceptable	90	(94%)
2 < |z-score| < 3	Questionable	5	(5%)
|z-score| ≥ 3	Unacceptable	1	(1%)
False Negative		0	(0%)

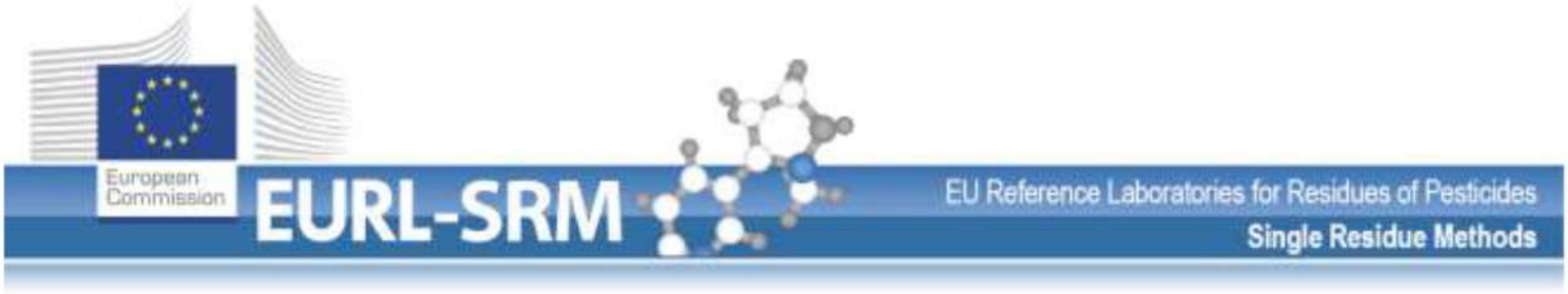
Results	96
False Neg.	0
AV	0.100 [mg/kg]
CV*	23.1%
MRRL	0.01 [mg/kg]
UAV-test	passed



* Calibration Std. in **pure solvent**
+ Reason for poor performance: „**not correceted for recovery**“

Moderately overestimated apparent recoveries of Dodine also observed by EURL-SRM
→ Attributed to **interactions of Dodine in the injector** of LC-MS/MS
Solution: Use Matrix-Based calibrations standard (See Observation SRM-15)

Analytical Observation Report SRM-15



Analytical Observation concerning…

☑ ***a compound*** ☐ ***a matrix*** ☑ ***a method*** ☐ ***other***

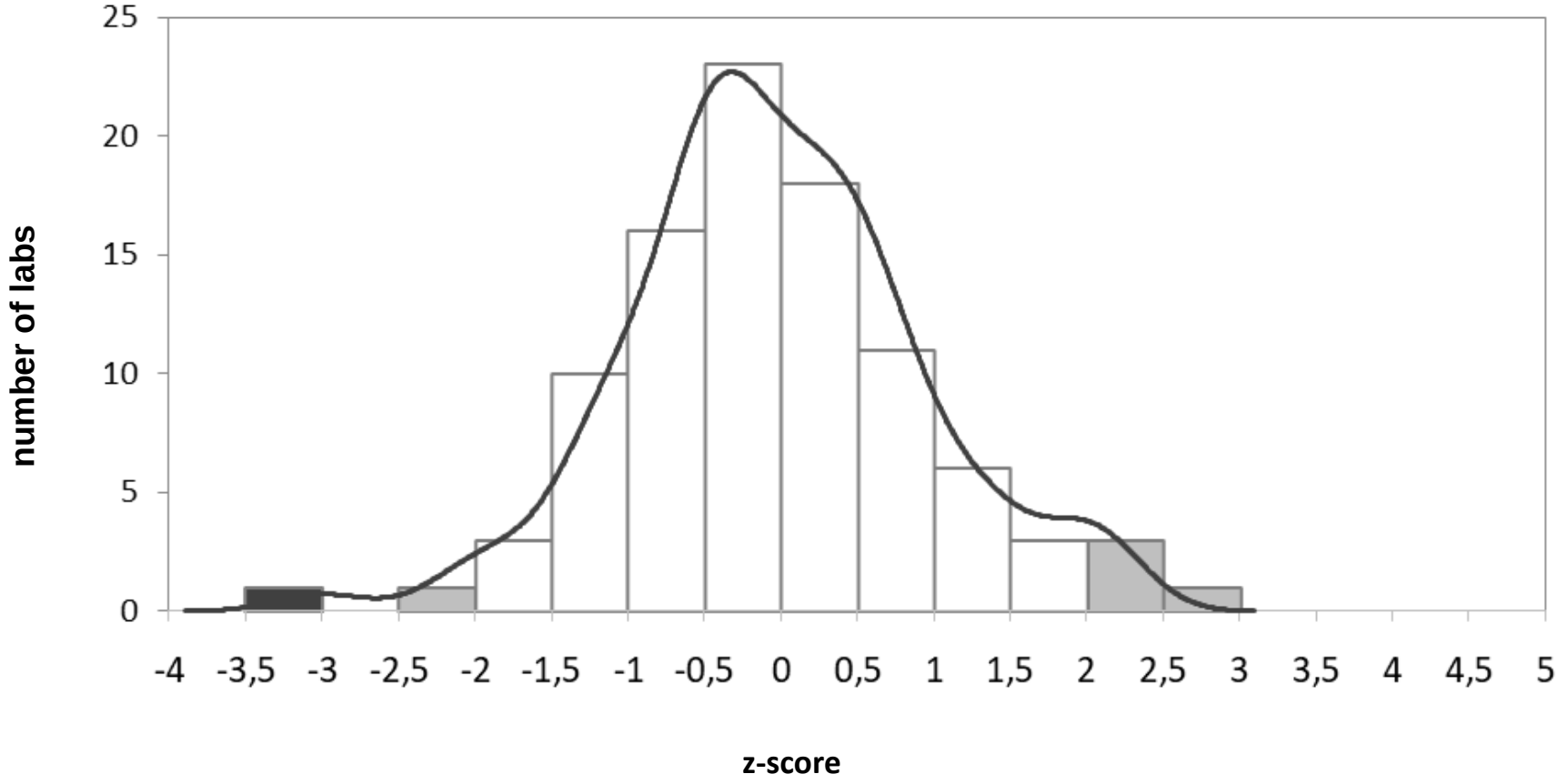
Analysis of Dodine by the QuEChERS Method - Interactions in the injector and role of matrix

Reported by: EURL-SRM

Version 1 (last update: 23.02.2015)

Dodine

Results	96
False Neg.	0
AV	0.100 [mg/kg]
CV*	23.1%
MRRL	0.01 [mg/kg]
UAV-test	passed



EURL-SRM

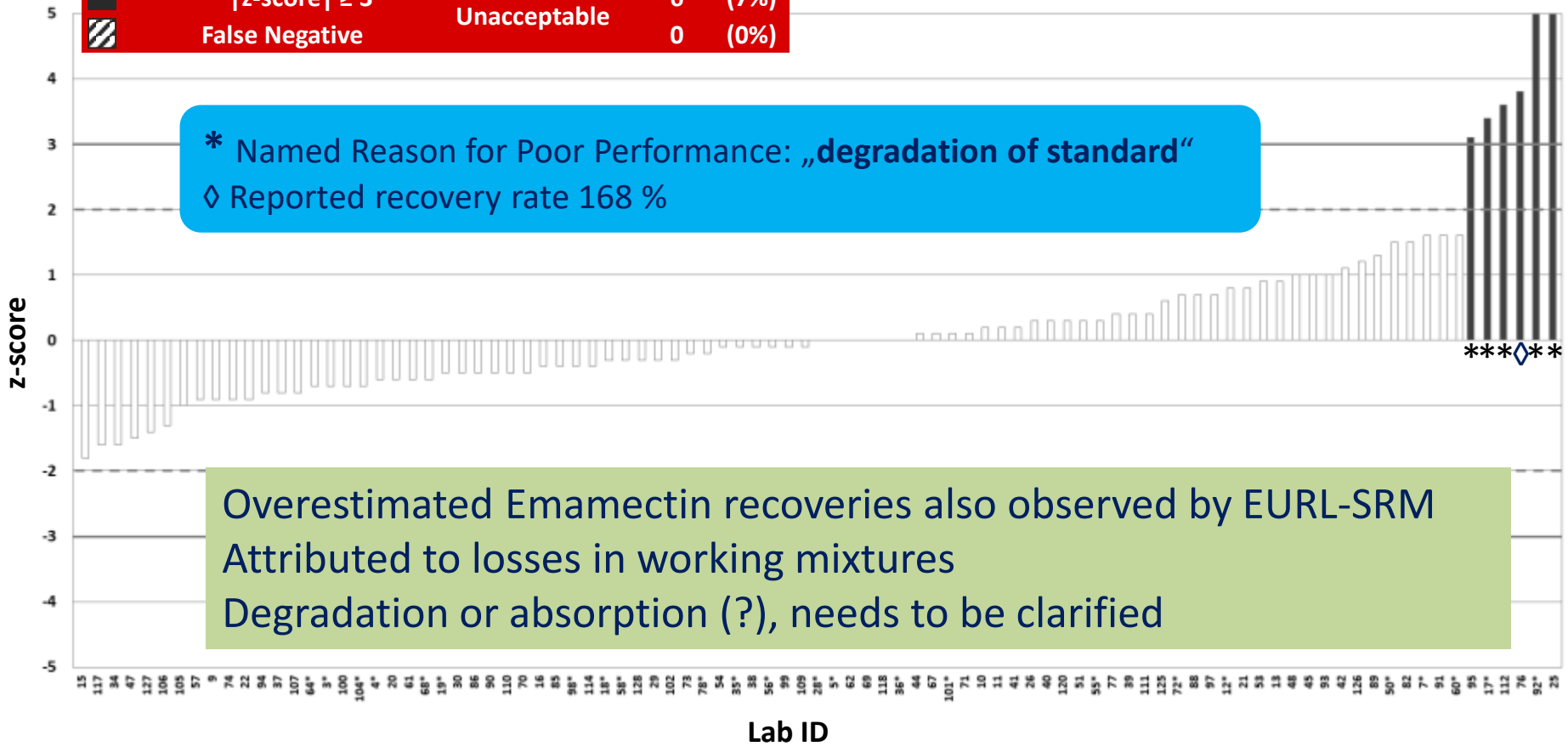
EMAMECTIN B1A

Emamectin B1a

	|z-score| ≤ 2	Acceptable	85	(93%)
	2 < |z-score| < 3	Questionable	0	(0%)
	|z-score| ≥ 3	Unacceptable	6	(7%)
	False Negative		0	(0%)

Results	91
False Neg.	0
AV	0.0461 [mg/kg]
CV*	21.5%
MRRL	0.01 [mg/kg]
UAV-test	passed

2x z>5

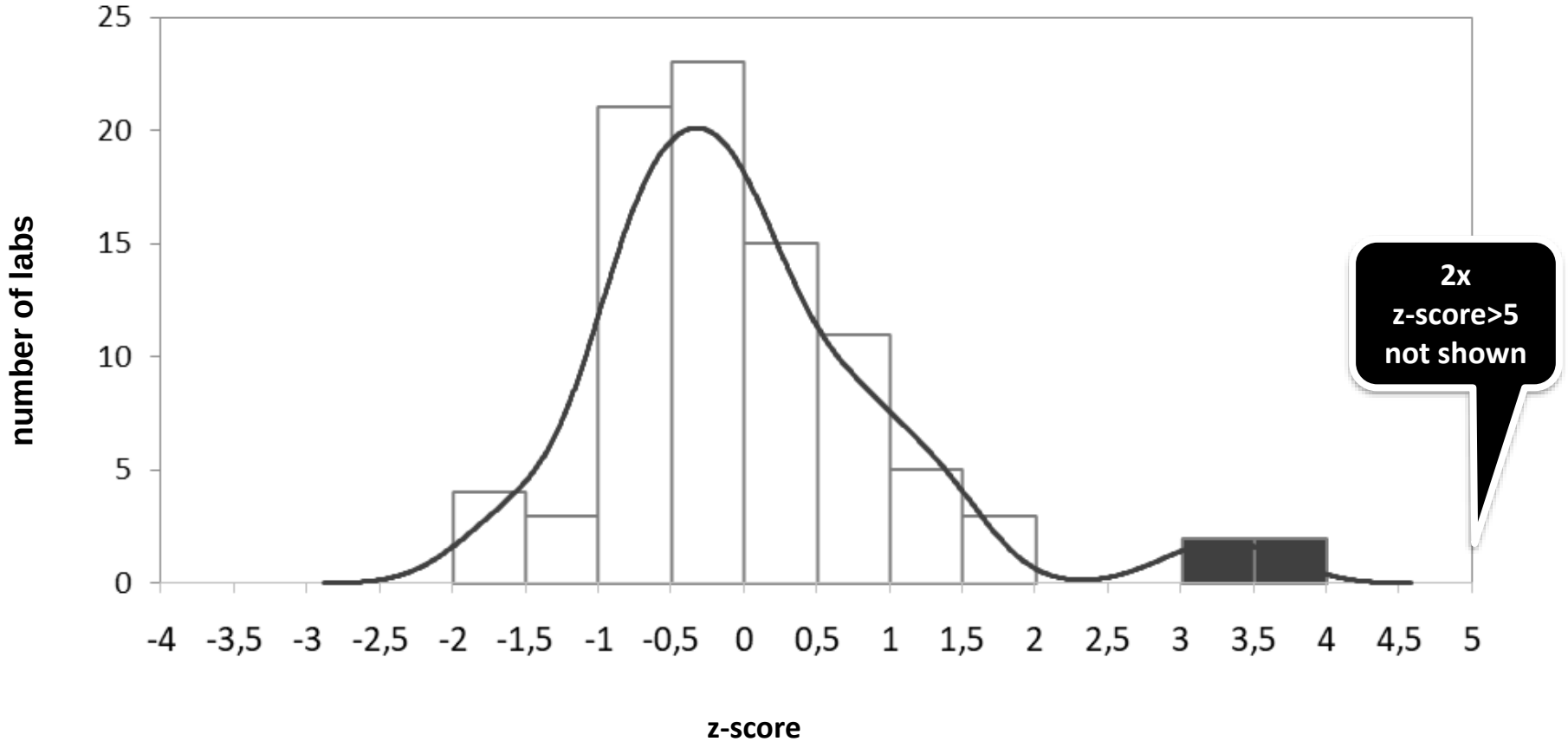


* Named Reason for Poor Performance: „**degradation of standard**“
◊ Reported recovery rate 168 %

Overestimated Emamectin recoveries also observed by EURL-SRM
Attributed to losses in working mixtures
Degradation or absorption (?), needs to be clarified

Emamectin B1a

Results	91
False Neg.	0
AV	0.0461 [mg/kg]
CV*	21.5%
MRRL	0.01 [mg/kg]
UAV-test	passed

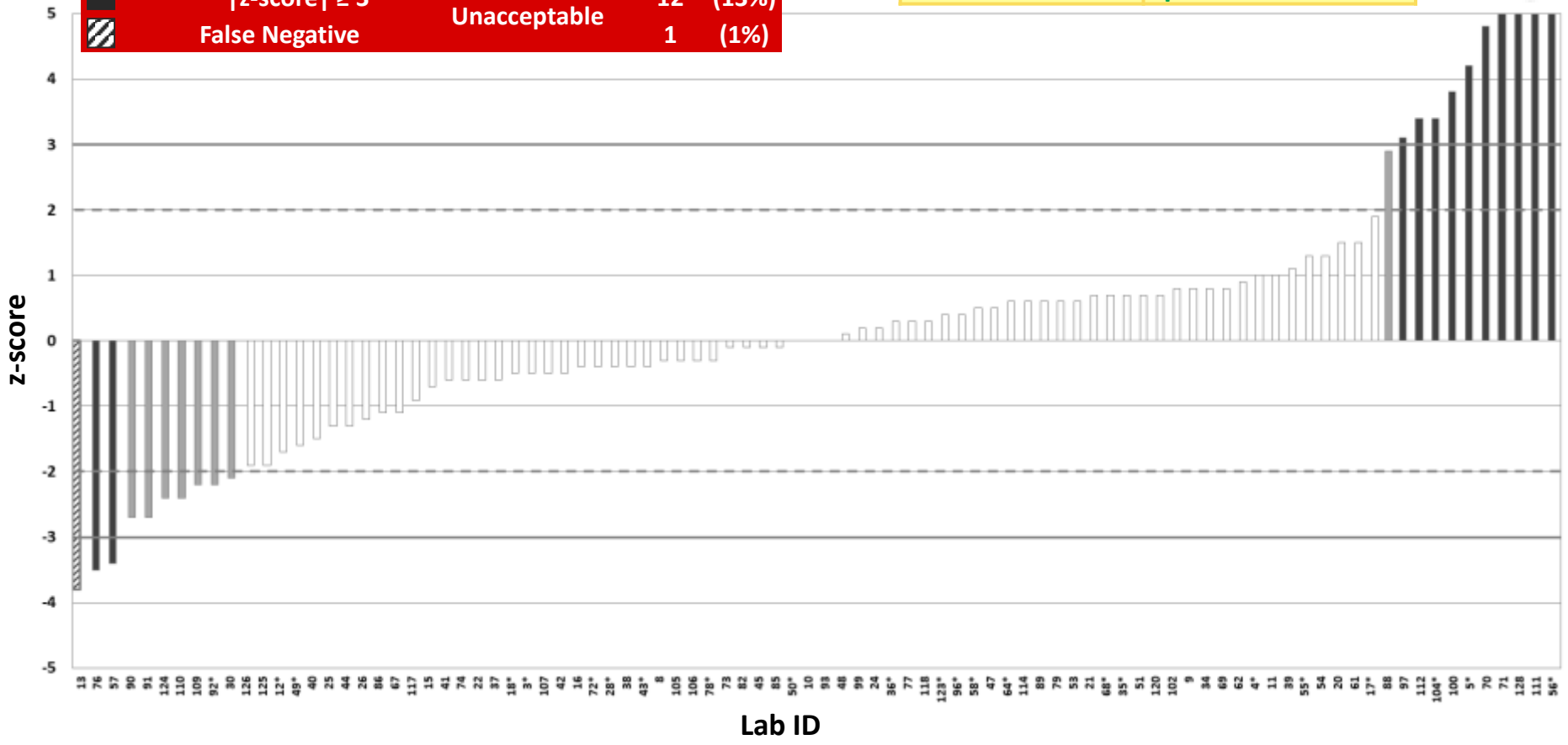


Folpet

|z-score| ≤ 2	Acceptable	69	(77%)
2 < |z-score| < 3	Questionable	8	(9%)
|z-score| ≥ 3	Unacceptable	12	(13%)
False Negative		1	(1%)

Results	89
False Neg.	1
AV	0.249 [mg/kg]
CV*	34.5%
MRRL	0.02 [mg/kg]
UAV-test	passed

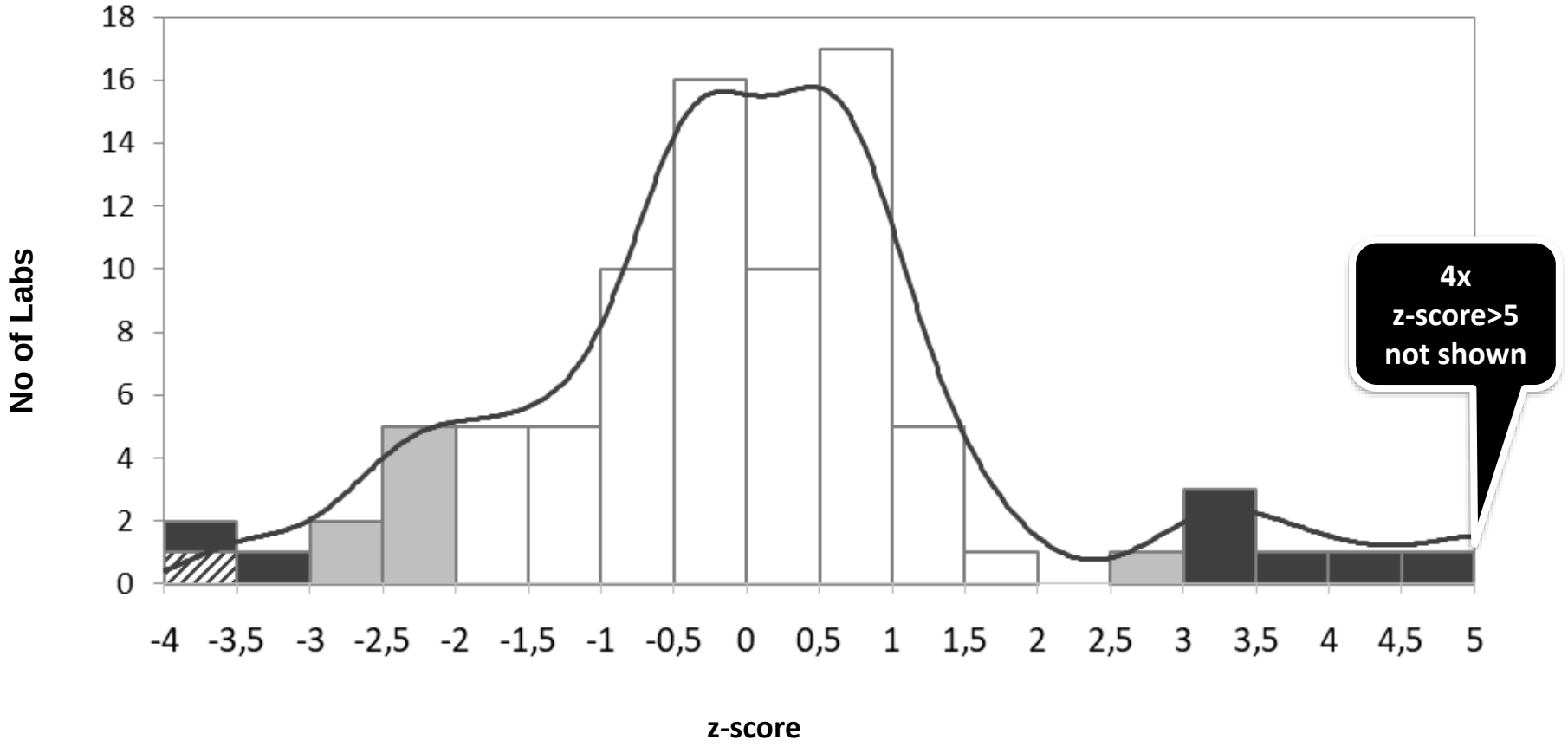
4x z>5



FOLPET

Folpet

Results	89
False Neg.	1
AV	0.249 [mg/kg]
CV*	34.5%
MRRL	0.02 [mg/kg]
UAV-test	passed



Investigation on FOLPET behaviour DURING THAWING

Rec Tomato 0.25 ppm n=2		Folpet	PI derived from Folpet NO PI Spiking calculated as Folpet
Time after Spiking	Extraction	Rec %	generation rate (%)
15h	QuEChERS	32	68
4h	QuEChERS	92	19
0h	QuEChERS	106	-
15h	QuE+1%FA	32	66
4h	QuE+1%FA	97	19
0h	QuE+1%FA	112	-

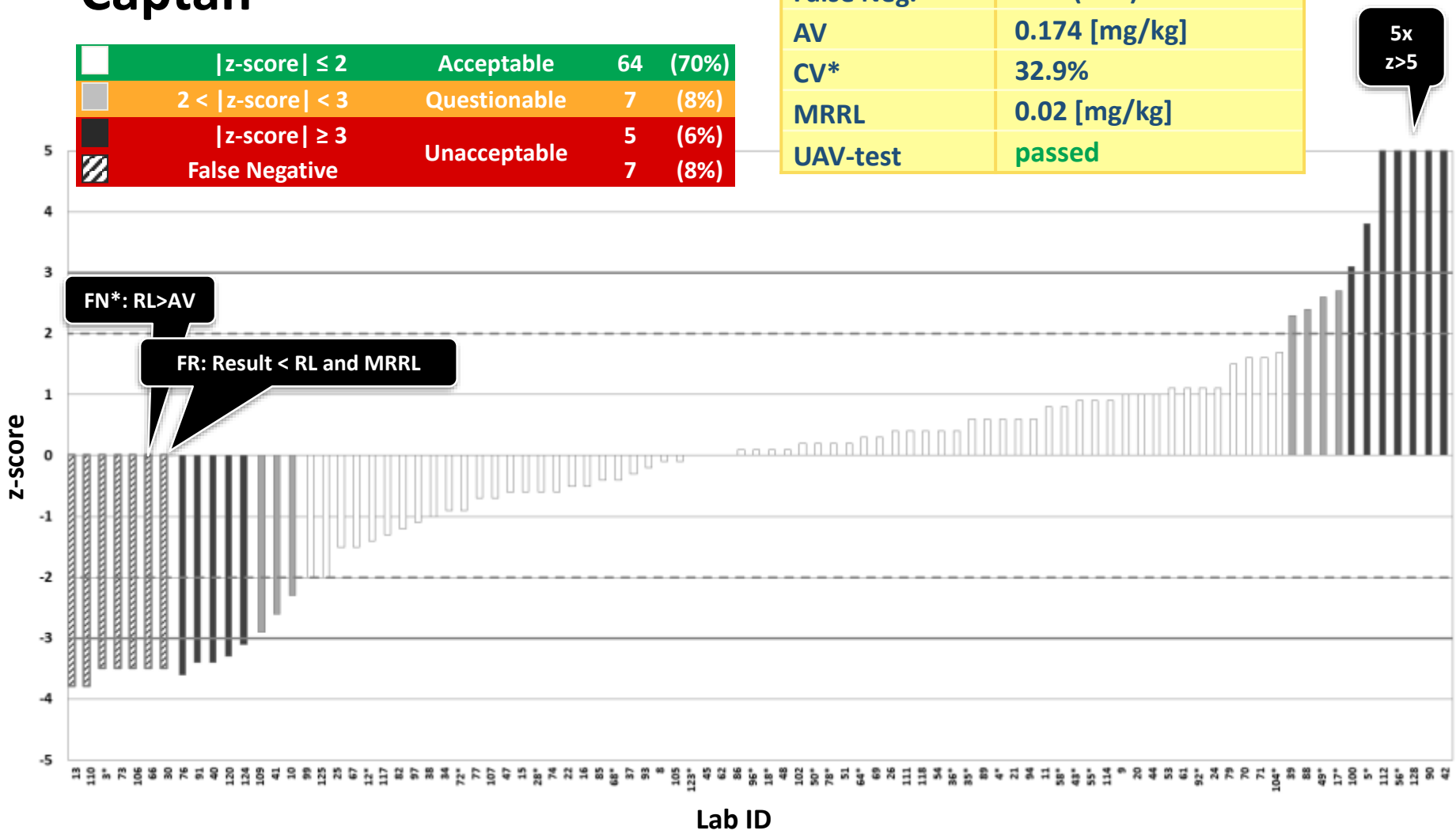
Loss of Folpet that goes along with PI generation

Thawed tomato blank was SPIKED WITH FOLPET and left standing at RT;
Analysis by LC-MS/MS:
Sample Preparation QuEChERS (No d-SPE) OR FA- QuEChERS (No d-SPE)

Captan

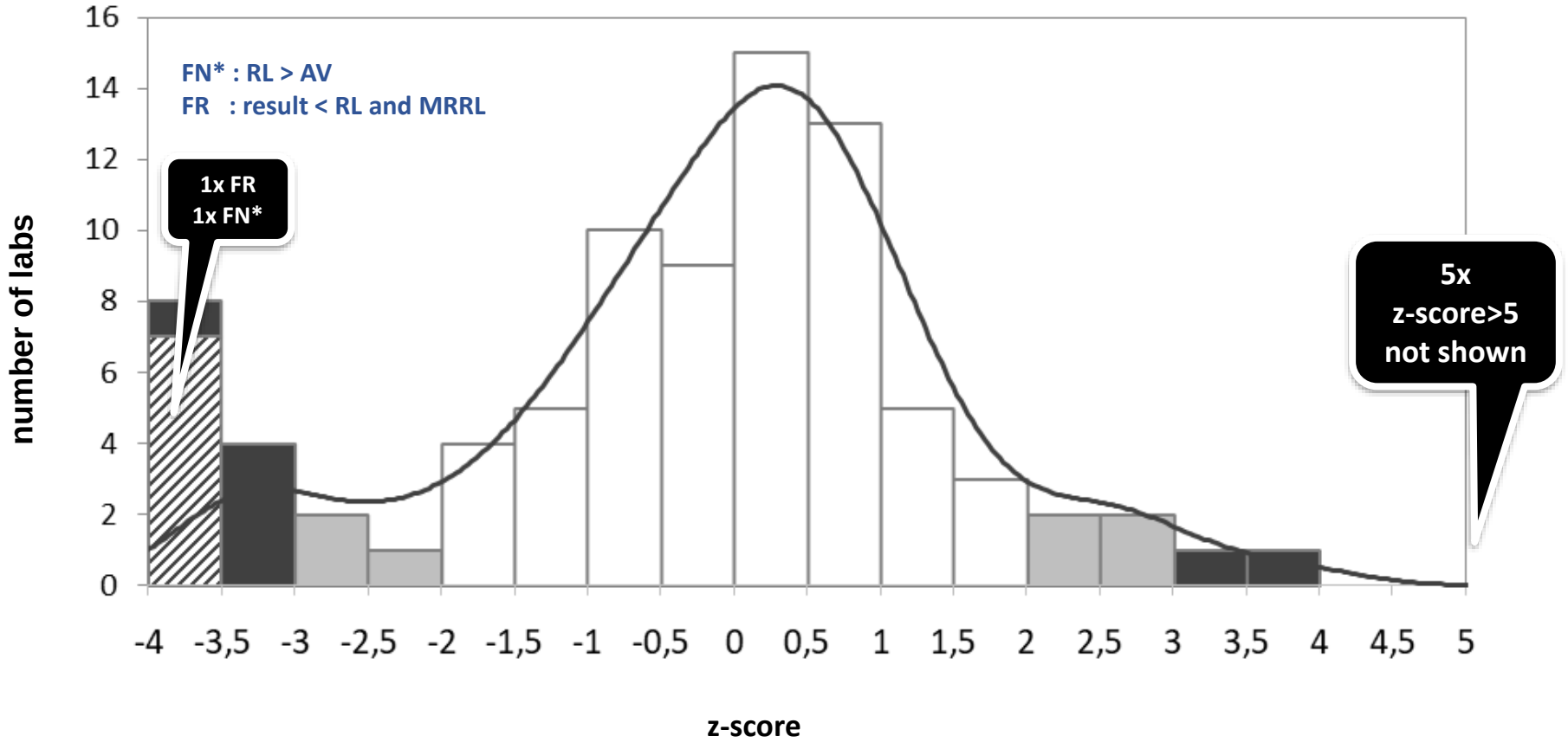
|z-score| ≤ 2	Acceptable	64	(70%)
2 < |z-score| < 3	Questionable	7	(8%)
|z-score| ≥ 3	Unacceptable	5	(6%)
False Negative		7	(8%)

Results	84
False Neg.	5 +1 (FN*)
AV	0.174 [mg/kg]
CV*	32.9%
MRRL	0.02 [mg/kg]
UAV-test	passed



Captan

Results	84
False Neg.	5 +1 (FN*)
AV	0.174 [mg/kg]
CV*	32.9%
MRRL	0.02 [mg/kg]
UAV-test	passed



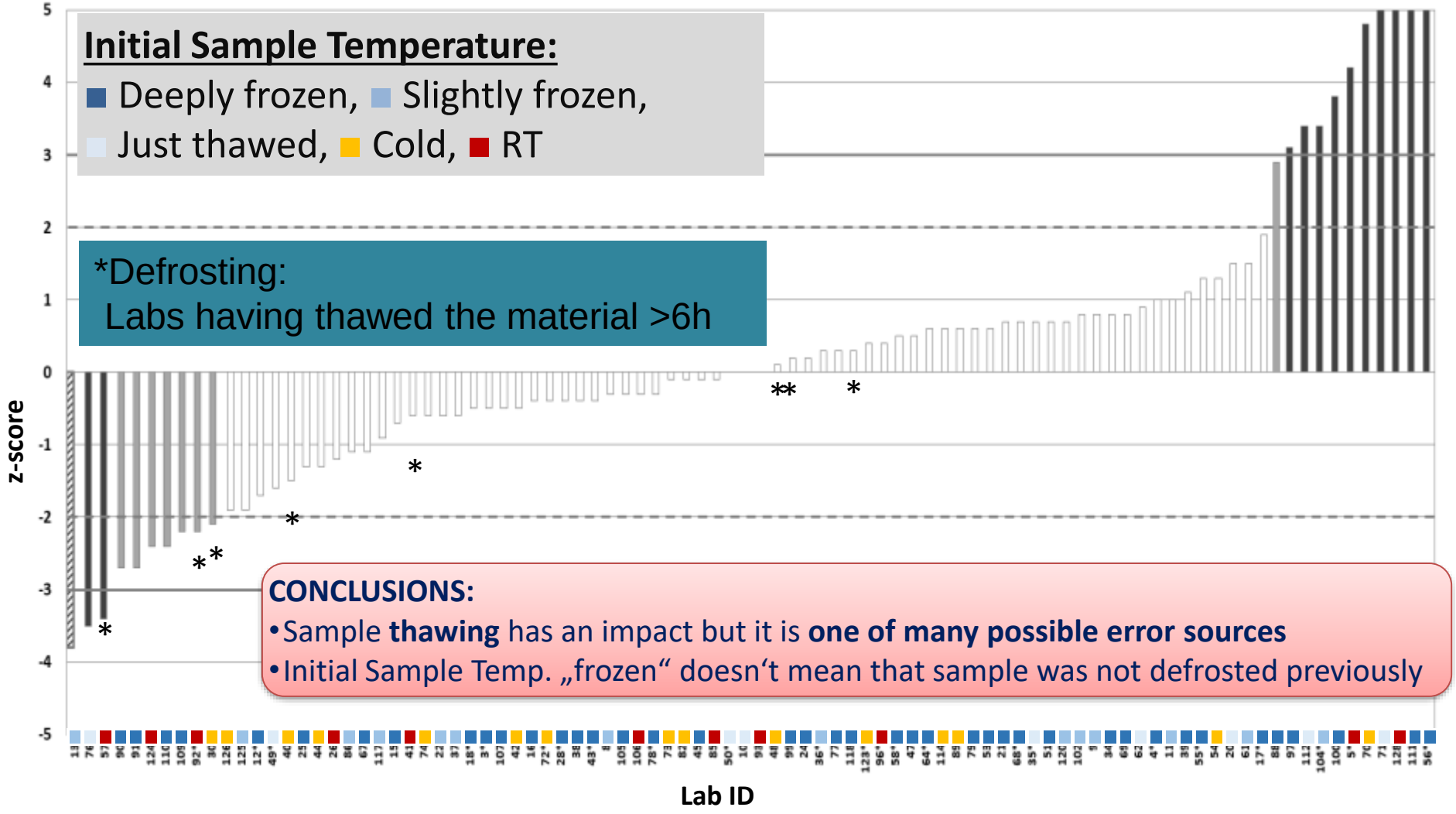
Investigation on CAPTAN behaviour DURING THAWING

Rec Tomato 0.25 ppm n=2		Captan	THPI derived from Captan NO THPI Spiking calculated as Captan
Time after Spiking	Extraction	Rec %	generation rate (%)
15h	QuEChERS	-	102
4h	QuEChERS	57	48
0h	QuEChERS	104	-
15h	QuE+1%FA	-	109
4h	QuE+1%FA	59	48
0h	QuE+1%FA	91	-

Loss of Captan that goes along with THPI generation

Thawed tomato blank was SPIKED WITH CAPTAN and left standing at RT;
Analysis by LC-MS/MS:
Sample Preparation QuEChERS (No d-SPE) OR FA- QuEChERS (No d-SPE)

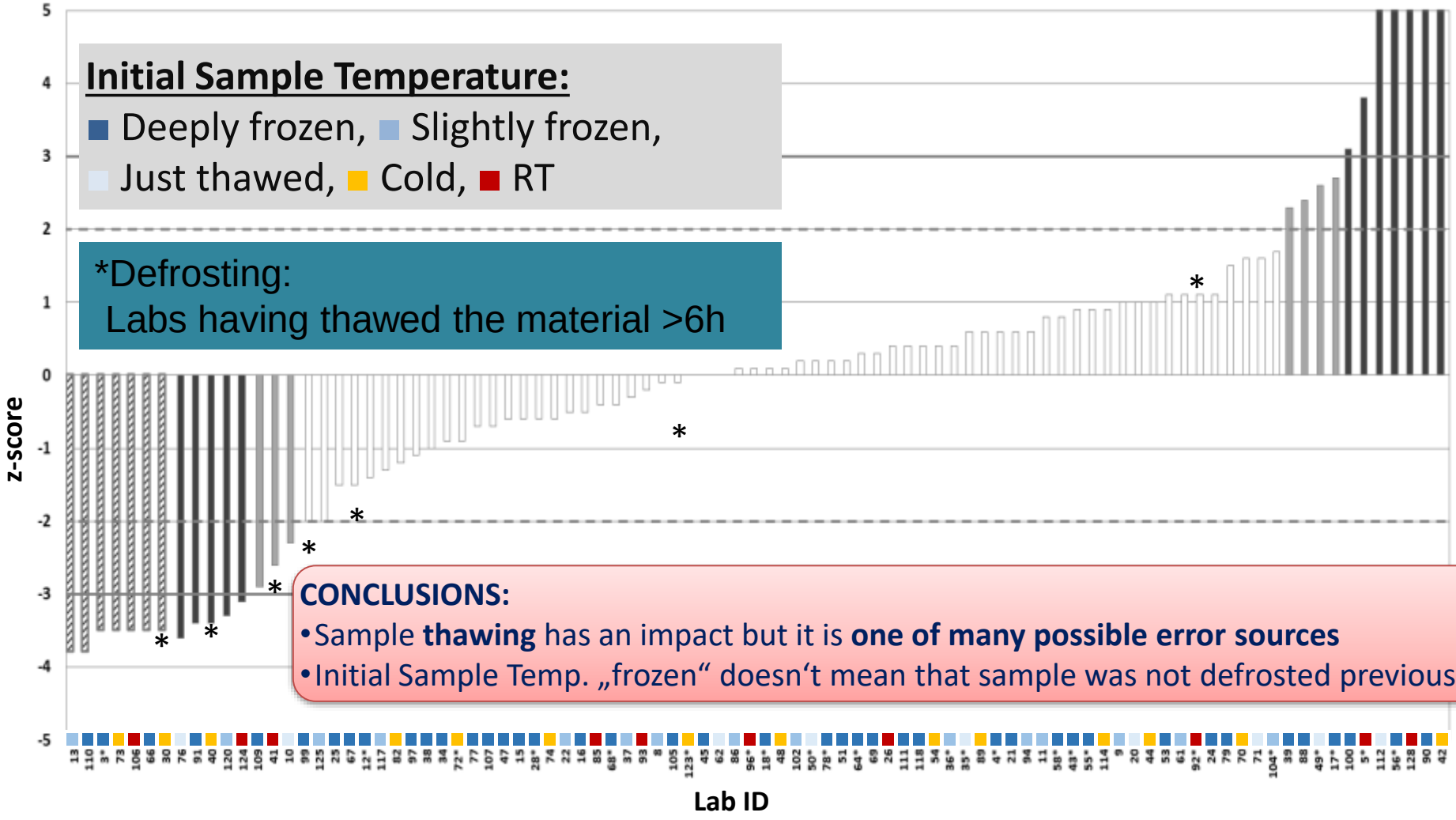
Folpet – Defrosting and initial sample temperature



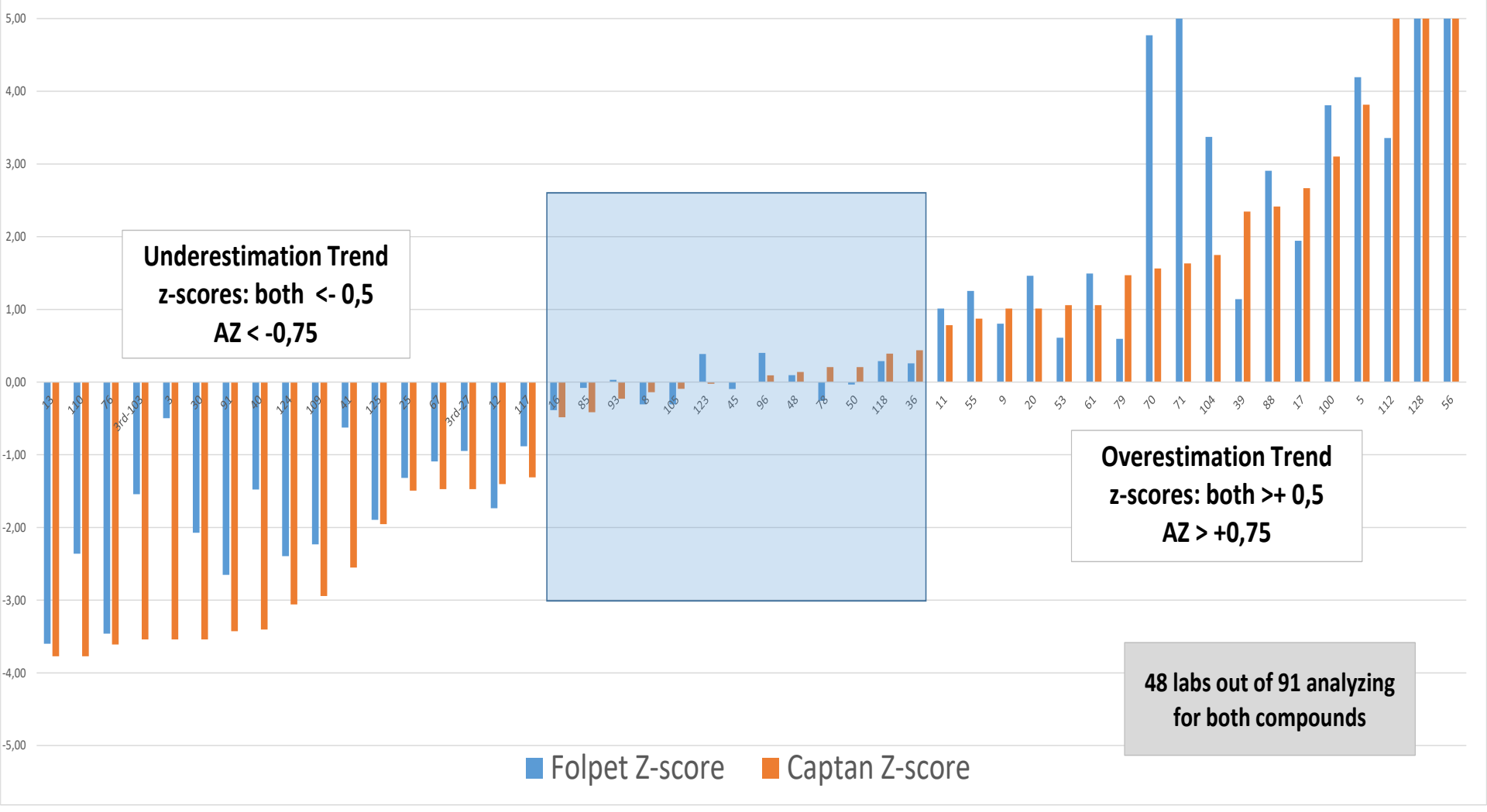
CONCLUSIONS:

- Sample **thawing** has an impact but it is **one of many possible error sources**
- Initial Sample Temp. „frozen“ doesn‘t mean that sample was not defrosted previously

Captan – Defrosting and initial sample temperature



Captan/Folpet – Indications for a Bias-Correlation



Folpet: Impact of ILIS

Folpet	Whole Population	Matching ILIS	No matching ILIS
No. Numerical results	89	22	67
No. FNs	1	0	1
No. Outliers °	2	0	2
AV [mg/kg]	**0.249**	**0.261**	**0.242**
CV* [%]	**34.5**	**20.8**	**40.3**
UAV [mg/kg]	0.0115	0.0144	0.0151
Tolerance [mg/kg]	0.0187	0.0196	0.0182
	passed	passed	passed

Procedural	10
StAdd-SP	4
StAdd-EA	2
MM	41 (1°)
SB	8 (1°)

Captan: Impact of ILIS

Captan	Whole Population	Matching ILIS	No matching ILIS
No. Numerical results	83	25	58
No. FNs	5+ 1 (FN*) + 1 FR	0	5+ 1 (FN*) + 1 (FN**)
No. Outliers °	5	1	4
AV [mg/kg]	**0.174**	**0.177**	**0.173**
CV* [%]	**32.9**	**30.1**	**34.9**
UAV [mg/kg]	0.0081	0.0136	0.0103
Tolerance [mg/kg]	0.0131	0.0133	0.013
	passed	failed	passed

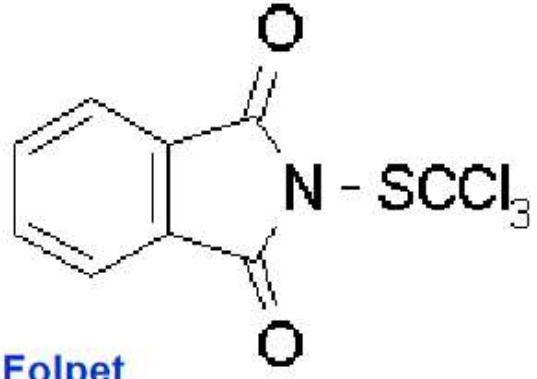
Procedural	7
StAdd-SP	4
StAdd-EA	1
MM	33 (4°)
SB	9

FN* : RL > AV

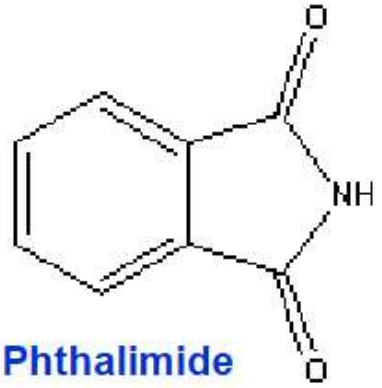
FR : result < RL and MRRL

Comparably strong fluctuation !!!
Possibly due to losses prior to ILIS-addition
Note: Captan is more sensitive to losses than folpet

DEGRADATION OF CAPTAN AND FOLPET DURING ANALYSIS

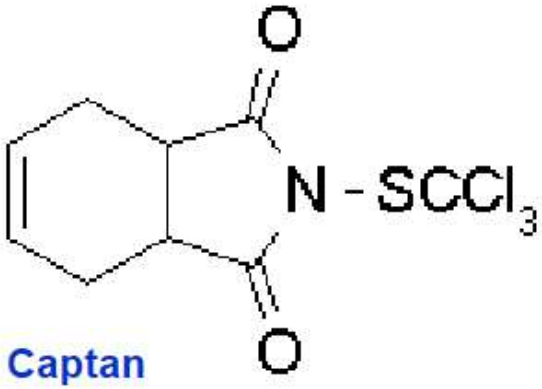


Folpet

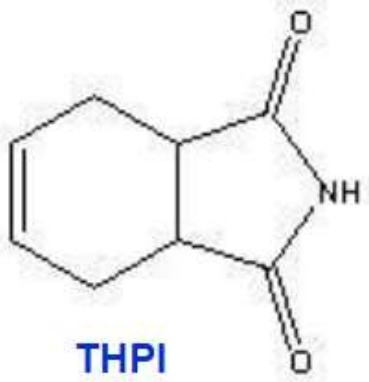


Phthalimide

Degradation e.g. during …
- homogenization,
- extraction
- cleanup
- extract storage
- GC-injecton



Captan



THPI

GC-ANALYSIS OF PI AND THPI IN PRESENCE OF PARENTS

FOLPET	PI	PI measured (calibrated w. PI)	overestimation of PI
spiked in one vial [ppm]		[ppm]	error [%]
0,1	0,1	0,11	27%
0,2	0,1	0,11	22%
0,3	0,1	0,14	53%
0,6	0,1	0,19	116%
1	0,1	0,24	178%

CAPTAN	THPI	THPI measured (calibrated w. THPI)	overestimation of THPI
spiked in one vial [ppm]		[ppm]	error [%]
0,1	0,1	0,13	31%
0,2	0,1	0,12	20%
0,3	0,1	0,15	50%
0,6	0,1	0,19	102%
1	0,1	0,25	159%

Tomato blank extract (QuEChERS, d-SPE, AP)
Spiked w. Folpet/ Captan and PI/THPI at different levels
Simultaneous measurement by GC-MS/MS

Situation in PT-material

		Captan/ THPI	Folpet/ PI
Parent (mg/kg)		0,172	0,249
Degradant (mg/kg)		0,59	0,10
Ratio Parent/ Degradant	Conc.	0.29	2.54
	Mols	0.15	1.27

Low Captan/THPI ratio

TAKEAWAY MESSAGE:

IN PRESSENCE OF CAPTAN OR FOLPET (PARENT) AT EXCESS LEVELS THE LEVELS OF THE RESPECTIVE DEGRADANTS TENT TO BE OVERESTIMATED !!!

Compound(s)	No. of Method Finder List/Version/Date of Update	Link
Captan & Tetrahydrophthalimid, Folpet & Phthalimid	**SRM-07/(V3) /06.04.2017** and **SRM-42/(V1) /30.06.2019**	Report SRM-07 (GC) Report SRM-42 (LC)
	Short Description of SRM-07: This document describes approaches for the analysis of Captan and Folpet in QuEChERS extracts via GC-MS or GC-MS/MS. Different approaches for correcting the results of the parent molecules for matrix effects during GC analysis or for losses during the entire procedure are presented and discussed. In addition two approaches for analyzing Captan and Folpet next to their legally relevant metabolites Tetrahydrophthalimide (THPI) and Phthalimide are presented and discussed. **Short Description of SRM-42:** Various possibilities for the LC-MS/MS analysis of Captan/THPI and Folpet/Phthalimide were studied employing APCI and ESI interfaces. LC-MS/MS analysis circumvents problems related to GC-analysis but further efforts to improve sensitivity are required. The active hydrolysis of Captan and Folpet to their respective degradants (THPI and PI), was also studied aiming to reduce the number of analytes to be measured. Unfortunately, conversion yields were often not satisfacory and further studies are needed.	

GC-ANALYSIS OF PI AND THPI IN PRESENCE OF PARENTS

EU Reference Laboratories for Residues of Pesticides
Single Residue Methods

SRM07

EURL-SRM – Analytical Observation Report

concerning the following…

- **Compound(s)**: Captan, Folpet, Phthalimide (PI), Tetrahydrophthalimide (THPI)
- **Commodities**: Fruit and vegetables, cereals
- **Extraction Method(s)**: QuEChERS, A-QuEChERS
- **Instrumental analysis**: GC-MS, GC-MS/MS

Quantification of Residues of Folpet and Captan in QuEChERS Extracts

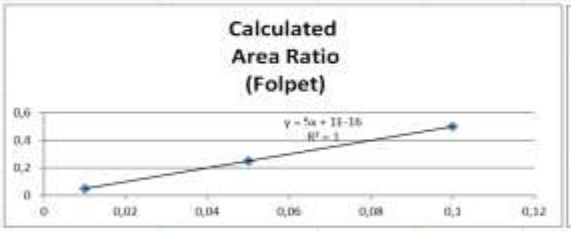
Version 3.1 (last update: 06.04.17)

GC-ANALYSIS OF PI AND THPI IN PRESENCE OF PARENTS

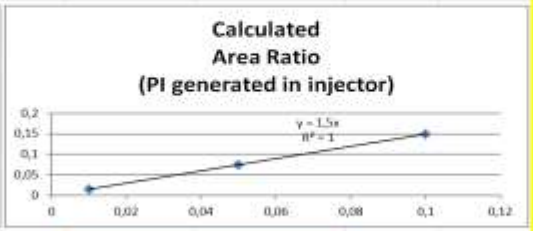
CALIBRATION DATA

Calibration Solution I: Spiked with Folpet, Folpet-D4 and Chlorpyrifos-D10 (preferably matrix-matched)

	µg/l	Enter Area of Folpet from Calibr. Sln I	Enter Area of ILIS (Folpet-D4) from Calibr. Sln I	Calculated Area Ratio (Folpet)	Enter Area of PI from Calibr. Sln I (generated in injector)	Enter Area of IS (e.g. Chlorpyrifos-D10) from Calibr. Sln I	Calculated Area Ratio (PI generated in injector)
Cal 1	0,01	1000	20000	0,05	1500	100000	0,015
Cal 2	0,05	5000	20000	0,25	7500	100000	0,075
Cal 3	0,1	10000	20000	0,5	15000	100000	0,15



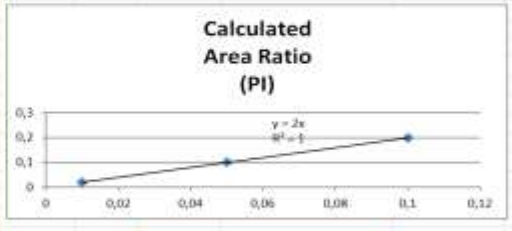
slope	5
intercept	0,0000



slope	1,5
intercept	0,0000

Calibration Solution II: Spiked with PI and Chlorpyrifos-D10 (preferably matrix-matched)

	µg/l	Enter Area of PI from Calibr. Sln II	Enter Area of IS (e.g. Chlorpyrifos-D10) from Calibr. Sln II	Calculated Area Ratio (PI)
Cal 1	0,01	2000	100000	0,02
Cal 2	0,05	10000	100000	0,1
Cal 3	0,1	20000	100000	0,2



slope	2
intercept	0,0000

SAMPLE DATA

Enter Sample Names / Codes here	Sample amount per IS Portion in g (typically 1 when employing 10 g for extraction)	Enter Area of Folpet from Sample Extract	Enter Area of ILIS (Folpet-D4) from Sample Extract	Calculated Area Ratio (Folpet)	Enter Area of PI (= Original + Injector-generated)	Enter Area of IS (e.g. Chlorpyrifos-D10) from Sample Extract	Calculated Area Ratio (PI)
Sample Name 1	1	2500	20000	0,125	50000	100000	0,5
Sample Name 2	1	7500	20000	0,375	75000	100000	0,75
Sample Name 3	1	5000	20000	0,25	20000	100000	0,2
Sample Name 4	1	10000	20000	0,5	30000	100000	0,3
Sample Name 5	1	30000	20000	1,5	100000	100000	1

	Folpet in Extract	Folpet in Sample
	µg/l	mg/kg
Sample Name 1	0,025	0,025
Sample Name 2	0,075	0,075
Sample Name 3	0,05	0,05
Sample Name 4	0,1	0,1
Sample Name 5	0,3	0,3

	PI built during injection	
	Calc. Area Ratio	µg/l
Sample Name 1	0,0375	0,01875
Sample Name 2	0,1125	0,05625
Sample Name 3	0,075	0,0375
Sample Name 4	0,15	0,075
Sample Name 5	0,45	0,225

	PI, total
	µg/l
Sample Name 1	0,25
Sample Name 2	0,375
Sample Name 3	0,1
Sample Name 4	0,15
Sample Name 5	0,5

	PI in Extract	PI in Sample	Sum of Folpet and PI, calc. as Folpet
	µg/l	mg/kg	mg/kg
Sample Name 1	0,23125	0,23125	0,491
Sample Name 2	0,31875	0,31875	0,718
Sample Name 3	0,0625	0,0625	0,176
Sample Name 4	0,075	0,075	0,251
Sample Name 5	0,275	0,275	0,854

SRM07

Excel file for the calculation Captan/THPI and Folpet/Phthalimide **using external calibration** (see Description of Procedure)

Excel file for the calculation Captan/THPI and Folpet/Phthalimide **using standard additions** (see Description of Procedure)

GC-ANALYSIS OF PI AND THPI IN PRESENCE OF PARENTS

Principle

1) **Parent is quantified** using external calbration and ILIS.

2) **The rate with which the degradant is formed in the injector** (through thermal decomp. of parent) is determined using the external calibration.

3) The **signal of degradant theoretically expected** from the amount of parent on the sample is **calculated.**

4) The **theoretical signal of degradant** is deducted from signal of degradant measured in sample.

Limitations: Where the ratio between parent and degradant is very high the quantification of the degradant is prone to errors (quantification of parent and sum is less affected)

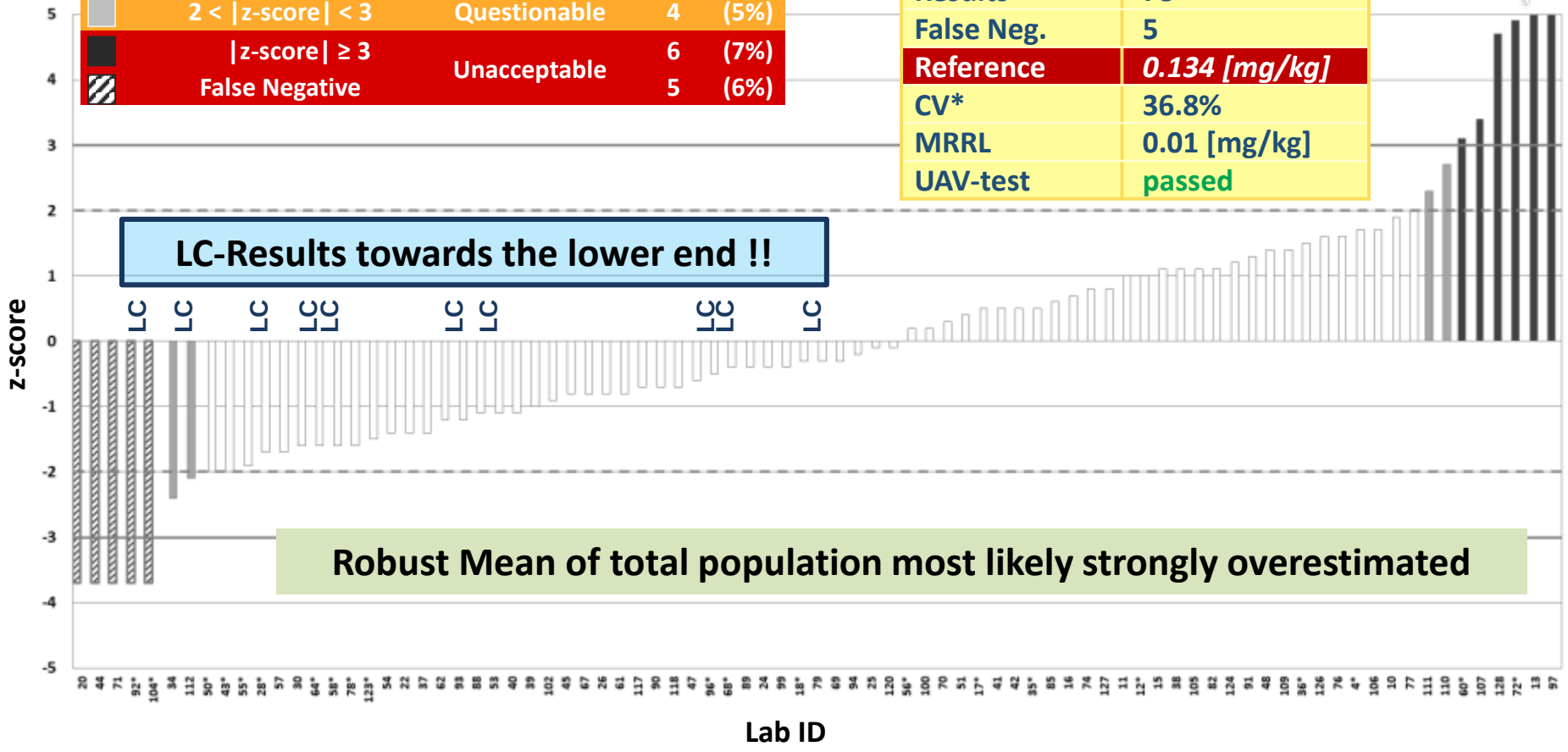
Phthalimide

(Ref. Value for z-score-calc.: Robust Mean of ALL Results)

2x z>5

|z-score| ≤ 2	Acceptable	68	(82%)
2 < |z-score| < 3	Questionable	4	(5%)
|z-score| ≥ 3	Unacceptable	6	(7%)
False Negative		5	(6%)

Results	78
False Neg.	5
Reference	*0.134 [mg/kg]*
CV*	36.8%
MRRL	0.01 [mg/kg]
UAV-test	passed

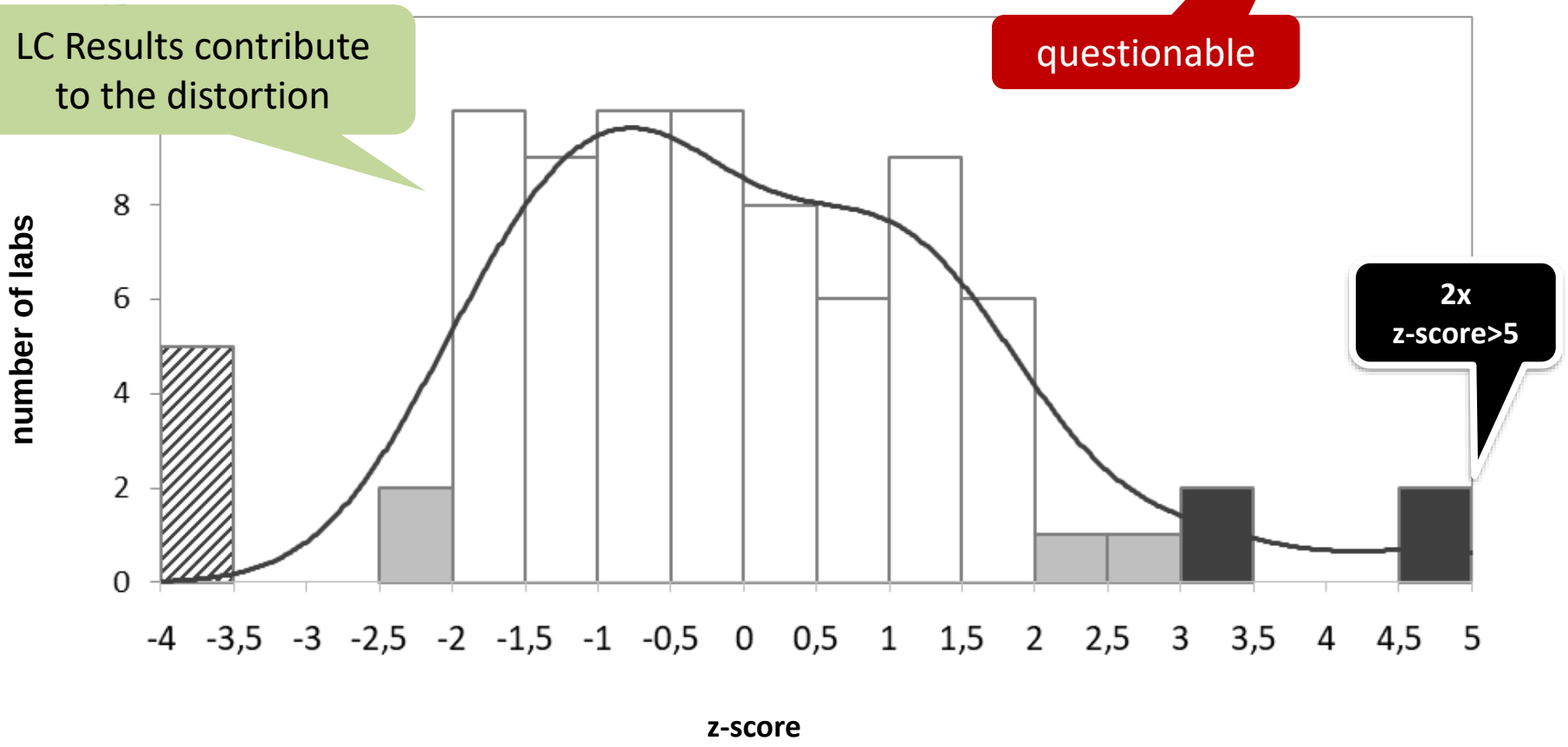


Phthalimide
(Reference: Robust Mean of ALL Results)

Results	78
False Neg.	5
AV	*0.134 [mg/kg]*
CV*	36.8%
MRRL	0.01 [mg/kg]
UAV-test	passed

questionable

LC Results contribute to the distortion



EURL-SRM

Analytical Observation Report SRM-42

European Commission
EURL-SRM
EU Reference Laboratories for Residues of Pesticides
Single Residue Methods

EURL-SRM - Analytical Observations Report

concerning the following…

- **Compound(s)**: Captan, Folpet, Phthalimide, Tetrahydrophthalimide
- **Commodities**: Fruit and vegetables, cereals
- **Extraction Method(s)**: Citrate buffered QuEChERS,
- **Instrumental analysis**: LC-MS/MS

Analysis of Captan, Folpet and their respective metabolites Phthalimide and Tetrahydrophthalimide via LC-MS/MS either directly or following hydrolysis

Phthalimide: Comparison of LC and GC results

	LC-Results (incl. EURL)	GC-Results	All Results PT-Participants
Numerical Values	9+1	69	78
Outliers	0	2	2
FNs	1	4	5
„AV“ (Robust mean)	**0.092**	**0.140**	0.134
CV*	**27.0%**	**35.2%**	**36.8%**

Too few results robust mean too uncertain

Compare:

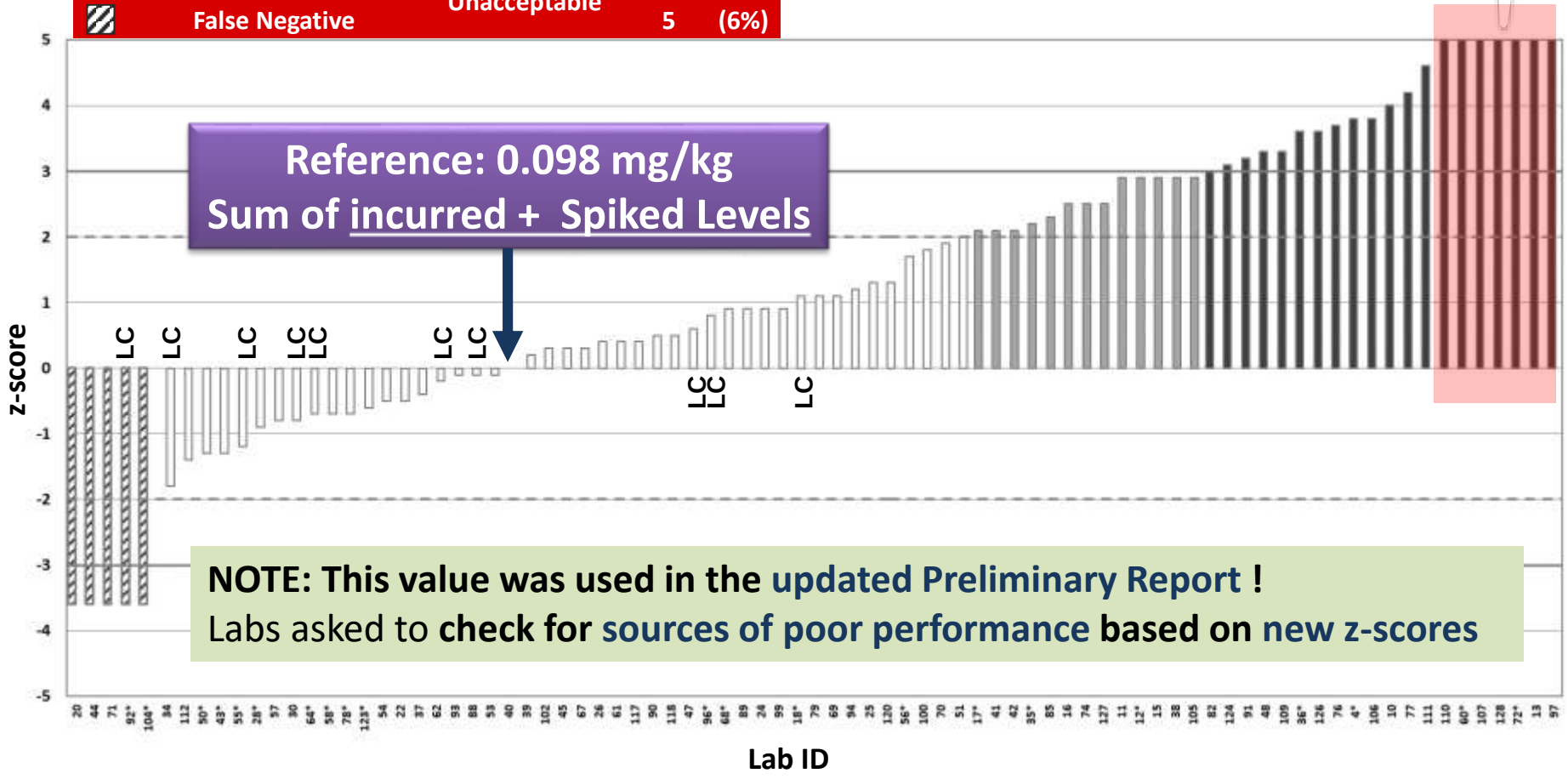
- Incurred + Spiked: 0.098 mg/kg
- EURL-SRM (homogeneity test): 0.093 mg/kg

Phthalimide

|z-score| ≤ 2	Acceptable	45	(54%)
2 < |z-score| < 3	Questionable	13	(16%)
|z-score| ≥ 3	Unacceptable	20	(26%)
False Negative		5	(6%)

Results	71 (excl. 7 outl.)
False Neg.	5
Reference (incurred+spiked)	*0.098 [mg/kg]*
RSD (%)	51.5%
MRRL	0.01 [mg/kg]
UAV-test	passed

7x z>5

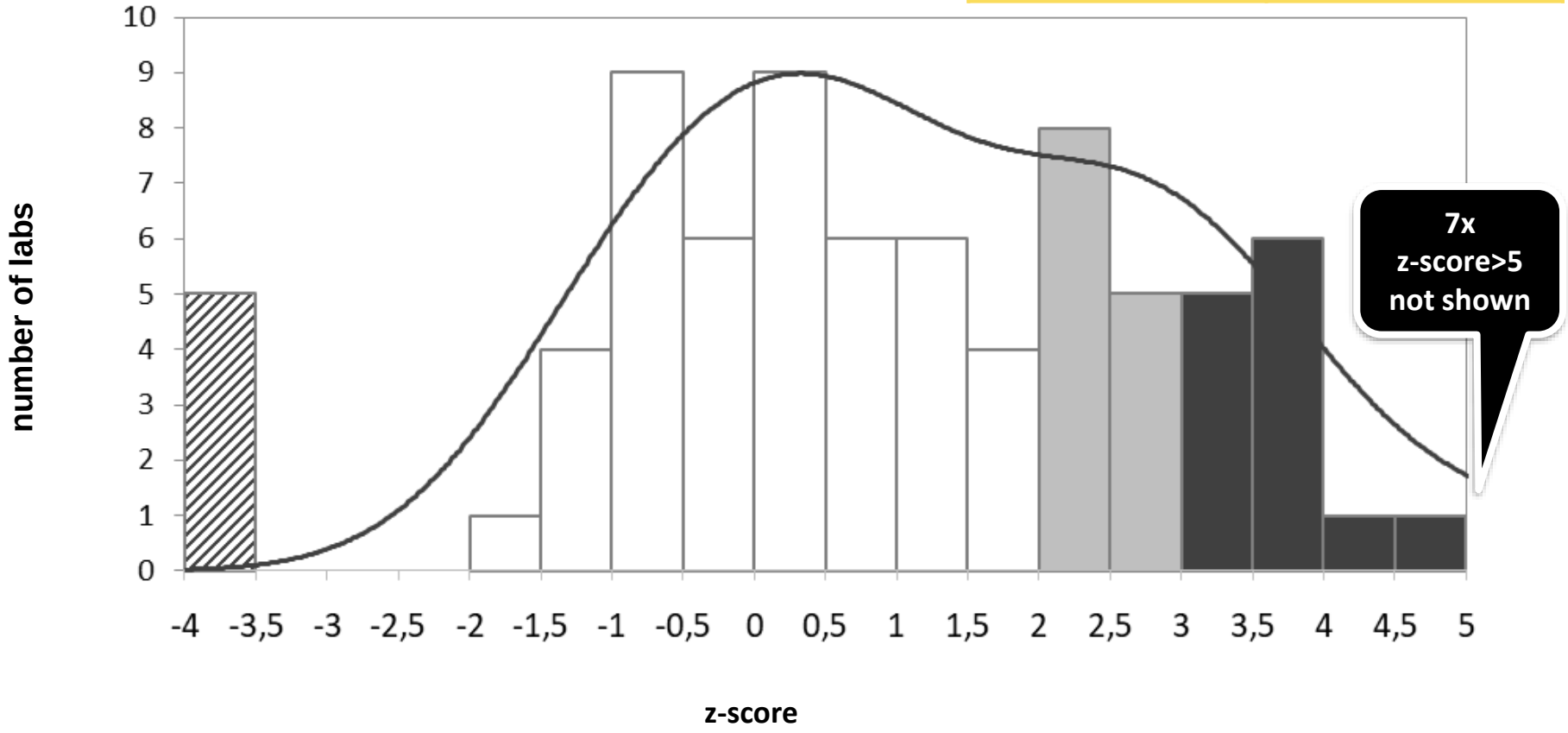


NOTE: This value was used in the updated Preliminary Report !
Labs asked to **check for sources of poor performance based on new z-scores**

Phthalimide

Reference: 0.098 mg/kg
Sum of incurred + Spiked Levels

Results	71 (excl. 7 outl.)
False Neg.	5
Reference (incurred+spiked)	*0.098 [mg/kg]*
RSD (%)	51.5%
MRRL	0.01 [mg/kg]
UAV-test	passed



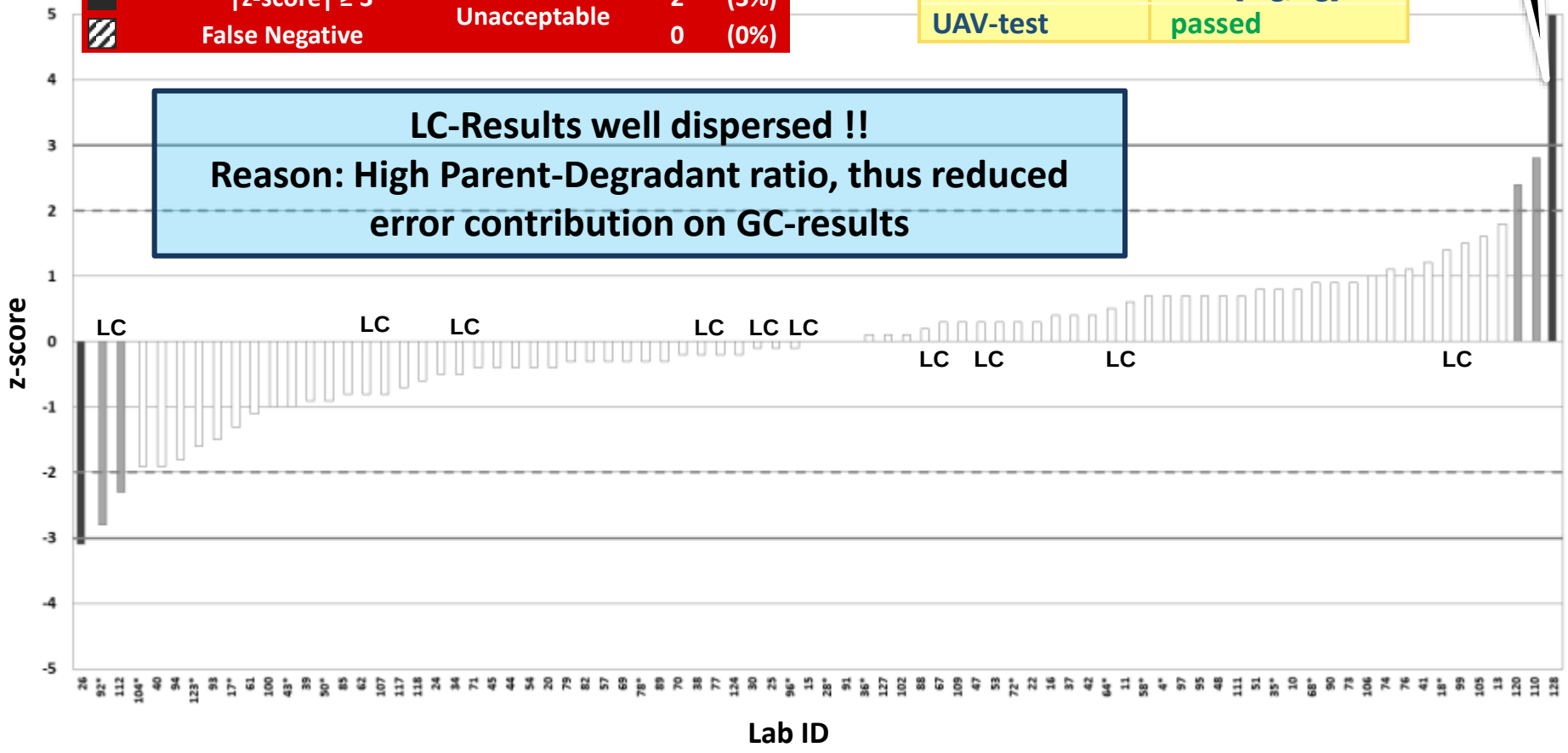
Tetrahydrophthalimide (THPI)

	|z-score| ≤ 2	Acceptable	74	(93%)
	2 < |z-score| < 3	Questionable	4	(5%)
	|z-score| ≥ 3	Unacceptable	2	(3%)
	False Negative		0	(0%)

Results	80
False Neg.	0
AV	0.590 [mg/kg]
CV*	23.2%
MRRL	0.01 [mg/kg]
UAV-test	passed

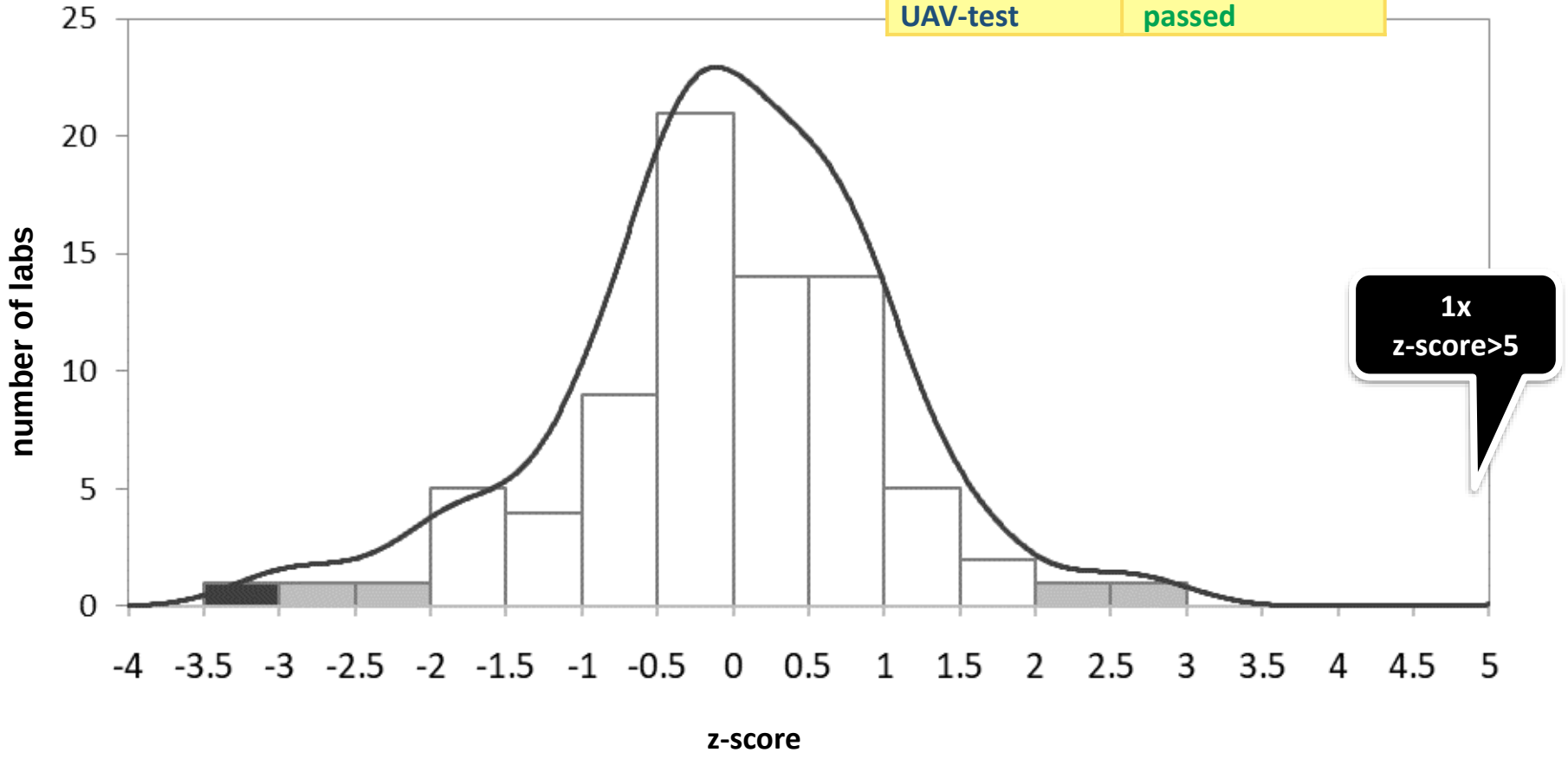
1x
z>5

LC-Results well dispersed !!
Reason: High Parent-Degradant ratio, thus reduced error contribution on GC-results



Tetrahydrophthalimide (THPI)

Results	80
False Neg.	0
AV	0.590 [mg/kg]
CV*	23.2%
MRRL	0.01 [mg/kg]
UAV-test	passed

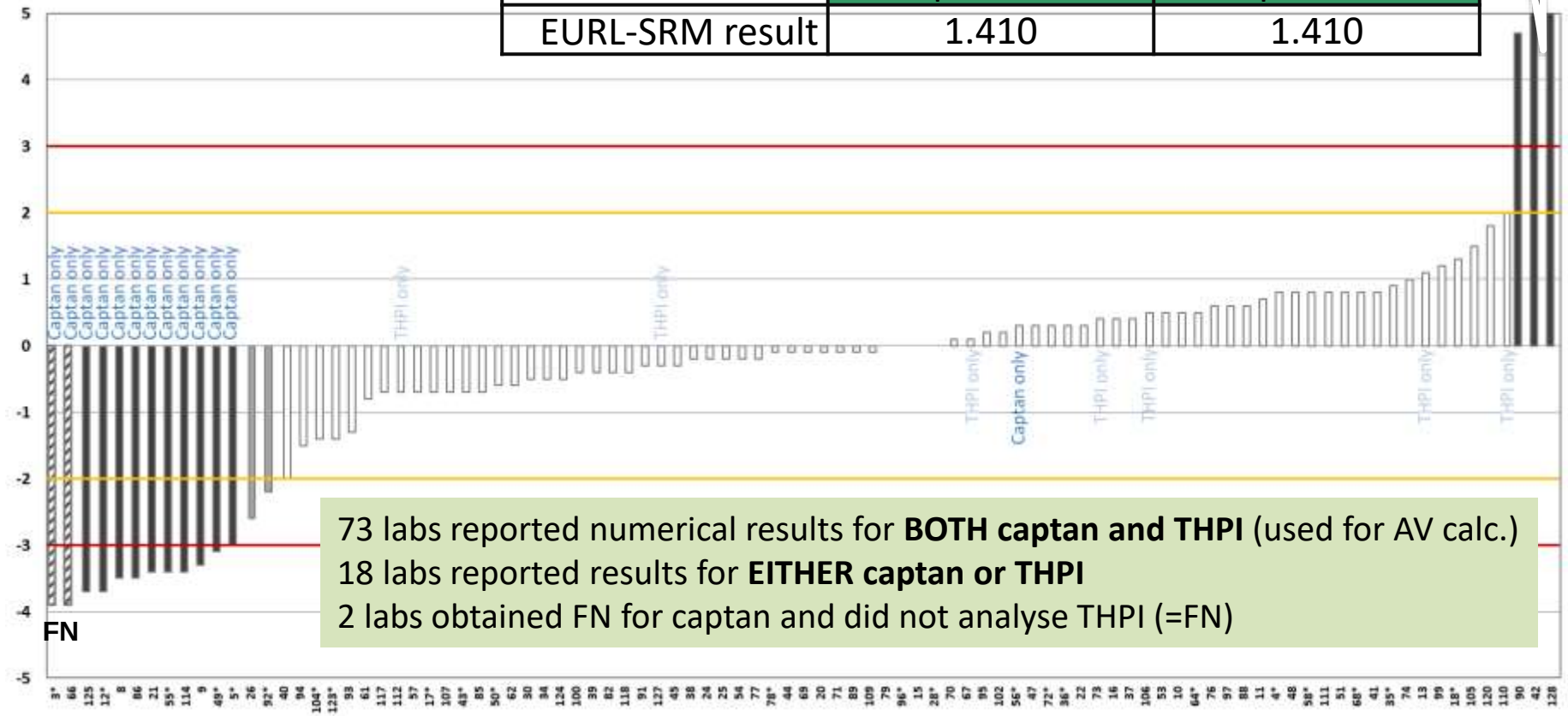


EURL-SRM

SUMMED EVALUATION: CAPTAN + THPI

z-scores of SUM
Captan + THPI,
expr. as Captan

	excl. 2 Outliers	All Results
Robust Mean	1.32	1.33
CV*	20.9%	21.5%
Uncertainty	0.040909	0.041863
Tolerance	0.098855	0.099785
	passed	passed
EURL-SRM result	1.410	1.410

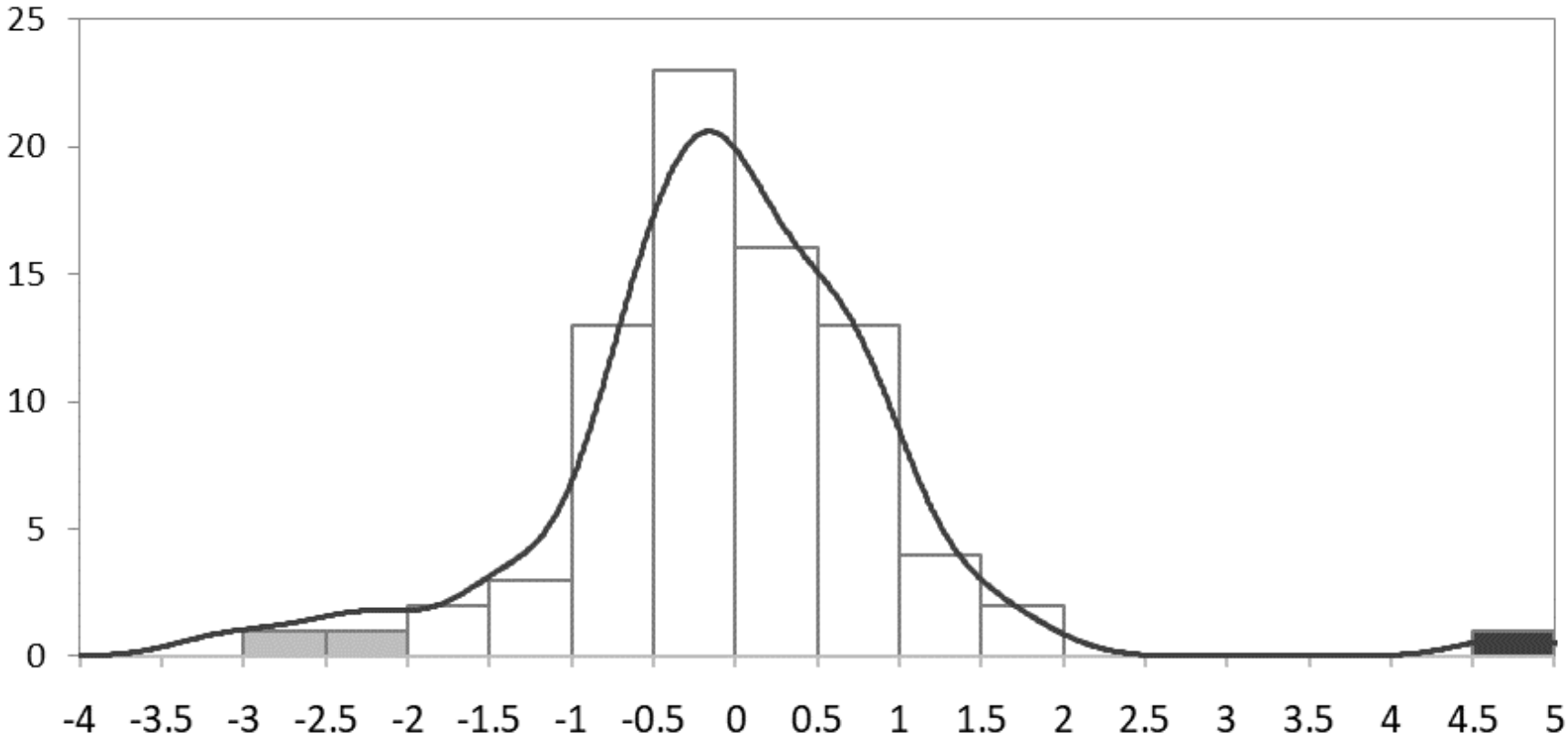


73 labs reported numerical results for **BOTH captan and THPI** (used for AV calc.)
18 labs reported results for **EITHER captan or THPI**
2 labs obtained FN for captan and did not analyse THPI (=FN)

SUMMED EVALUATION: CAPTAN + THPI

z-Scores: **Captan** + **THPI** **(Sum)** , expr. as Captan

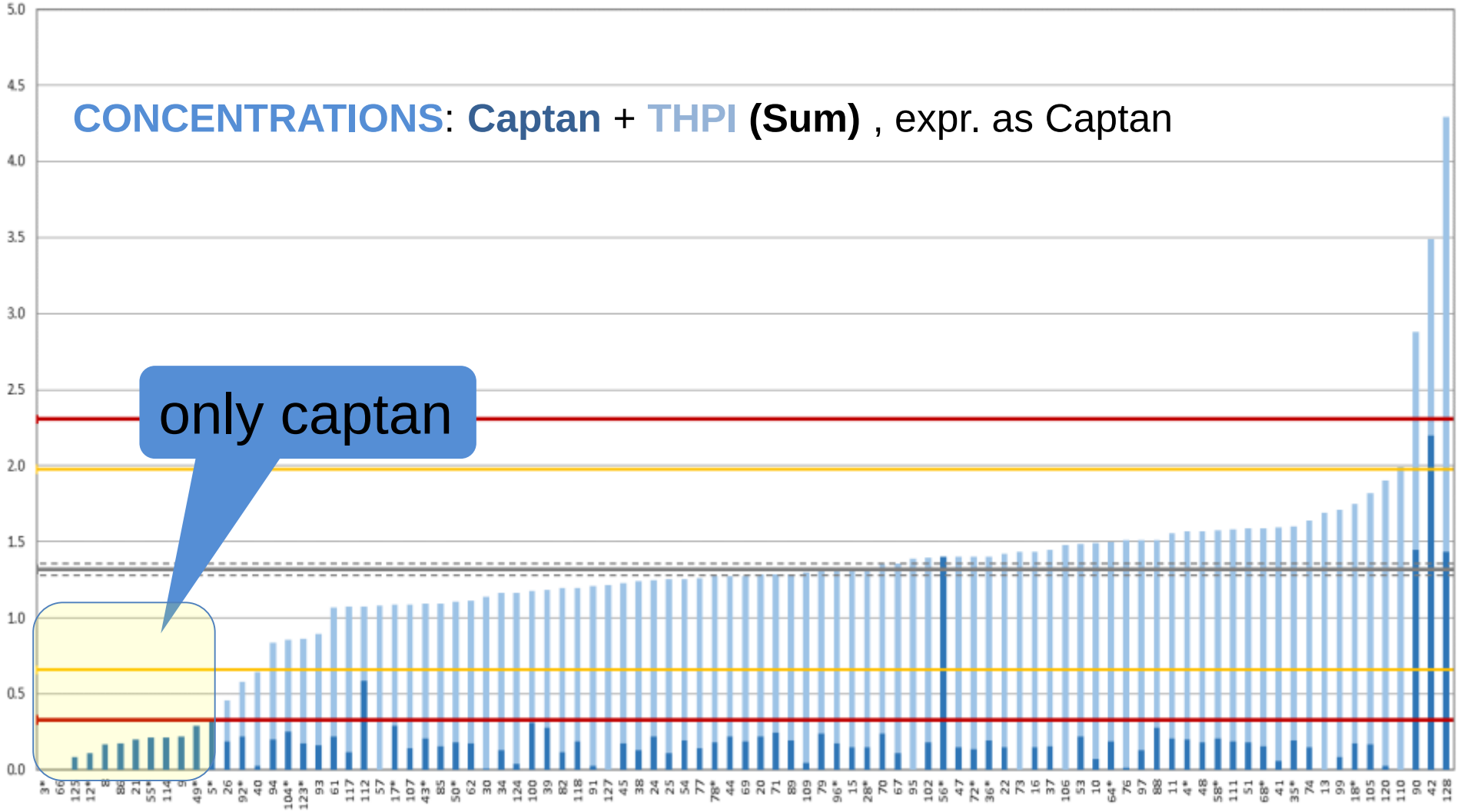
only those 73 results containing both captan and THPI



EURL-SRM

SUMMED EVALUATION: CAPTAN + THPI

Captan + **THPI**, expr. as Captan



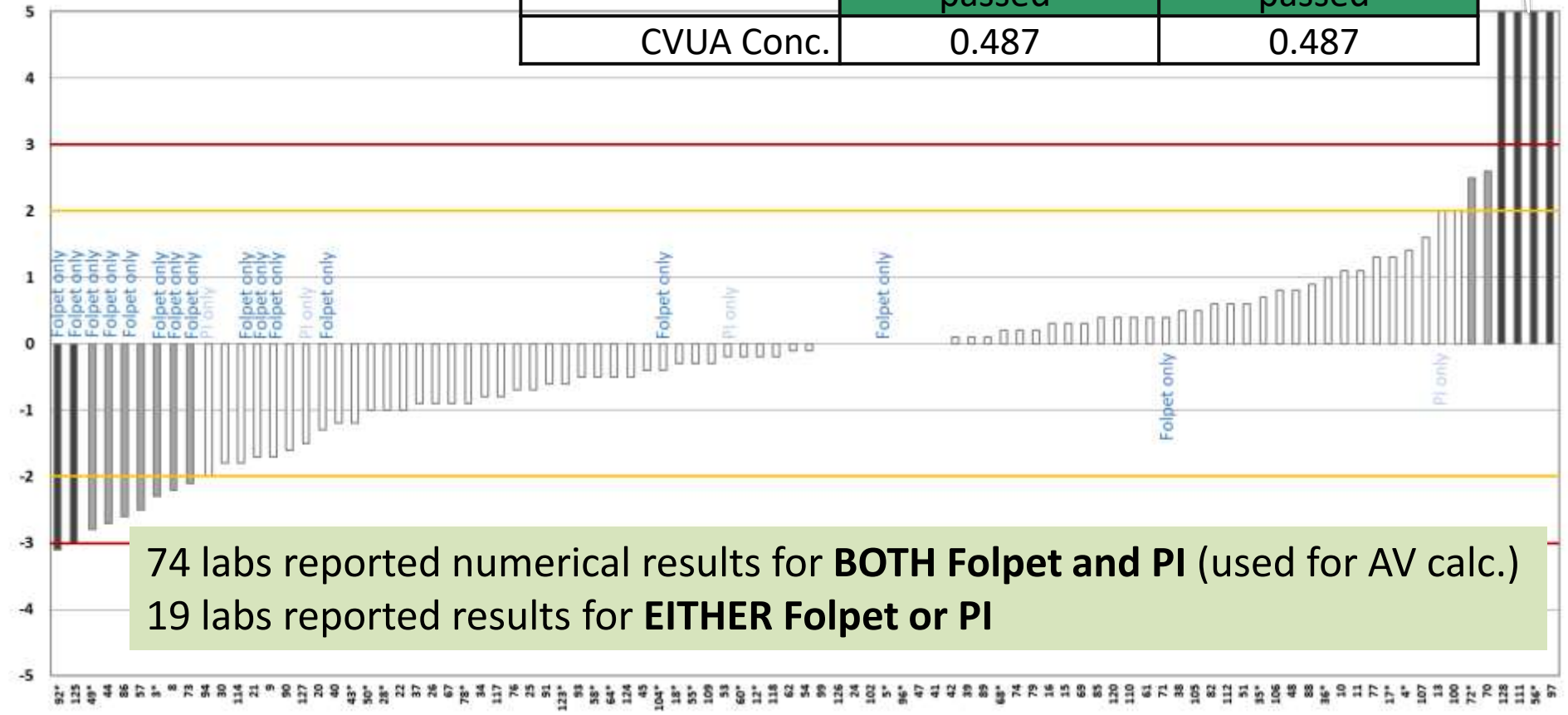
EURL-SRM

SUMMED EVALUATION: FOLPET + PI

z-scores of SUM
Folpet + **PI**,
(expr. as Folpet)

	excl. 4 Outliers	All Results
Robust Mean	0.510	0.522
CV*	19.9%	20.7%
Uncertainty	0.015173	0.015727
Tolerance	0.038283	0.039183
	passed	passed
CVUA Conc.	0.487	0.487

4x z>5

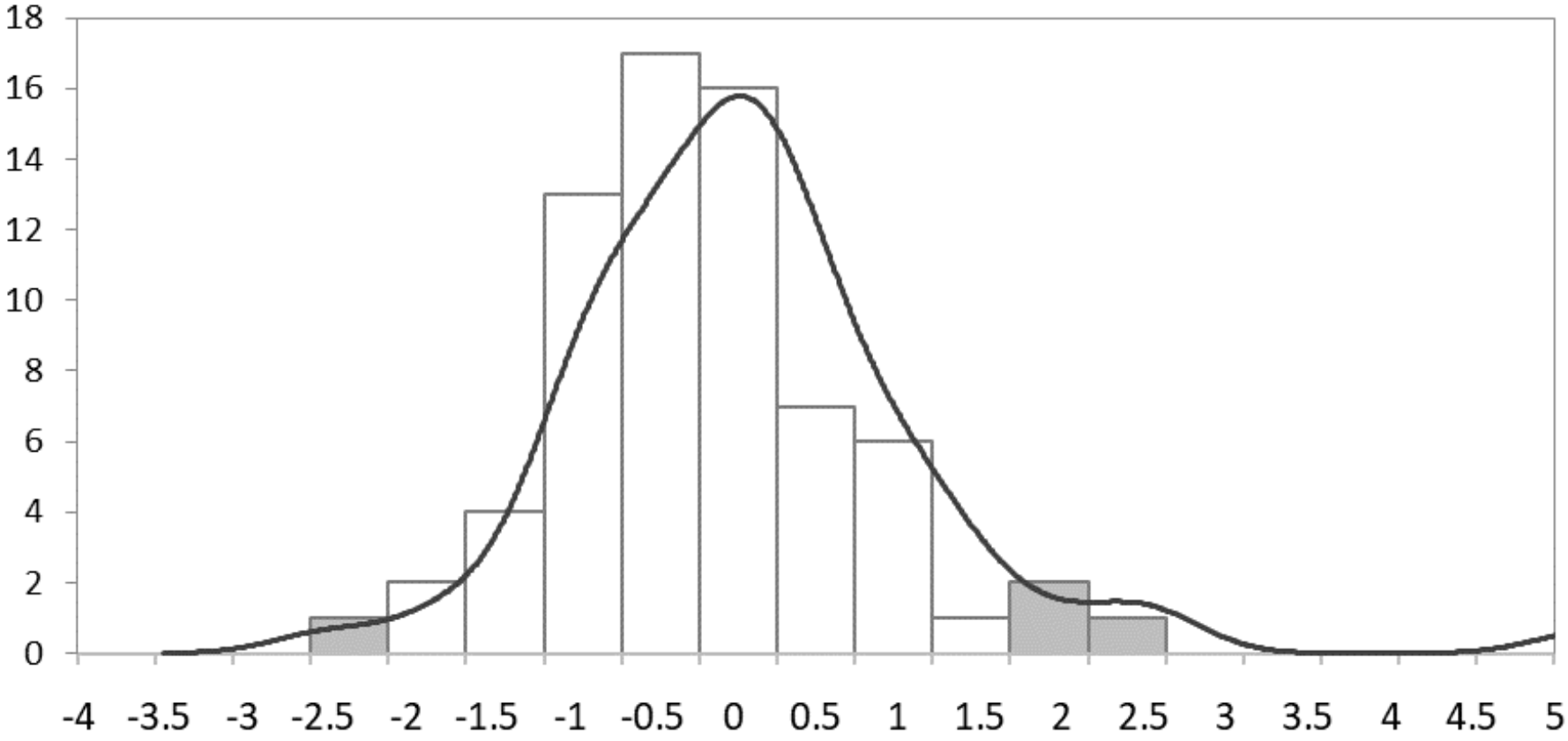


74 labs reported numerical results for **BOTH Folpet and PI** (used for AV calc.)
19 labs reported results for **EITHER Folpet or PI**

SUMMED EVALUATION: FOLPET + PI

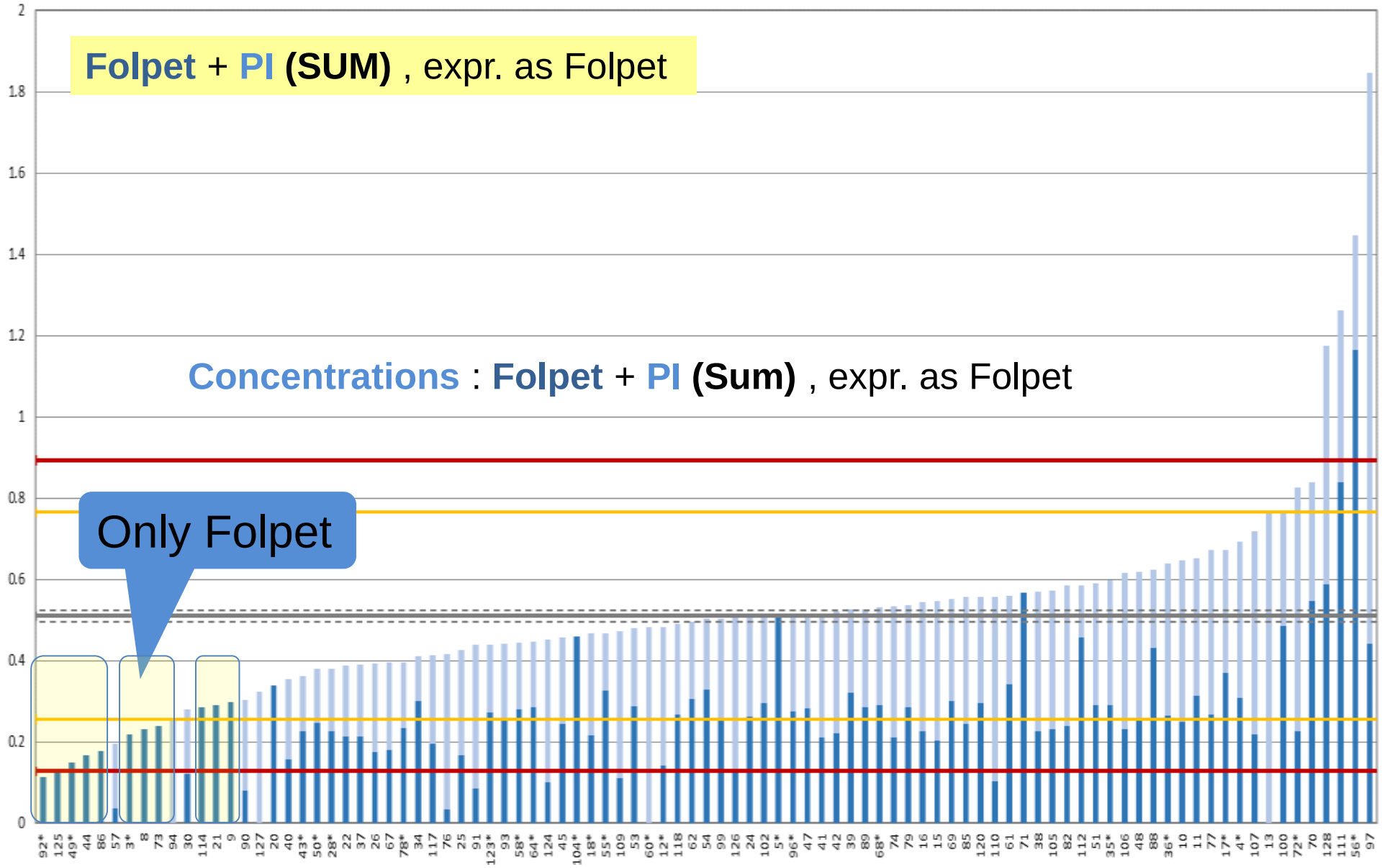
z-Scores: **Folpet** + **PI** **(Sum)** , expr. as Captan

only those 74 results containing both FOLPET and PI



EURL-SRM

SUMMED EVALUATION: FOLPET + PI



EURL-SRM

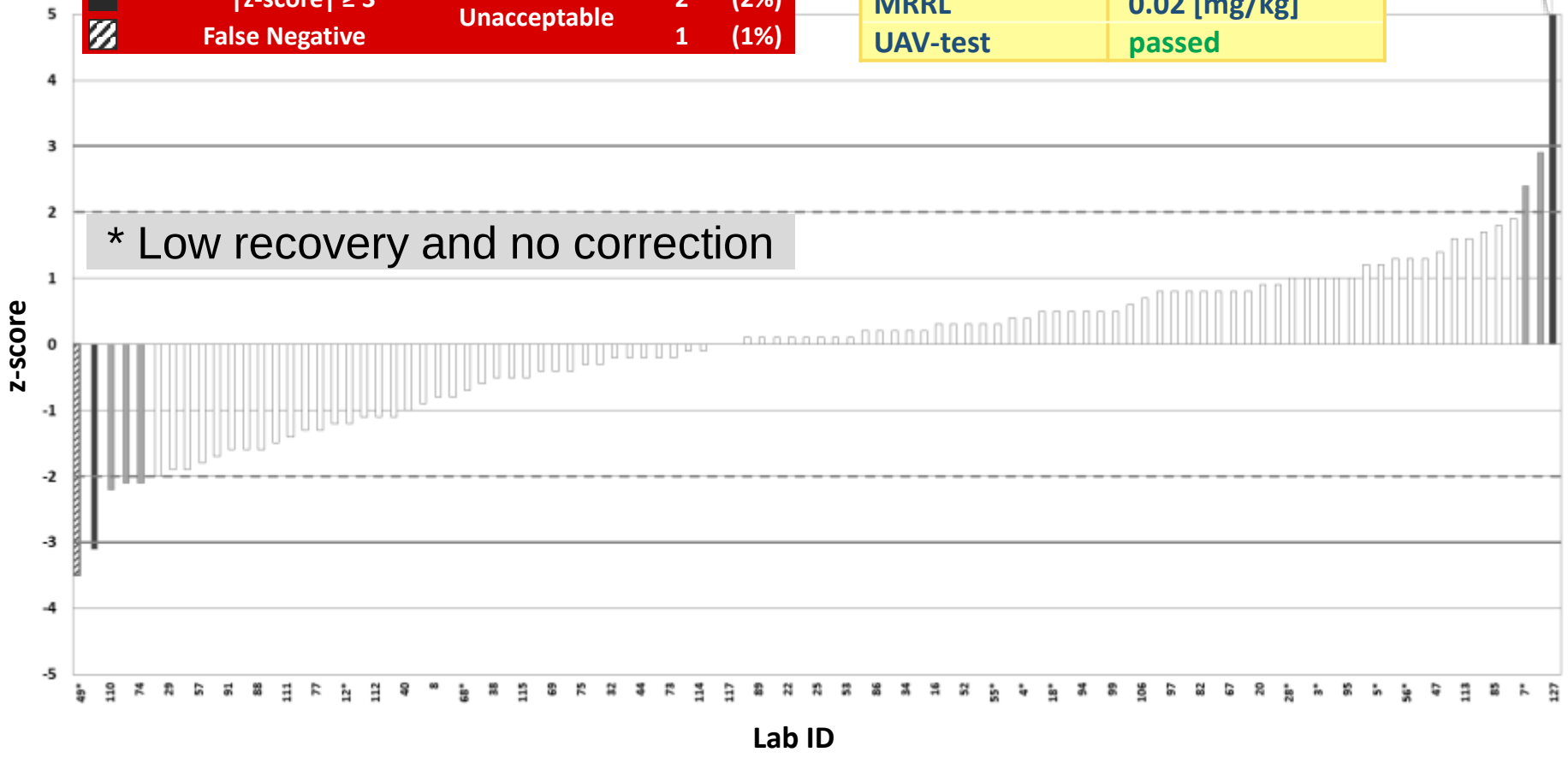
PYMETROZINE

Pymetrozine

	|z-score| ≤ 2	Acceptable	93	(92%)
	2 < |z-score| < 3	Questionable	5	(5%)
	|z-score| ≥ 3	Unacceptable	2	(2%)
	False Negative		1	(1%)

Results	100
False Neg.	1
AV	0.150 [mg/kg]
CV*	28.2%
MRRL	0.02 [mg/kg]
UAV-test	passed

1x z>5



* Low recovery and no correction

SRM-32

EU Reference Laboratories for Residues of Pesticides
Single Residue Methods

EURL-SRM - Analytical Observations Report

concerning the following…

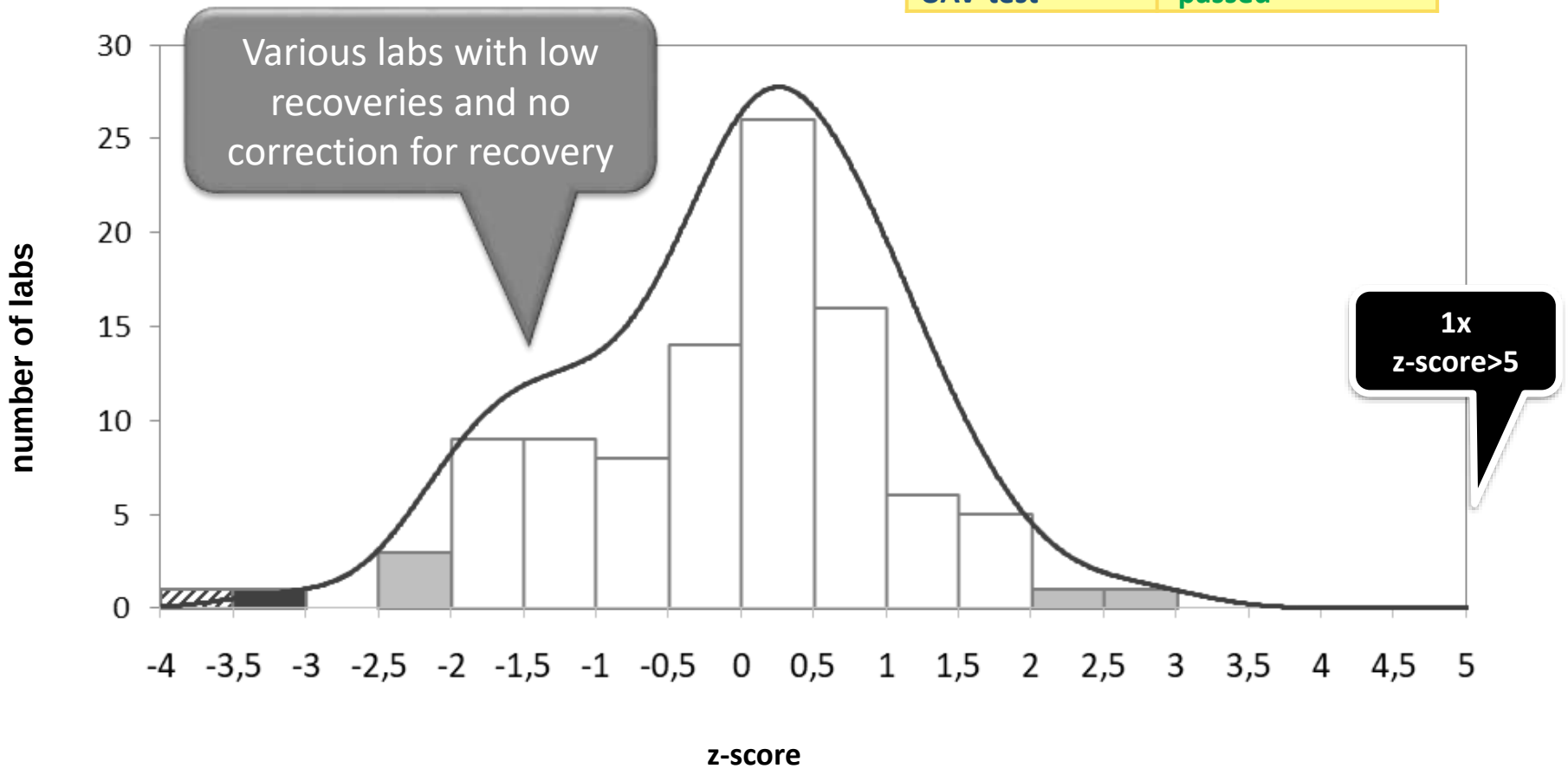
- **Compound(s)**: Pymetrozine
- **Commodities**: Various commodities of plant origin
- **Method(s)**: QuEChERS, adjustment of pH
- **Instrumentation**: LC-MS/MS

Analysis of Pymetrozine by the QuEChERS Method - Impact of pH on Recovery Rate

Reported by: EURL-SRM
Version 1 (last update: 18.04.2016)

Pymetrozine

Results	100
False Neg.	1
AV	0.150 [mg/kg]
CV*	28.2%
MRRL	0.02 [mg/kg]
UAV-test	passed



RESULT OVERVIEW

OPTIONAL Compounds

EURL-SRM

BIFENAZATE (SUM)

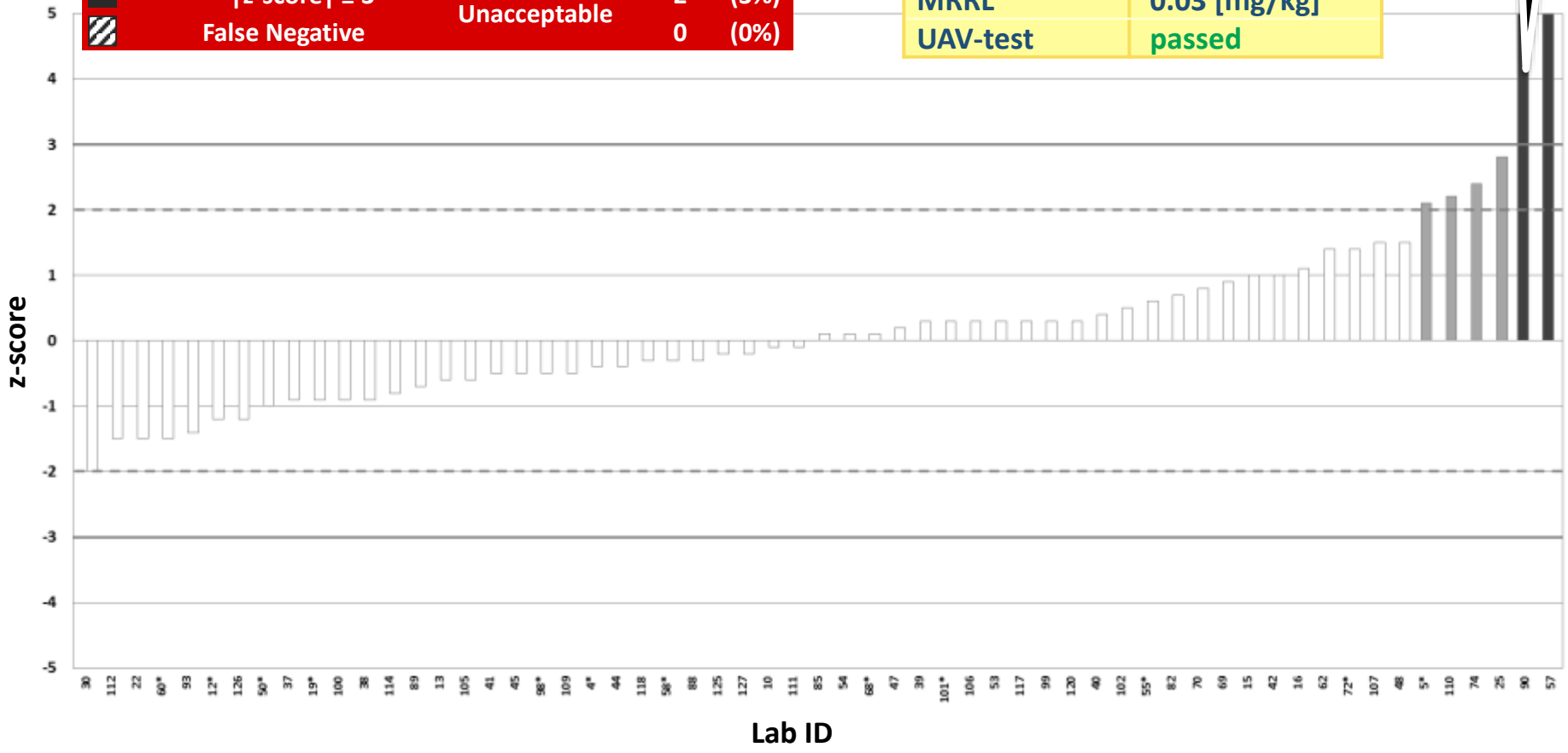
Bifenazate (sum)

	|z-score| ≤ 2	Acceptable	53	(90%)
	2 < |z-score| < 3	Questionable	4	(7%)
	|z-score| ≥ 3	Unacceptable	2	(3%)
	False Negative		0	(0%)

Results	59
False Neg.	0
AV	0.296 [mg/kg]
CV*	26.0%
MRRL	0.03 [mg/kg]
UAV-test	passed

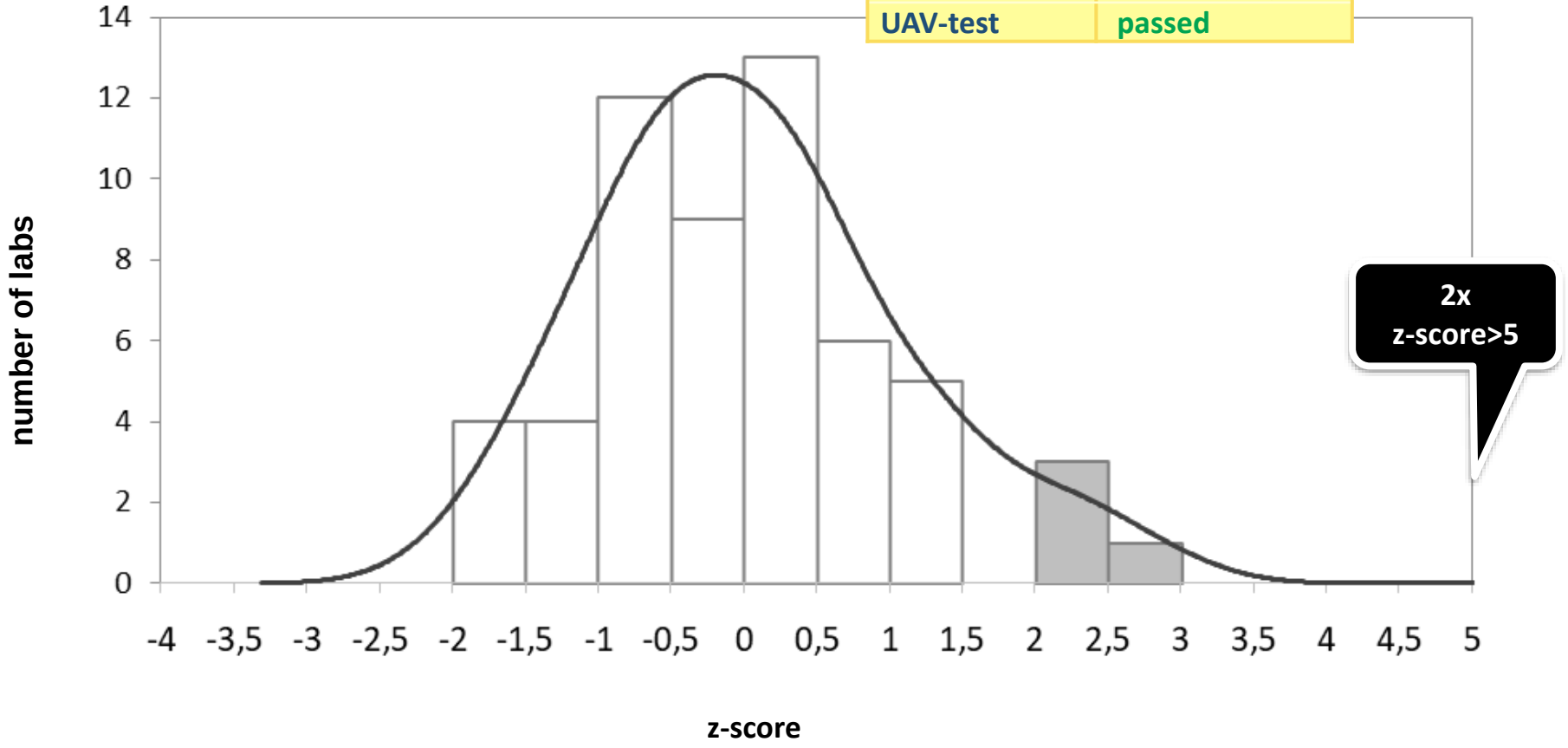
Ca. 1 % as Bifenazate-Diazene
Ca. 99 % as Bifenazate

2x
z>5

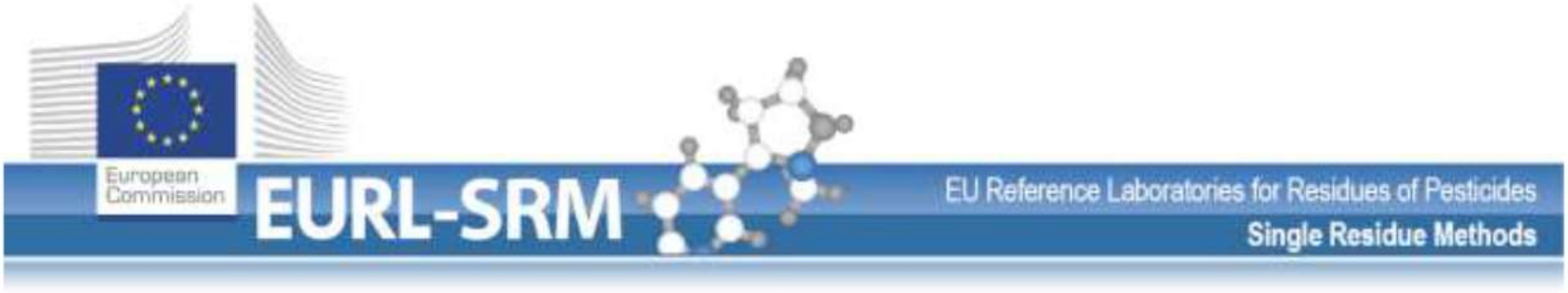


Bifenazate (sum)

Results	59
False Neg.	0
AV	0.296 [mg/kg]
CV*	26.0%
MRRL	0.03 [mg/kg]
UAV-test	passed



Analytical Method Report SRM-34



EURL-SRM - Analytical Method Report

Concerning the following…

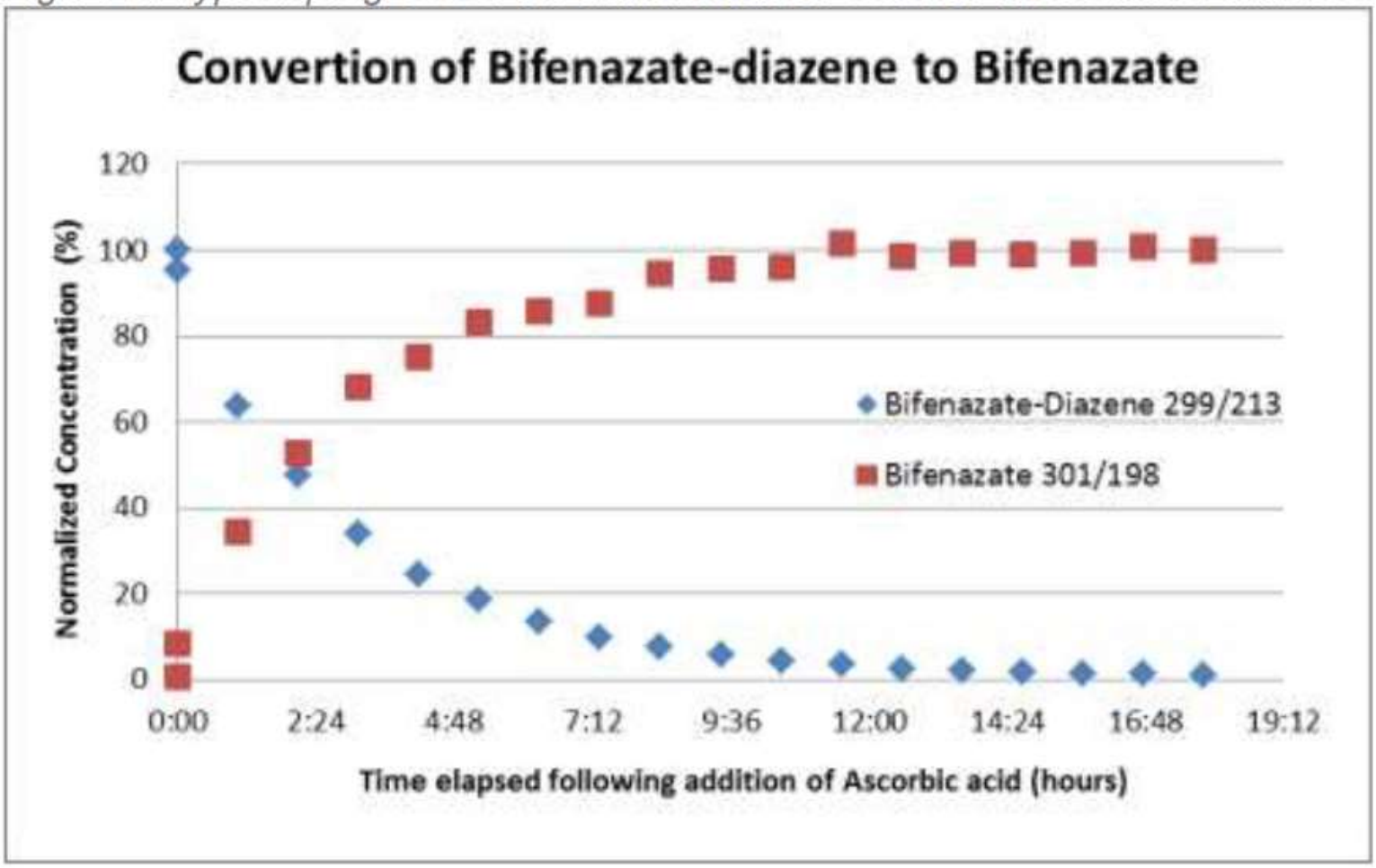
- **Compound(s)**: Bifenazate, Bifenazate-diazene
- **Commodities**: Fruit and vegetables, cereals
- **Extraction Method(s)**: QuEChERS modified
- **Instrumental analysis**: LC-MS/MS

Analysis of Bifenazate (sum) by the QuEChERS Method using LC-MS/MS

Version 1 (last update: 17.03.2017)

Transformation of Bifenazate diazene to Bifenazate by AA

Figure 1: Typical progress of the transformation reaction in cucumber extracts



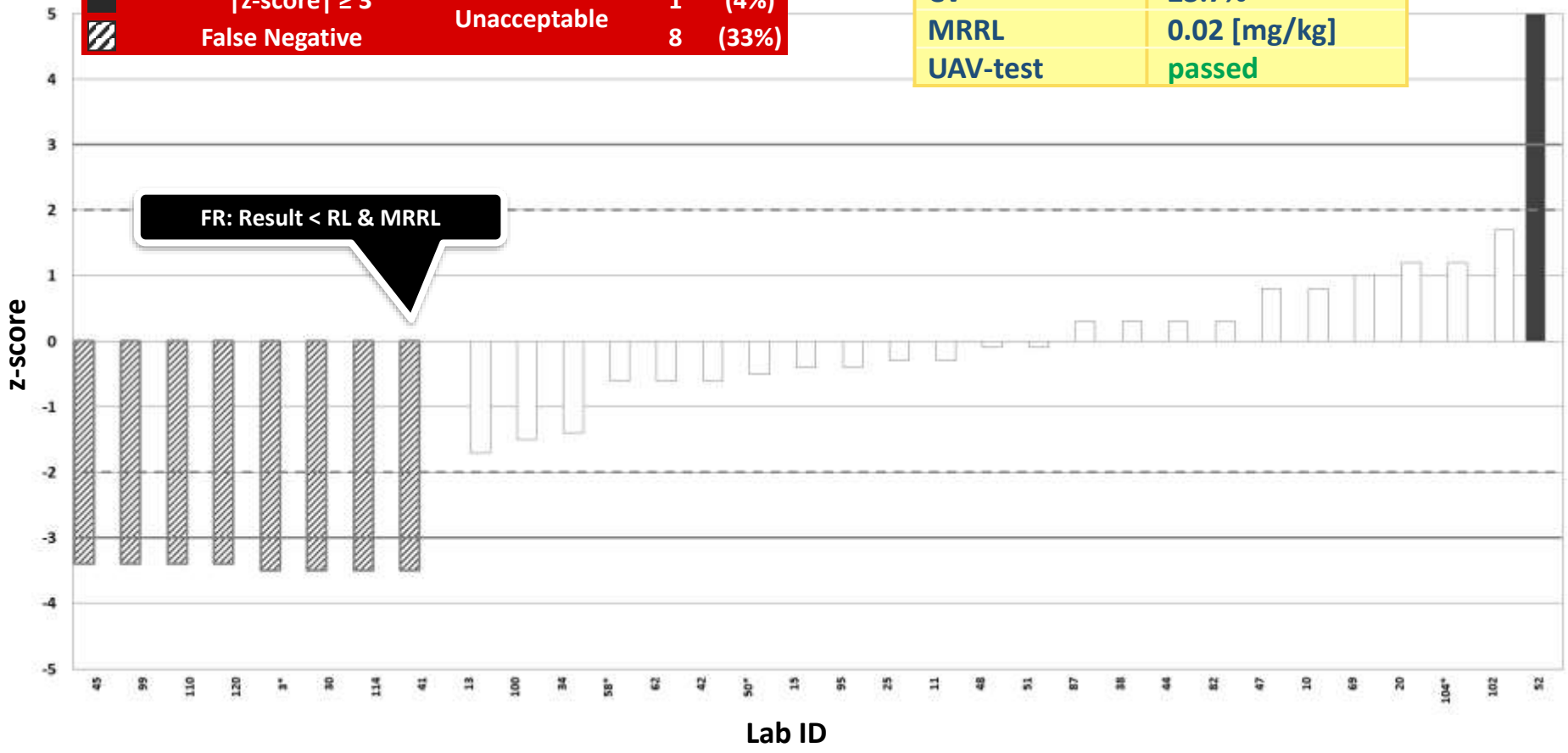
Chloridazon-desphenyl

|z-score| ≤ 2	Acceptable	23	(70%)
2 < |z-score| < 3	Questionable	0	(0%)
|z-score| ≥ 3	Unacceptable	1	(4%)
False Negative		8	(33%)

Results	25
False Neg.	7
AV	0.0616 [mg/kg]
CV*	23.7%
MRRL	0.02 [mg/kg]
UAV-test	passed

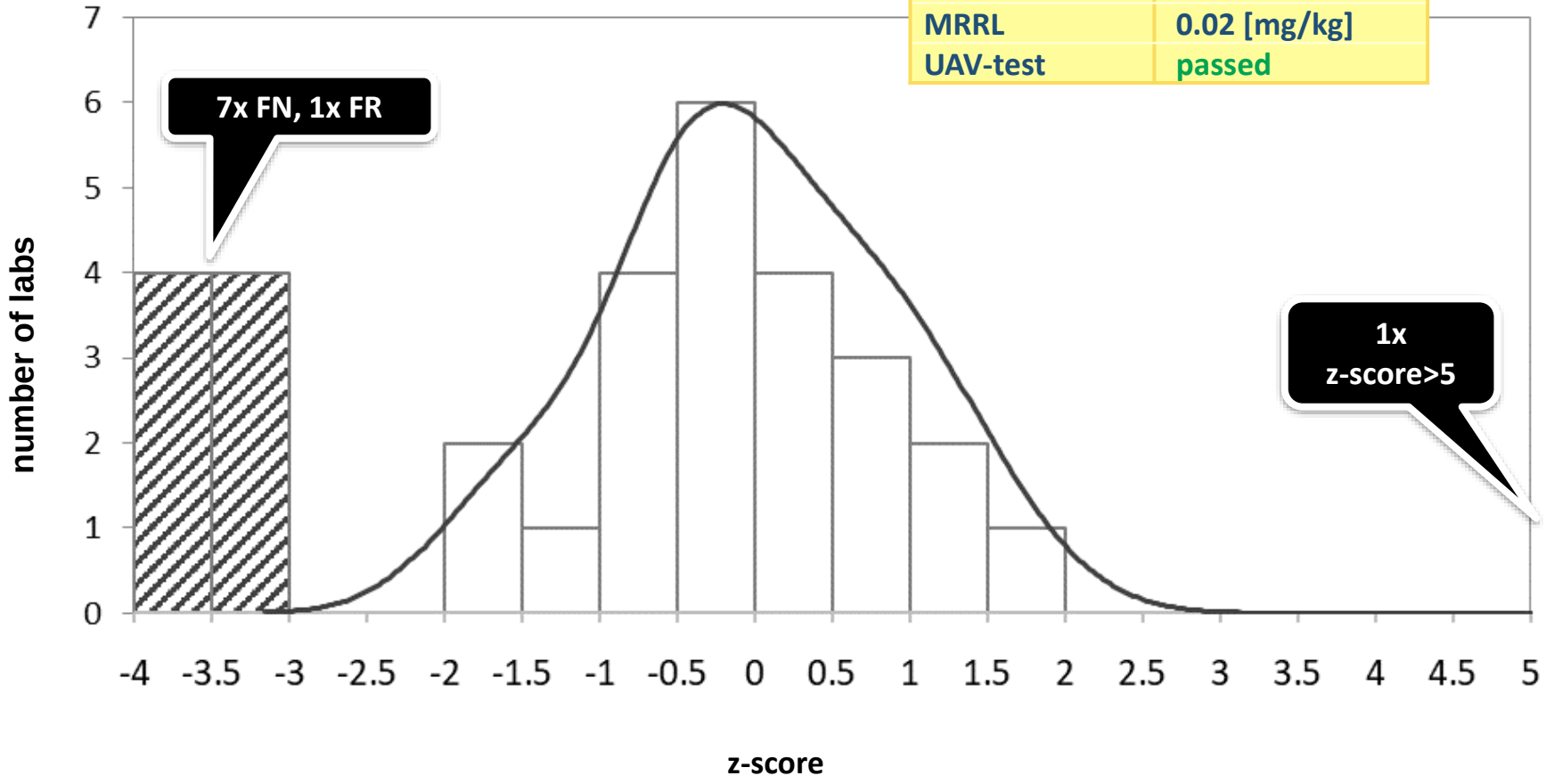
1x z>5

FR: Result < RL & MRRL



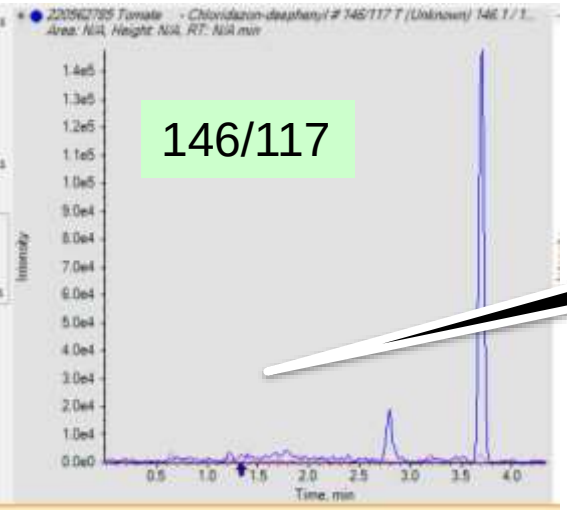
Chloridazon-desphenyl

Results	25
False Neg.	7
AV	0.0616 [mg/kg]
CV*	23.7%
MRRL	0.02 [mg/kg]
UAV-test	passed



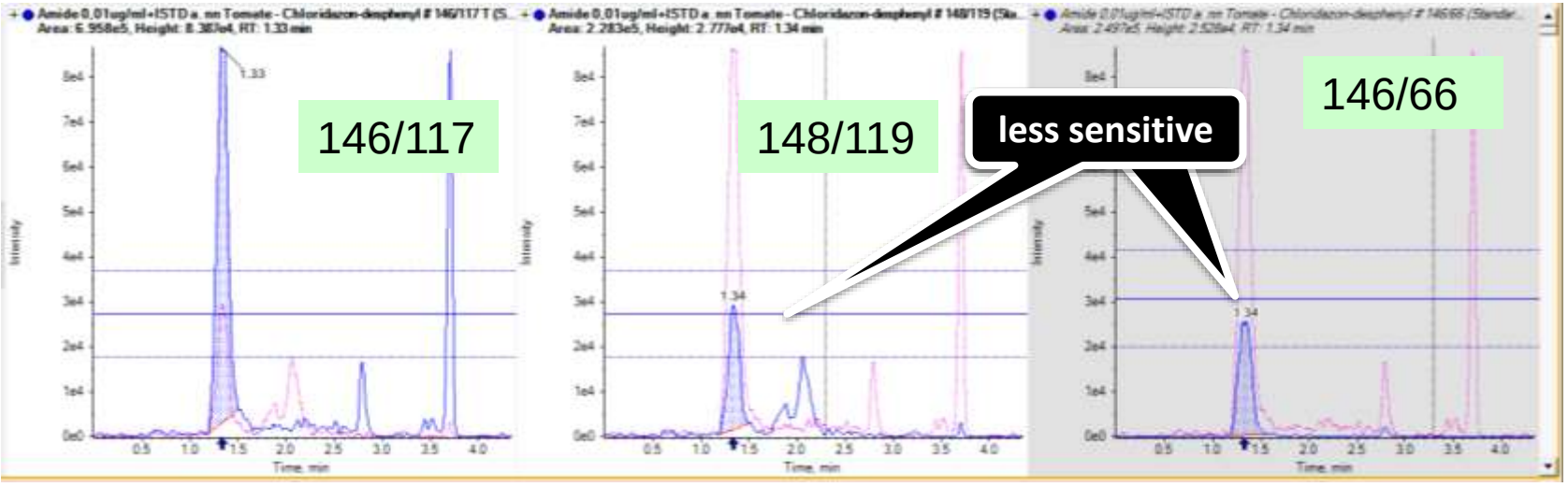
CHLORIDAZON-DESPHENYL

Blank Tomato Extract (QuPPe)



MRM interferred in some matrices, but not in tomato

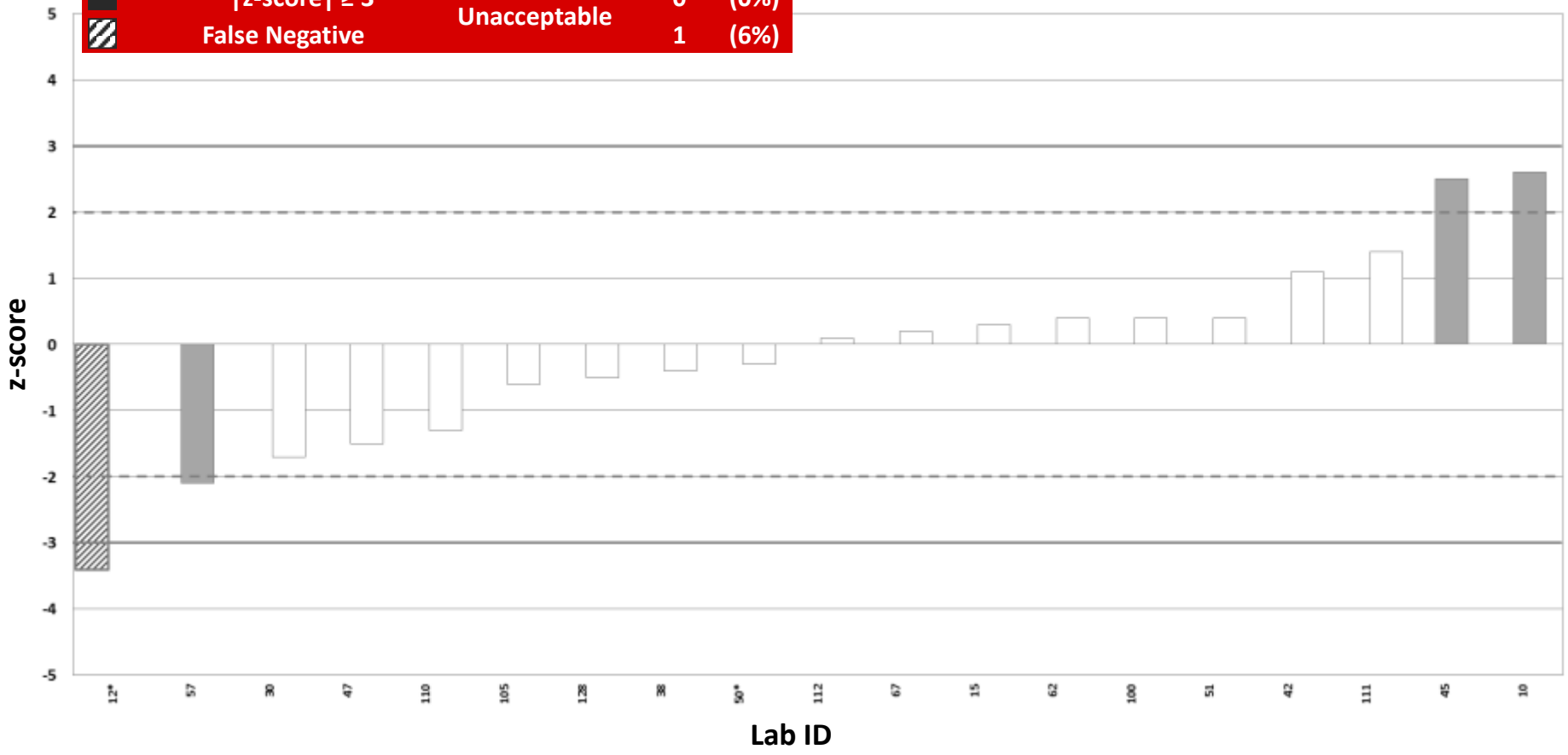
Tomato Extract (QuPPe) + 0.01µg/mL Chloridazon-desphenyl (= 0.02 mg/kg)



ETU

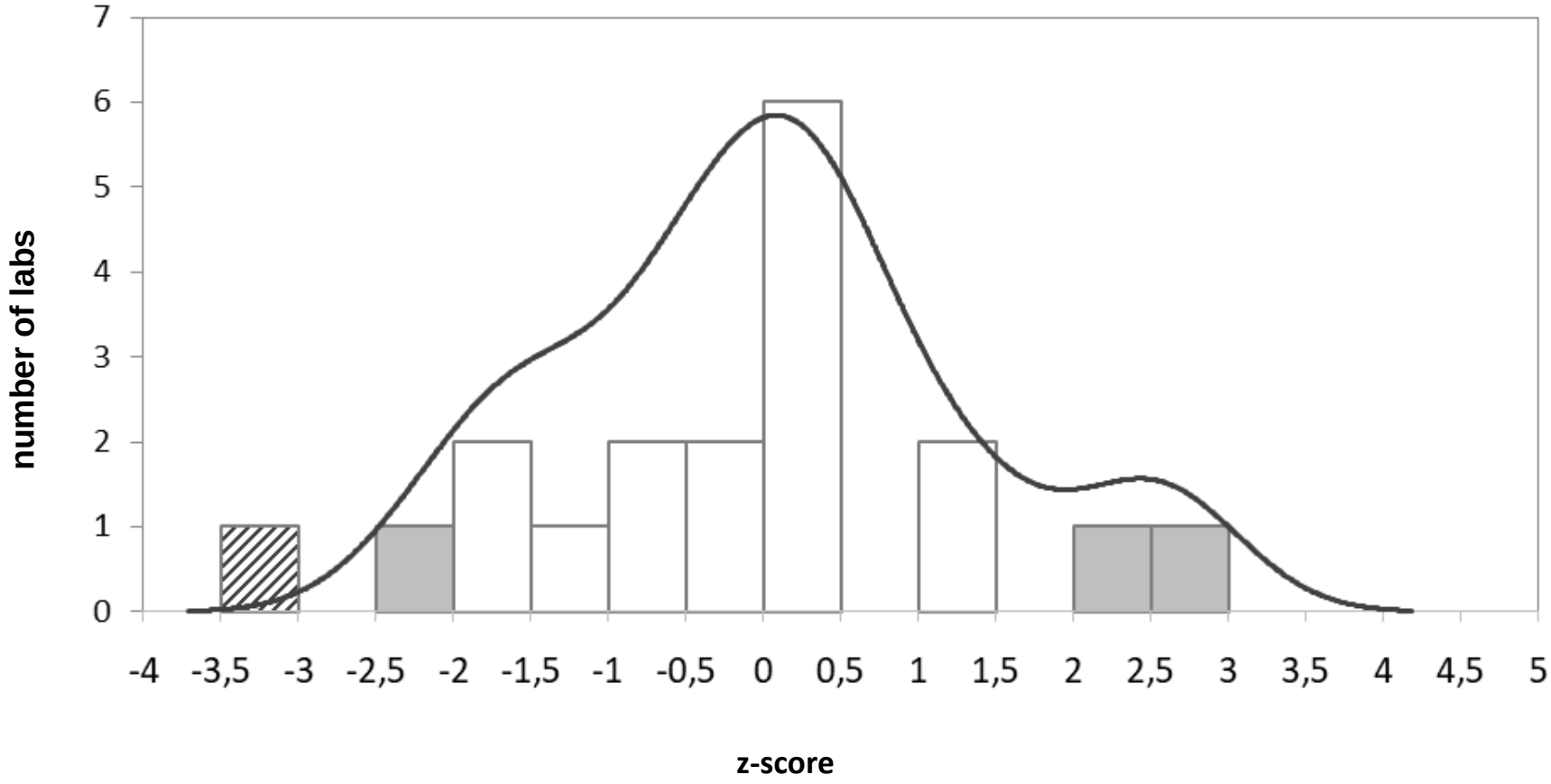
|z-score| ≤ 2	Acceptable	15	(79%)
2 < |z-score| < 3	Questionable	3	(16%)
|z-score| ≥ 3	Unacceptable	0	(0%)
False Negative		1	(6%)

Results	19 (18 numerical)
False Neg.	1
AV	0.0629 [mg/kg]
CV*	33.1%
MRRL	0.01 [mg/kg]
UAV-test	failed

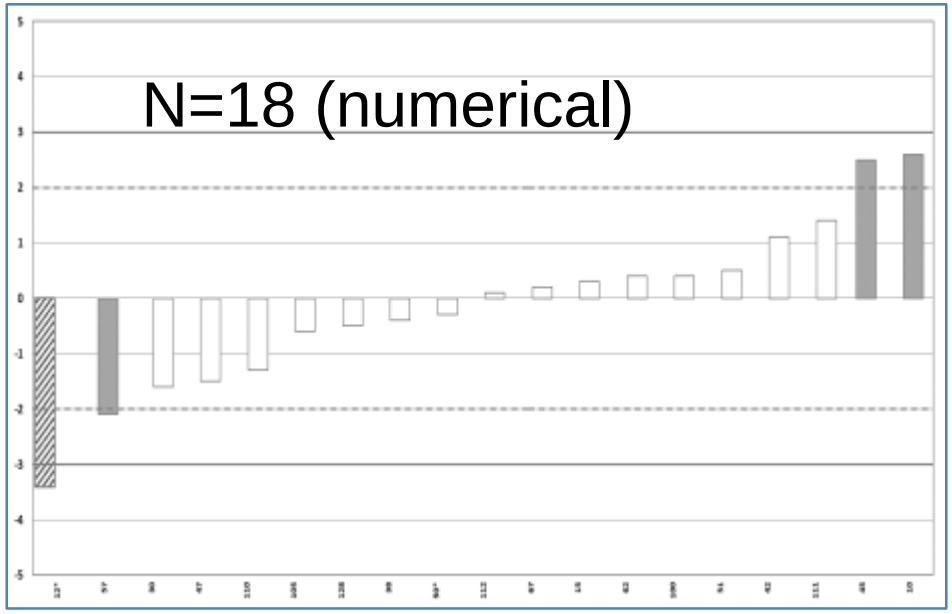


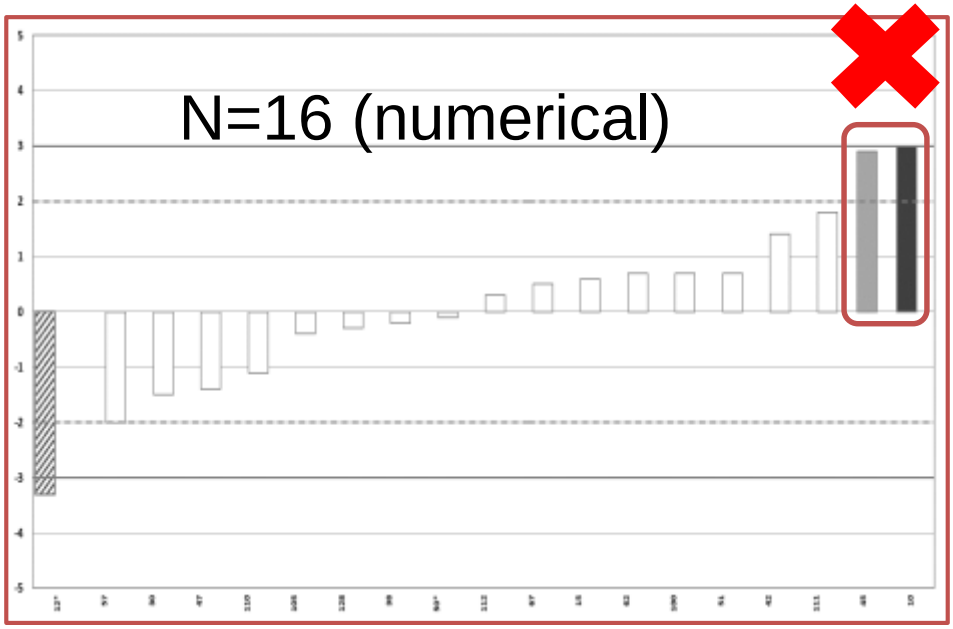
ETU

Results	19 (18 numerical)
False Neg.	1
AV	0.0629 [mg/kg]
CV*	33.1%
MRRL	0.01 [mg/kg]
UAV-test	failed



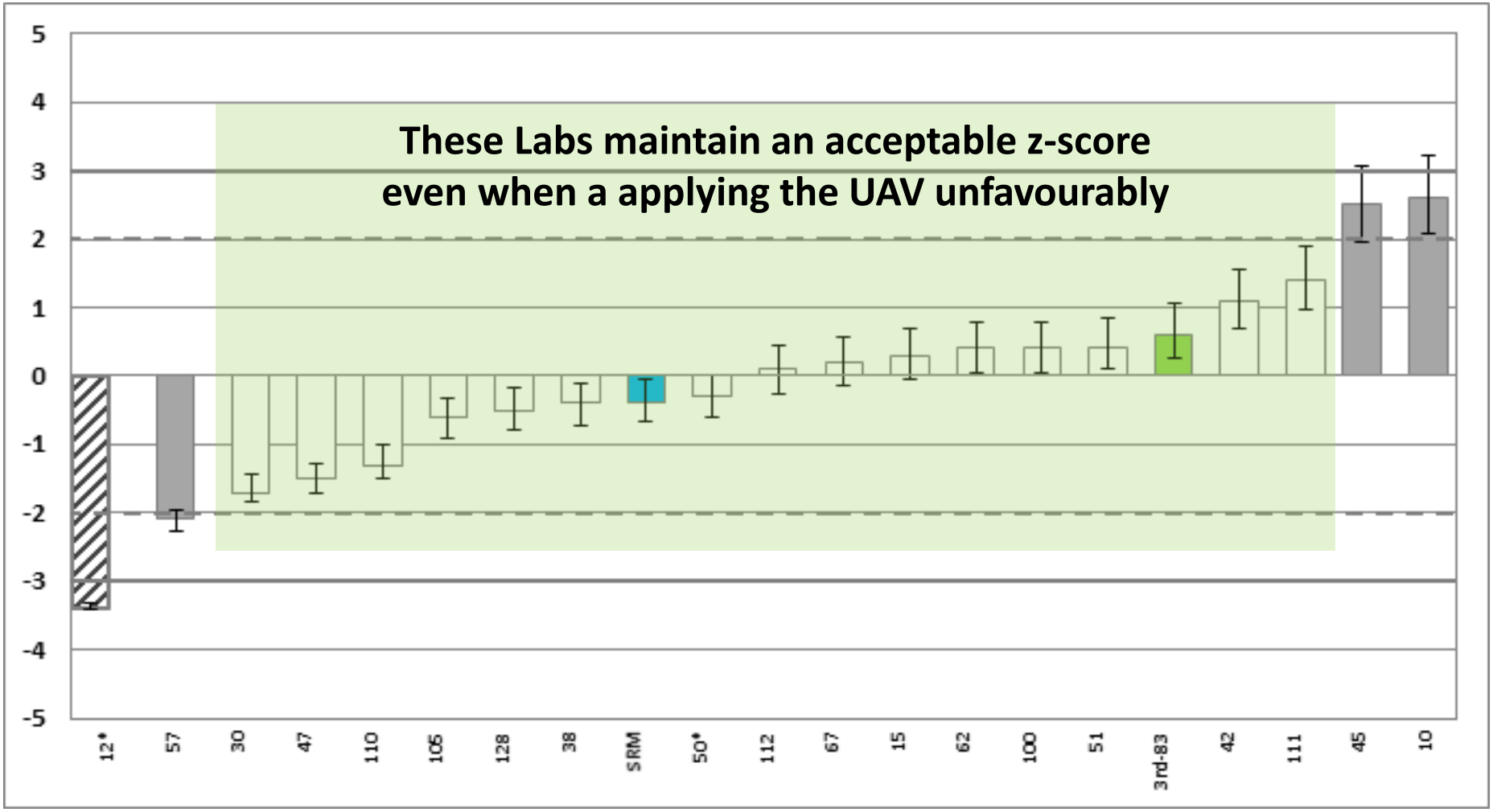
	All Participants (Preliminary Report)	excl. „2 Outliers“
Numerical Results considered	18	16
Robust Mean	0.0629	0.0591
AlgA STD	0.020807	0.017160
CV*	**33.1%**	**29.1%**
Uncertainty of AV	0.006130	0.005362
Tolerance (using FFP 25%)	0.004715	0.004429
	failed	failed



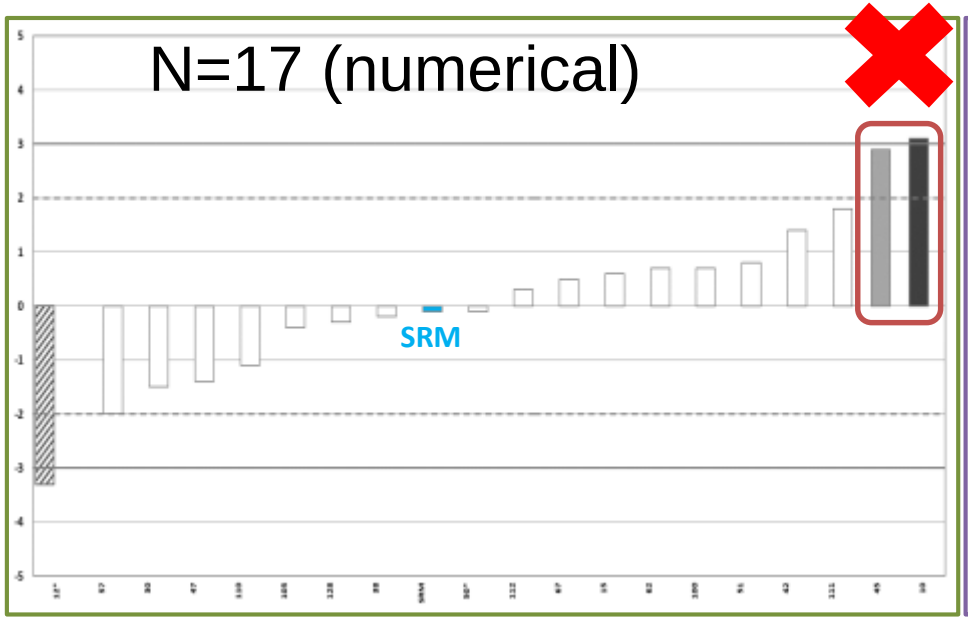


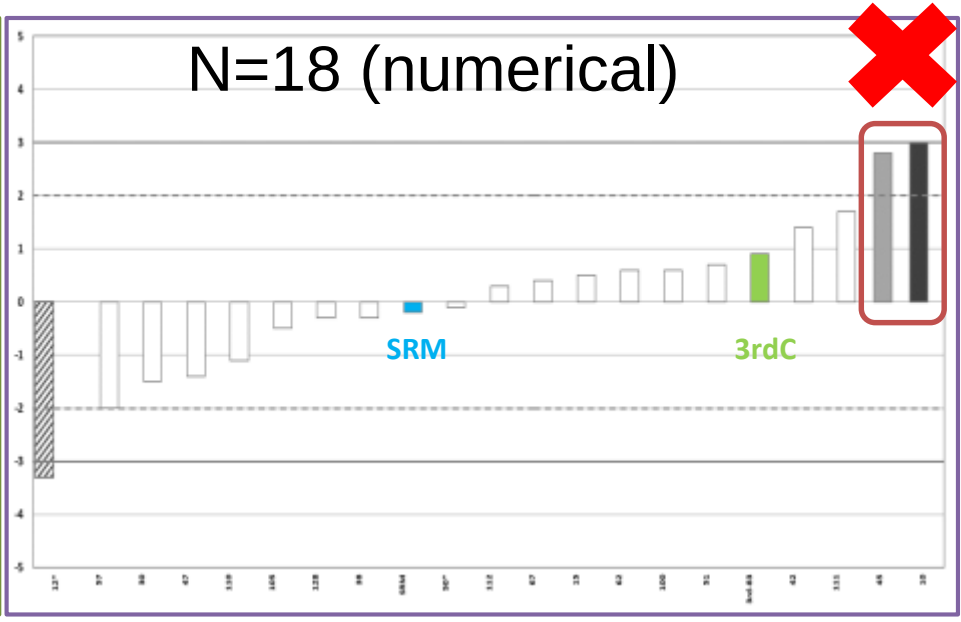
ETU (z-score range considering the UAV)

AV_{min}=AV-UAV; AV_{max}=AV+UAV



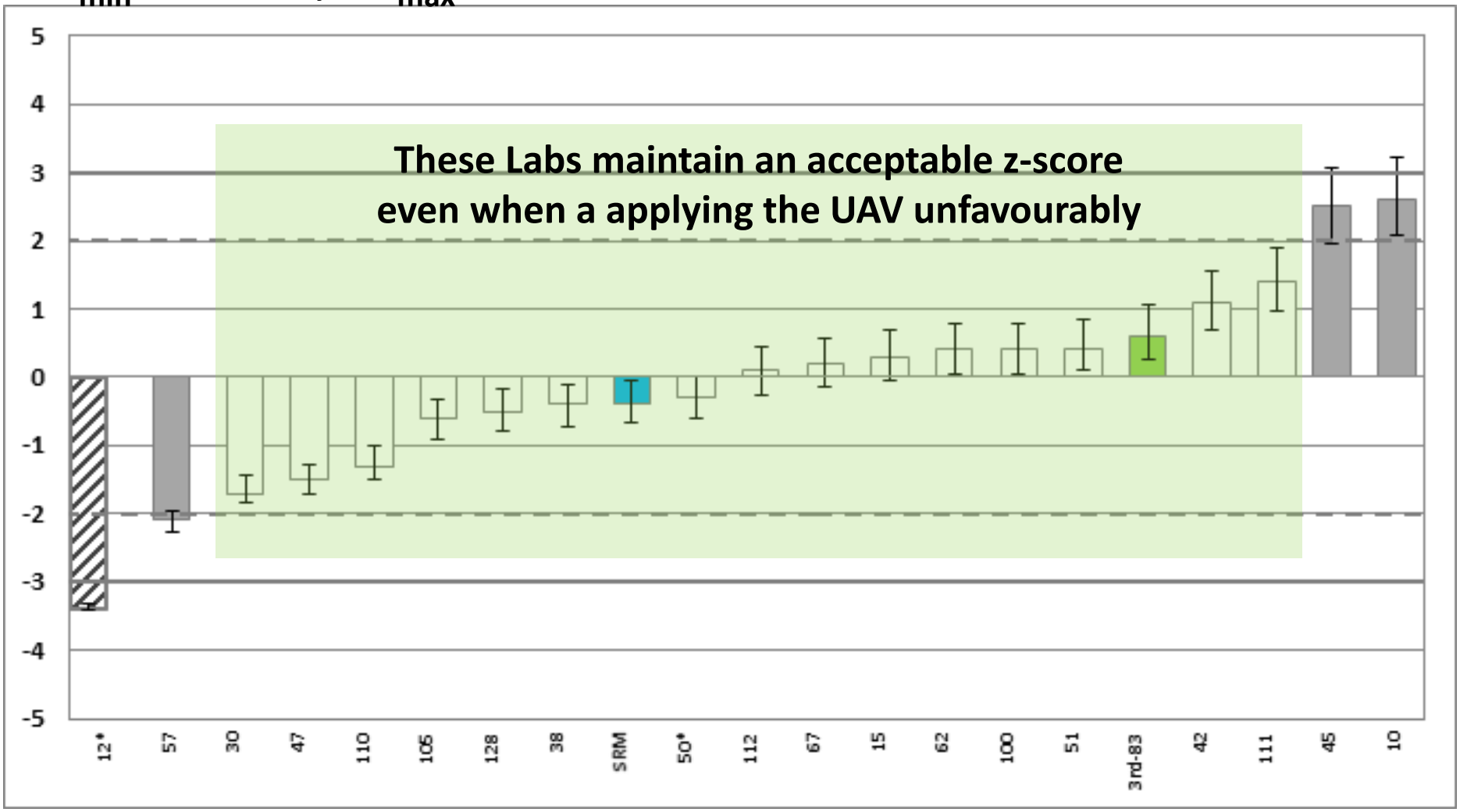
	+ EURL-SRM result (excl. 2 Outliers)	+ EURL-SRM + 3rdC result (excl. 2 Outliers)
Numerical Results considered	17	18
Robust Mean	0.0589	0.0598
AlgA STD	0.016315	0.016240
CV*	**27.7%**	**27.2%**
Uncertainty	0.004946	0.004784
Tolerance (using FFP 25%)	0.004418	0.004485
	failed	failed





ETU (N=18); z-score range considering the UAV

AV_{min}=AV-UAV; AV_{max}=AV+UAV

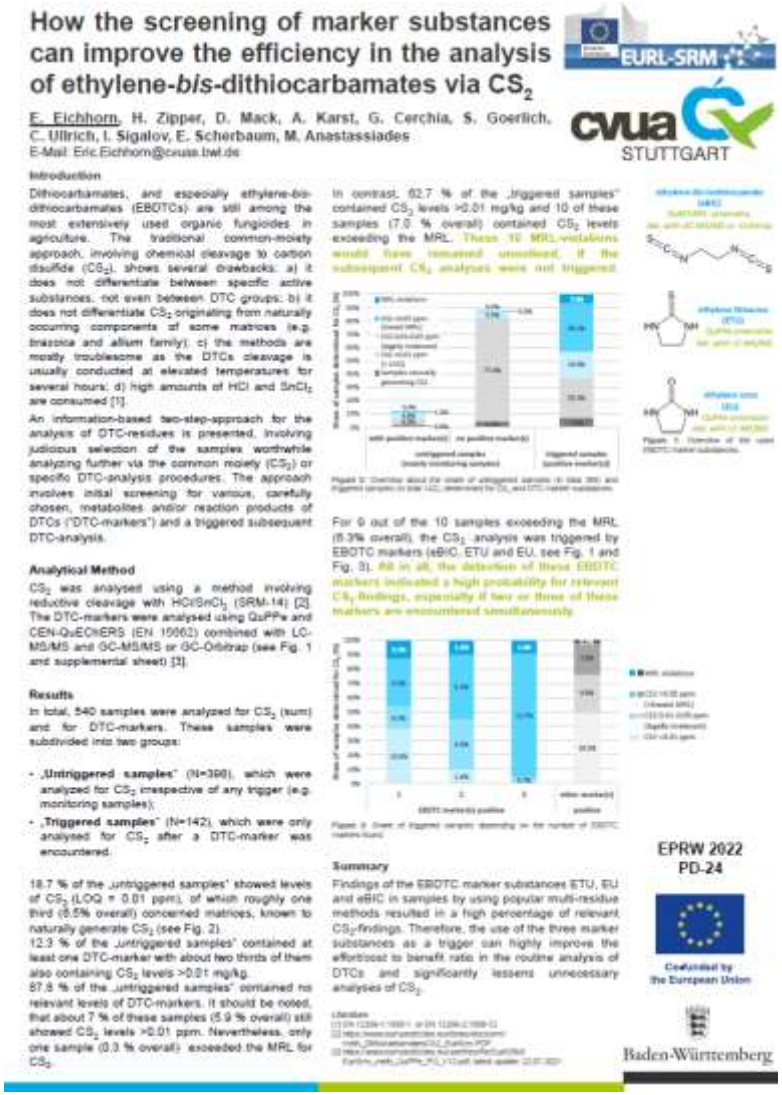


Screening of Dithiocarbamate Marker Compounds

- or -

how to employ the DTC-analysis method via CS_2 more efficiently

Screening of Dithiocarbamate Marker Compounds



How the screening of marker substances can improve the efficiency in the analysis of ethylene-*bis*-dithiocarbamates via CS_2

E. Eichhorn, H. Zipper, D. Mack, A. Karst, G. Cerchia, S. Goerlich, C. Ullrich, I. Sigalov, E. Scherbaum, M. Anastassiades
E-Mail: Eric.Eichhorn@cvua.bwl.de

EURL-SRM

cvua STUTTGART

Introduction

Dithiocarbamates, and especially ethylene-bis-dithiocarbamates (EBDTCs) are still among the most extensively used organic fungicides in agriculture. The traditional common-moiety approach, involving chemical cleavage to carbon disulfide (CS_2), shows several drawbacks: a) it does not differentiate between specific active substances, not even between DTC groups; b) it does not differentiate CS_2 originating from naturally occurring components of some matrices (e.g. brassica and allium family); c) the methods are mostly troublesome as the DTCs cleavage is usually conducted at elevated temperatures for several hours; d) high amounts of HCl and $SnCl_2$ are consumed [1].

An information-based two-step-approach for the analysis of DTC-residues is presented, involving judicious selection of the samples worthwhile analyzing further via the common moiety (CS_2) or specific DTC-analysis procedures. The approach involves initial screening for various, carefully chosen, metabolites and/or reaction products of DTCs ("DTC-markers") and a triggered subsequent DTC-analysis.

Analytical Method

CS_2 was analysed using a method involving reductive cleavage with $HCl/SnCl_2$ (SRM-14) [2]. The DTC-markers were analysed using QuPPe and CEN-QuEChERS (EN 15662) combined with LC-MS/MS and GC-MS/MS or GC-Orbitrap (see Fig. 1 and supplemental sheet) [3].

Results

In total, 540 samples were analyzed for CS_2 (sum) and for DTC-markers. These samples were subdivided into two groups:

- „**Untriggered samples**" (N=398), which were analyzed for CS_2 irrespective of any trigger (e.g. monitoring samples);
- „**Triggered samples**" (N=142), which were only analysed for CS_2 after a DTC-marker was encountered.

18.7 % of the „untriggered samples" showed levels of CS_2 (LOQ = 0.01 ppm), of which roughly one third (6.5% overall) concerned matrices, known to naturally generate CS_2 (see Fig. 2).
12.3 % of the „untriggered samples" contained at least one DTC-marker with about two thirds of them also containing CS_2 levels >0.01 mg/kg.
87.8 % of the „untriggered samples" contained no relevant levels of DTC-markers. It should be noted, that about 7 % of these samples (5.9 % overall) still showed CS_2 levels >0.01 ppm. Nevertheless, only one sample (0.3 % overall) exceeded the MRL for CS_2.

In contrast, 62.7 % of the „triggered samples" contained CS_2 levels >0.01 mg/kg and 10 of these samples (7.0 % overall) contained CS_2 levels exceeding the MRL. These 10 MRL-violations would have remained unnoticed, if the subsequent CS_2 analyses were not triggered.

For 9 out of the 10 samples exceeding the MRL (6.3% overall), the CS_2 analysis was triggered by EBDTC markers (eBIC, ETU and EU, see Fig. 1 and Fig. 3). All in all, the detection of these EBDTC markers indicated a high probability for relevant CS_2 findings, especially if two or three of these markers are encountered simultaneously.

Summary

Findings of the EBDTC marker substances ETU, EU and eBIC in samples by using popular multi-residue methods resulted in a high percentage of relevant CS_2-findings. Therefore, the use of the three marker substances as a trigger can highly improve the effortboost to benefit ratio in the routine analysis of DTCs and significantly lessens unnecessary analyses of CS_2.

EPRW 2022
PD-24

Co-funded by the European Union

Baden-Württemberg

Poster at the EPRW 2022

Background:

The **common moiety method** for DTCs[1] has **SEVERAL LIMITATIONS**:

a. It only allows a **collective DTC-analysis (no differentiation between individual DTC-groups** (not to mention individual active substances)

b. No differentiation between CS_2 originating from naturally occurring components of some matrices (e.g. brassica and allium family) and CS_2 originating from DTC-fungicides

c. The **methods are mostly very troublesome** as the cleavage of the DTCs is usually conducted at elevated temperatures for several hours

d. High amounts of hydrochloric acid and tin chloride are consumed

[1] (DIN EN 12396-1:1999-1 and DIN EN 12396-2:1998-12)

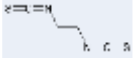
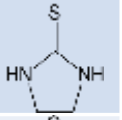
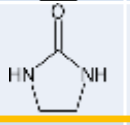
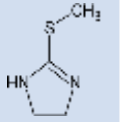
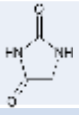
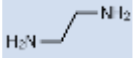
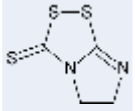
Aims of our study:

- **Identify possible DTC metabolites and/or reaction products** ("DTC-markers") that are ideally …
  a. **amenable to established MRMs** such as **QuEChERS and QuPPe**
  b. **analyzable** using **standard** LC- and GC-MS/MS **equipment**
  c. **commercially available**
  d. **specific** to treatments with DTC-fungicides

- **Selected DTC-markers should be suitable as triggers for subsequent DTC-analyses**

- **Improve cost/benefit ratio** - prevent unnecessary use of common moiety method

EURL-SRM DITHIOCARBAMATES

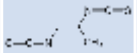
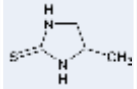
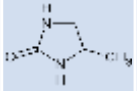
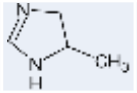
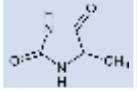
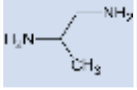
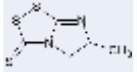
Marker substance	Chemical structure	Chroma-tography	MS-ionization	Remarks	Incorporated in study?	Usefulness as a trigger
Ethylene-*bis*-dithiocarbamate markers						
Ethylene-*bis*-isothiocyanate („eBIC“) CAS 3688-08-2		GC	EI neg.		yes	High
Ethylene thiourea („ETU“) CAS 96-45-7		LC (HILIC) [1)]	ESI pos.		yes	High
Ethylene urea („EU“) CAS 120-93-4		LC (HILIC) [1)]	ESI pos.		yes	High
S-methyl-ethylene thiourea („S-Me-ETU“) CAS 20112-79-2		LC (HILIC) [1)]	ESI pos.	• Often found at very low levels (<1 ppb); of low specificty as there was no significant difference regarding its findings (and levels) in the group of CS_2-containing and the group of non-CS_2-contaning samples • In relevant samples: always accompanied by eBIC and/or ETU, EU	yes	Low
Hydantoin CAS 461-72-3		LC (HILIC) [1)]	ESI pos. & ESI neg.	• ESI pos.: poor sensitivity • ESI neg.: just one useful MRM available	-	-
Ethylene diamine („EDA“) CAS 107-15-3		LC (HILIC) [1)]	ESI pos.	• Just one useful MRM available • Poor sensitivity	-	-
3H,5H,6H-imidazo[2,1-c]-[1,2,4]dithiazole-3-thione („Etem“) CAS 33813-20-6		LC (HILIC[1)]/ RP)	ESI pos.	• Just two findings out of 540 total samples, together with at least 2 other EBDTC markers • Limited standard stability • Stability issues in matrix extracts	yes	Low

Good markers for EBTCs

1) QuPPe Method 4.2 (“Quats&Co. BEH Amide”) https://www.eurl-pesticides.eu/userfiles/file/EurlSRM/EurlSrm_meth_QuPPe_PO_V12.pdf
2) Intermediate analytical observations as regards the analysis of propineb as propylenediamine following reductive cleavage with HCl/SnCl2 and measurement via ion-pair LC-MS/MS (https://www.eurl-pesticides.eu/userfiles/file/EurlSRM/EurlSrm_Observation_Propineb_V1.pdf)

EURL-SRM

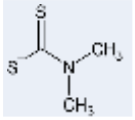
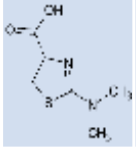
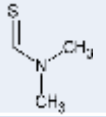
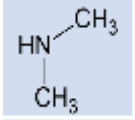
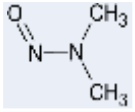
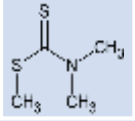
DITHIOCARBAMATES

Marker substance	Chemical structure	Chroma-tography	MS-ionization	Remarks	Incorporated in study?	Usefulness as a trigger
Propylene-*bis*-dithiocarbamate markers						
Propylene-*bis*-isothiocyanate („pBIC“) CAS 109704-32-7		GC	EI neg.		yes	**Tentatively high**
Propylene thiourea („PTU“) CAS 2122-19-2		LC (HILIC) [1]	ESI pos.		yes	**Tentatively high**
Propylene urea CAS 6531-31-3		LC (HILIC) [1]	ESI pos.	• Poor sensitivity • High matrix suppression	-	-
4-Methyl-imidazoline CAS 1615-03-8		LC (HILIC) [1]	ESI pos.	• Often found at low levels • Relevance enhanced at a threshold of 5 µg/kg	yes	**Tentatively high**
5-methyl-hydantoin CAS 616-03-5		LC (HILIC) [1]	ESI pos.	• ESI pos.: poor sensitivity • ESI neg.: just one useful MRM available	-	-
S-methyl-propylene thiourea („S-Me-PTU“) CAS 55536-61-3		-	-	• Analytical standard not available	-	-
Propylene diamine („PDA“) CAS 78-90-0		LC (HILIC) [1]	ESI pos.	• Poor sensitivity • Determination via ion-pair LC after traditional acidic hydrolysis for CS_2 as it is legally regulated according to Reg. (EC) No. 396/2005 [2]	-	-
6-Methyl-5,6-dihydroimidazo-[2,1-C][1,2,4]dithiazole-3-thione („Propineb-DIDT“) CAS N/A		LC (HILIC[1]/ RP)	ESI pos.	• Limited standard stability • Stability issues in matrix extracts	-	-

Too few samples were positive.
More analyses needed to finally decide.

EURL-SRM

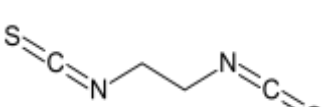
DITHIOCARBAMATES

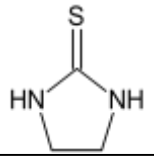
Marker substance	Chemical structure	Chroma-tography	MS-ionization	Remarks	Incorporated in study?	Usefulness as a trigger
Dimethyl-dithiocarbamate markers						
N,N-dimethyldithiocarbamate („Dibam“) CAS 128-04-1		LC (?)	ESI neg.	• Limited standard stability (highly reactive) • Chromatography difficult	-	-
2-(dimethylamino)-4,5-dihydro-1,3-thiazole-4-carboxylic acid („M1“) CAS 1417542-99-4		LC (HILIC) [1)]	ESI pos. / (ESI neg.?)	• Standard not commercially available yet	yes	**TBD**
Dimethylthioformamide (DMTF) CAS 758-16-7		GC / LC (HILIC) [1)]	EI neg. / ESI pos.		yes	**TBD**
Dimethylamine („DMA“) CAS 124-40-3		LC (HILIC) [1)]	ESI pos.	• Ubiquitous up to amounts of approx. 1 mg/kg	yes	**Very low**
N-Nitrosodimethylamine CAS 62-75-9		LC (HILIC) [1)]	ESI pos.	• Reported formation during water treatment • Poor sensitivity	-	-
N,N-dimethyldithiocarbamate-methyl CAS 3735-92-0		GC	EI neg.		yes	**TBD**

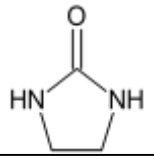
Too few samples were positive.
More analyses needed to finally decide.

Usefulness of EBDTC-markers

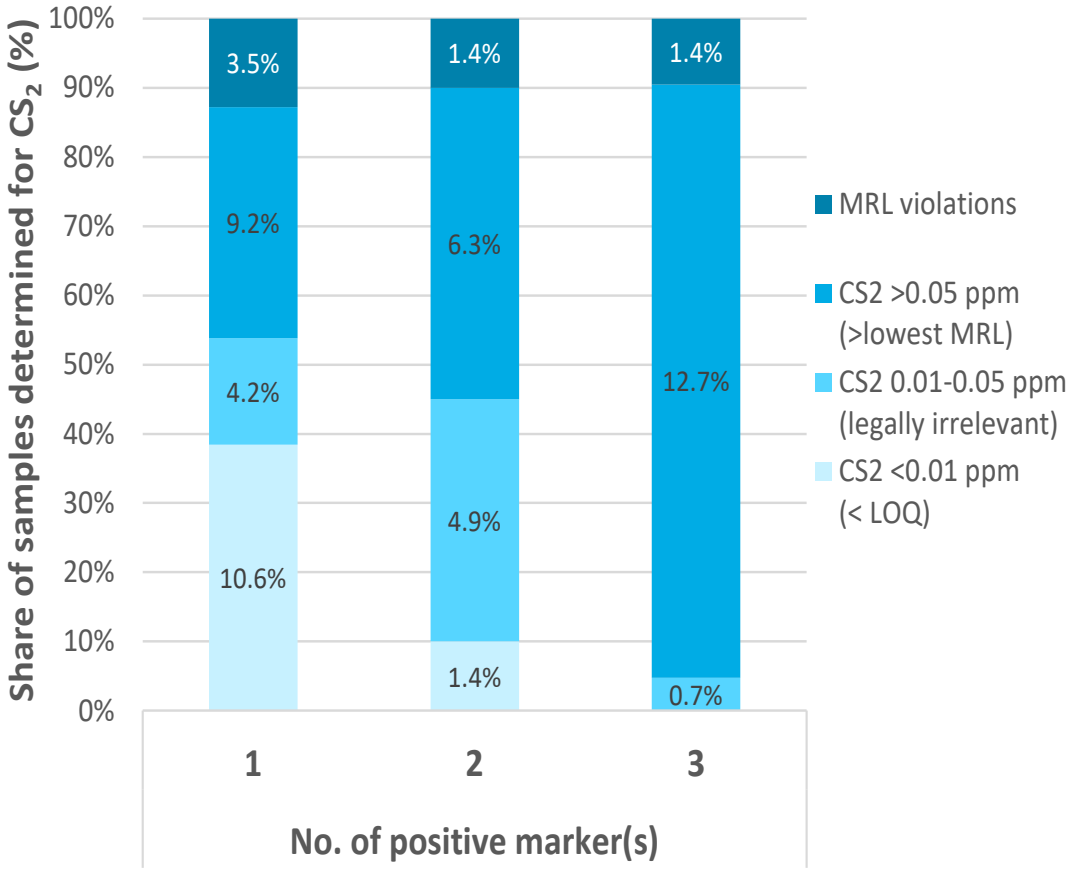
ethylene-*bis*-isothiocyanate (eBIC)	ethylene thiourea (ETU)	ethylene urea (EU)
QuEChERS- amenable, det. with GC-MS/MS or -Orbitrap	QuPPe-amenable det. with LC-MS/MS	QuPPe-amenable det. with LC-MS/MS







Relationship between no. of detected EBDTC-markers and CS_2-levels

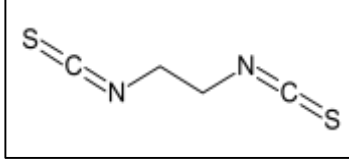


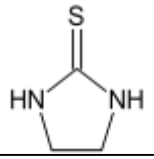
CS_2-levels in case of…

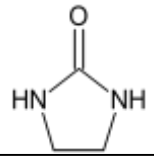
- **ONE** pos. EBDTC marker:
  ≥ LOQ (0.01 mg/kg): ~ 60 %
  ≥ 0.05 mg/kg (lowest MRL): ~ 45 %
  BUT MRL-EXCEEDANCES !!
- **TWO** pos. EBDTC markers:
  ≥ LOQ (0.01 mg/kg): > 90 %
  ≥ 0.05 mg/kg (lowest MRL): > 50 %
- **THREE** pos. EBDTC markers:
  ≥ 0.05 mg/kg (lowest MRL): **>95 %**

Usefulness of EBDTC-markers

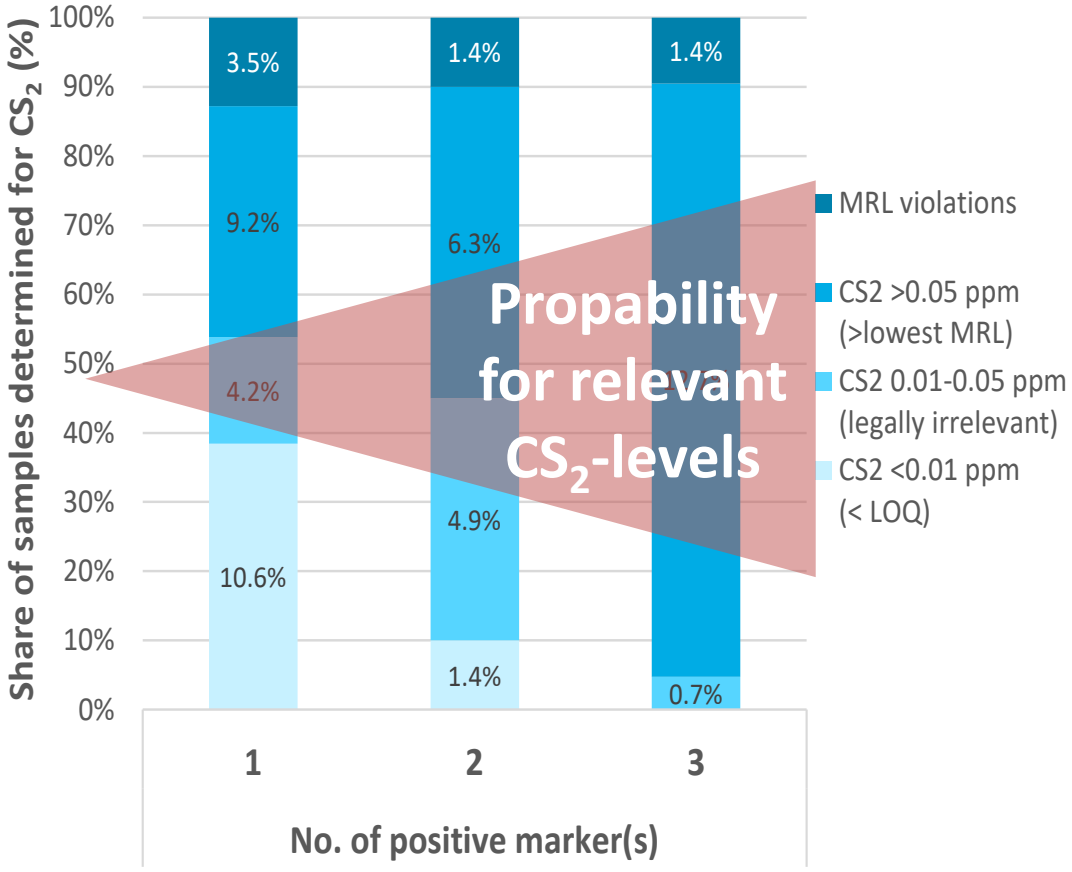
ethylene-*bis*-isothiocyanate (eBIC)	ethylene thiourea (ETU)	ethylene urea (EU)
QuEChERS- amenable, det. with GC-MS/MS or -Orbitrap	QuPPe-amenable det. with LC-MS/MS	QuPPe-amenable det. with LC-MS/MS







Relationship between no. of detected EBDTC-markers and CS_2-levels

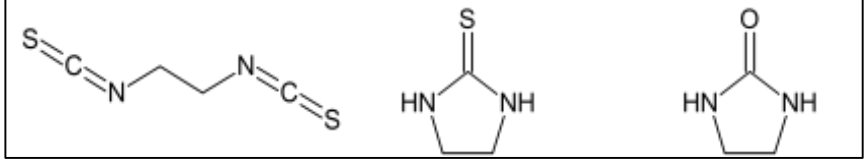


CS_2-levels in case of…

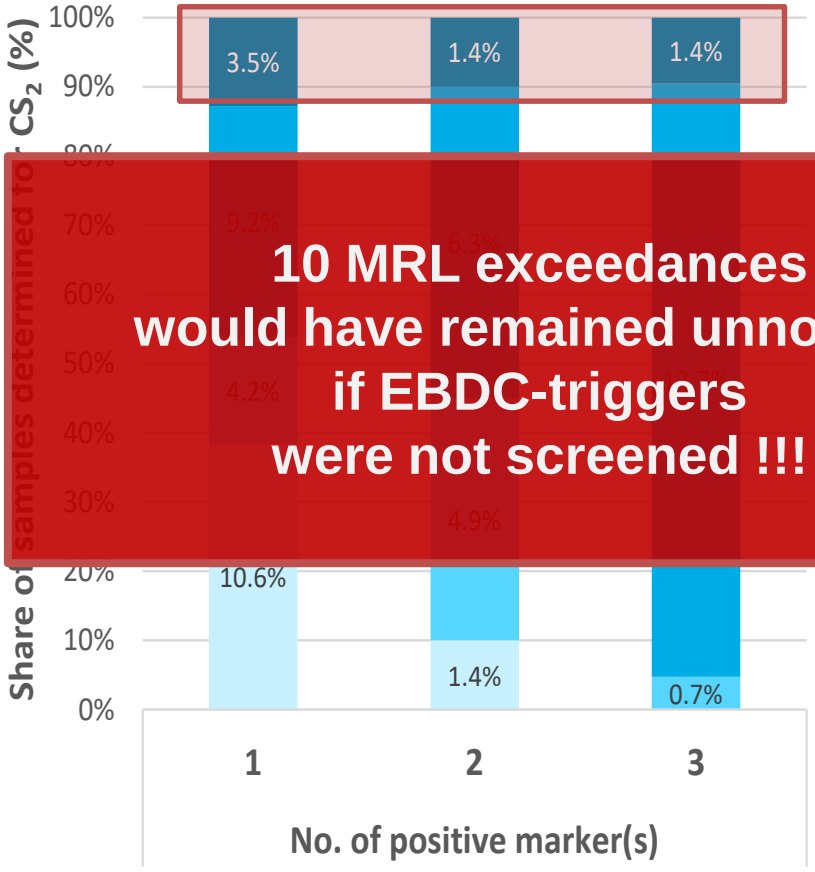
- **ONE** pos. EBDTC marker:
  ≥ LOQ (0.01 mg/kg): ~ 60 %
  ≥ 0.05 mg/kg (lowest MRL): ~ 45 %
  BUT MRL-EXCEEDANCES !!
- **TWO** pos. EBDTC markers:
  ≥ LOQ (0.01 mg/kg): > 90 %
  ≥ 0.05 mg/kg (lowest MRL): > 50 %
- **THREE** pos. EBDTC markers:
  ≥ 0.05 mg/kg (lowest MRL): **>95 %**

Usefulness of EBDTC-markers

ethylene-*bis*-isothiocyanate (eBIC)	ethylene thiourea (ETU)	ethylene urea (EU)
QuEChERS- amenable, det. with GC-MS/MS or -Orbitrap	QuPPe-amenable det. with LC-MS/MS	QuPPe-amenable det. with LC-MS/MS



Relationship between no. of detected EBDTC-markers and CS_2-levels



10 MRL exceedances would have remained unnoticed if EBDC-triggers were not screened !!!

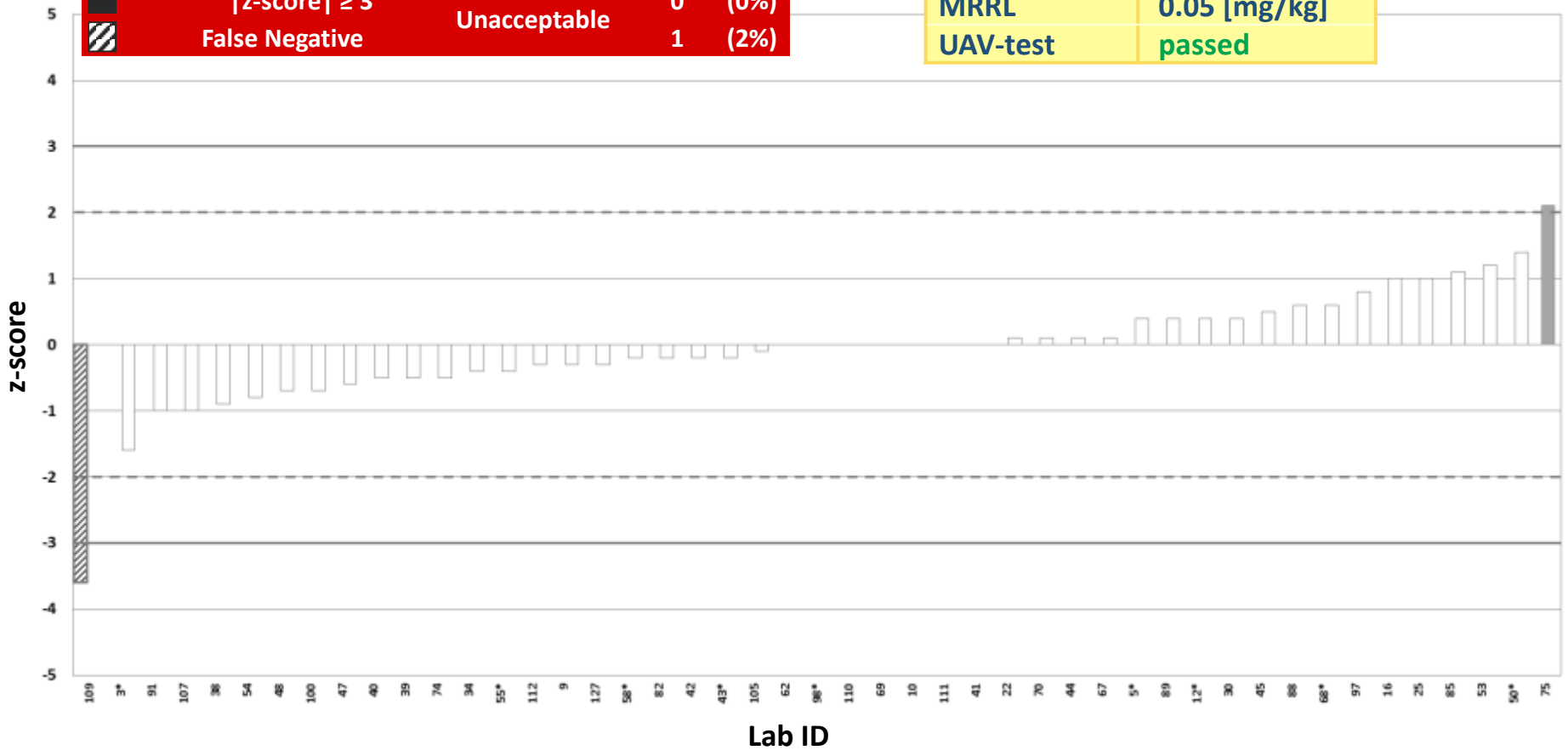
CS_2-levels in case of…

- **ONE** pos. EBDTC marker:
  ≥ LOQ (0.01 mg/kg): ~ 60 %
  ≥ 0.05 mg/kg (lowest MRL): ~ 45 %
  BUT MRL-EXCEEDANCES !!
- **TWO** pos. EBDTC markers:
  ≥ LOQ (0.01 mg/kg): > 90 %
  ≥ 0.05 mg/kg (lowest MRL): > 50 %
- **THREE** pos. EBDTC markers:
  ≥ 0.05 mg/kg (lowest MRL): **>95 %**

Maleic hydrazide

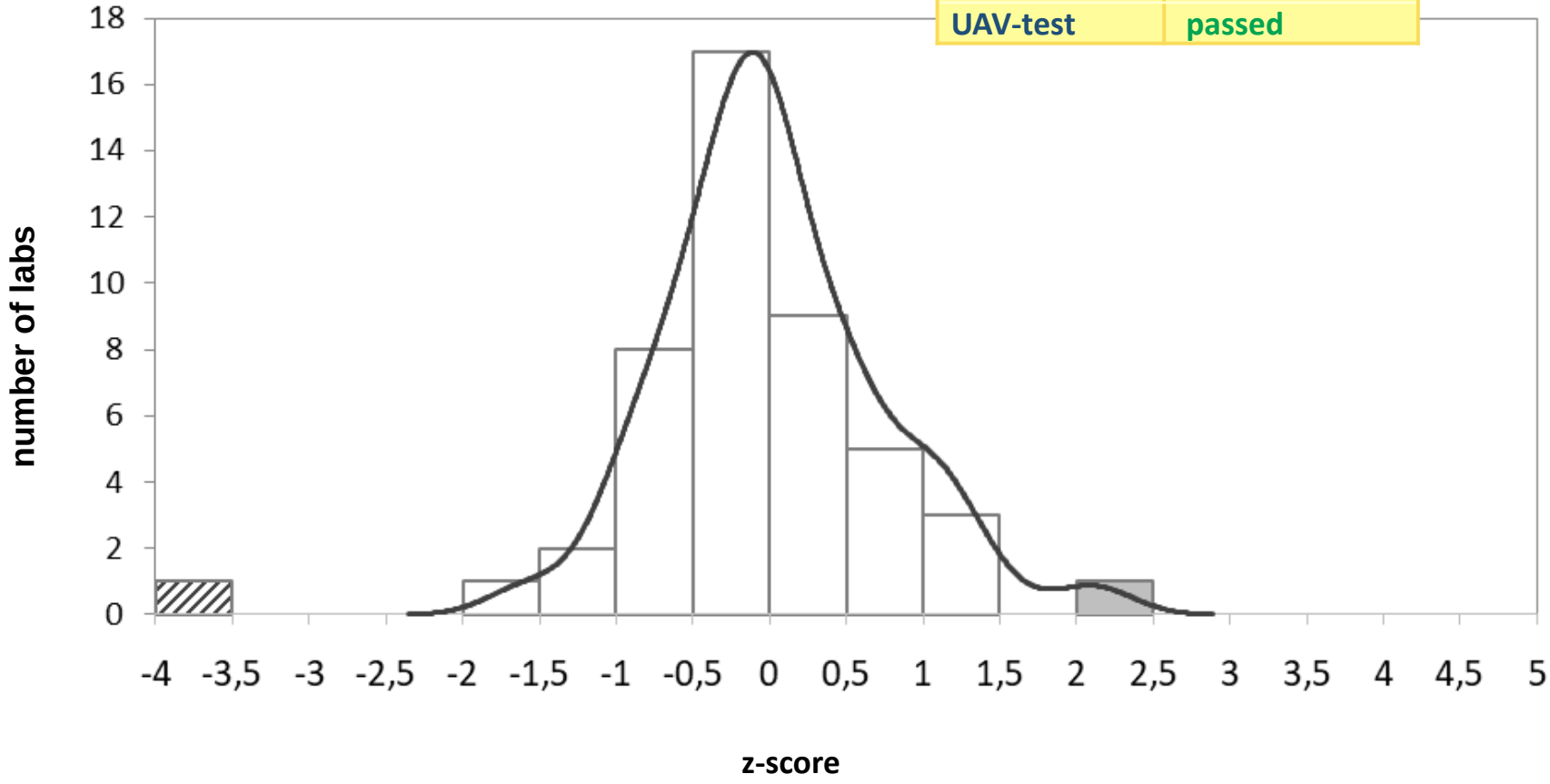
|z-score| ≤ 2	Acceptable	45	(96%)
2 < |z-score| < 3	Questionable	1	(2%)
|z-score| ≥ 3	Unacceptable	0	(0%)
False Negative		1	(2%)

Results	46
False Neg.	1
AV	0.544 [mg/kg]
CV*	16.6%
MRRL	0.05 [mg/kg]
UAV-test	passed



Maleic hydrazide

Results	46
False Neg.	1
AV	0.544 [mg/kg]
CV*	16.6%
MRRL	0.05 [mg/kg]
UAV-test	passed



Maleic hydrazide: impact of ILIS

Maleic hydrazide	Whole Population	Matching ILIS	No matching ILIS
No. Numerical results	46	21	25
No. FNs	1	0	1
No. Outliers °	0	0	0
AV [mg/kg]	**0.544**	**0.523**	**0.563**
CV* [%]	**16.6**	**7.6**	**21.9**
UAV [mg/kg]	0.0167	0.0108	0.0308
Tolerance [mg/kg]	0.0408	0.0392	0.0422
	passed	passed	passed

Procedural	6
StAdd-SP	3
StAdd-EA	2
MM	10
MB	1
SB	3

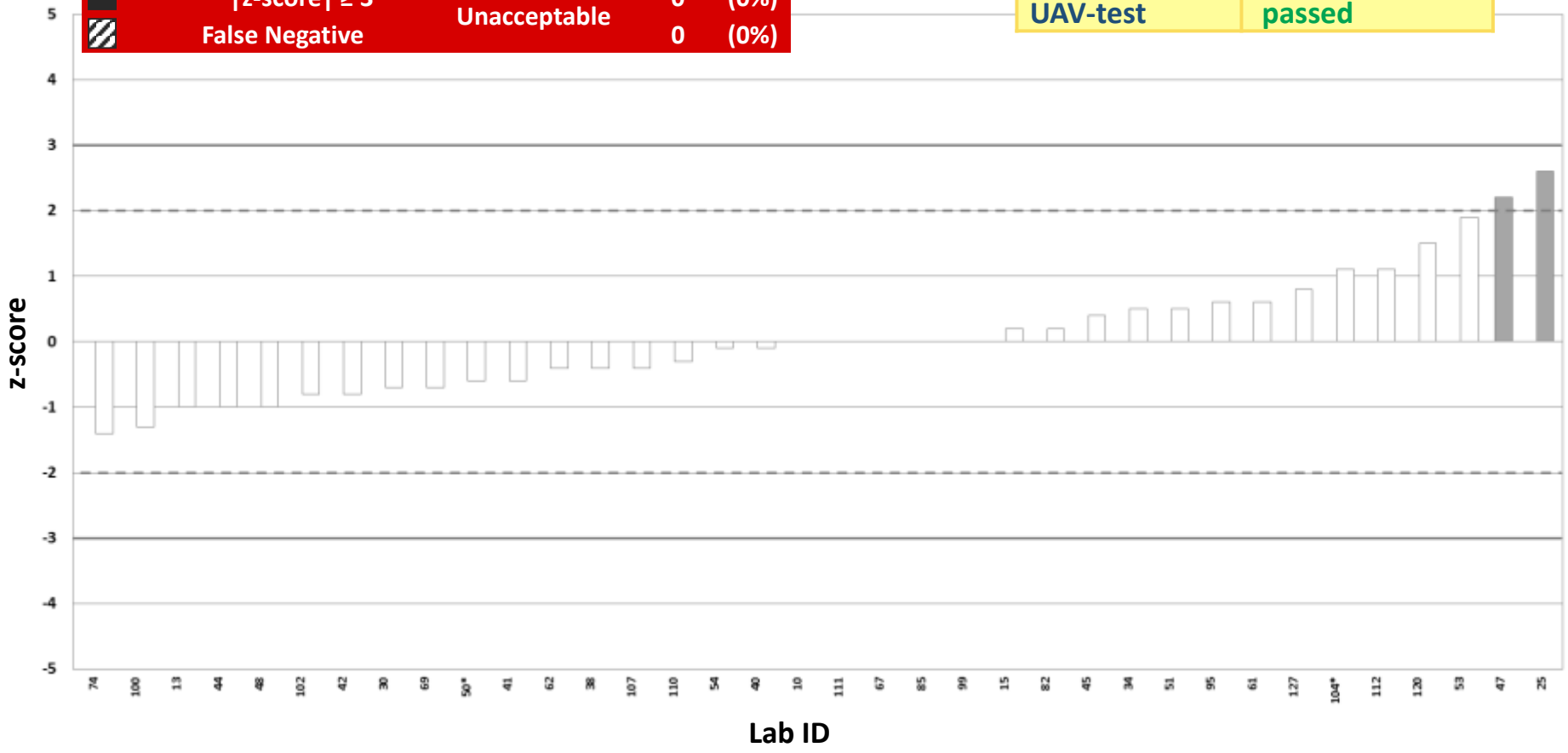
EURL-SRM

OXYMATRINE

Oxymatrine

|z-score| ≤ 2	Acceptable	34	(94%)
2 < |z-score| < 3	Questionable	2	(6%)
|z-score| ≥ 3	Unacceptable	0	(0%)
False Negative		0	(0%)

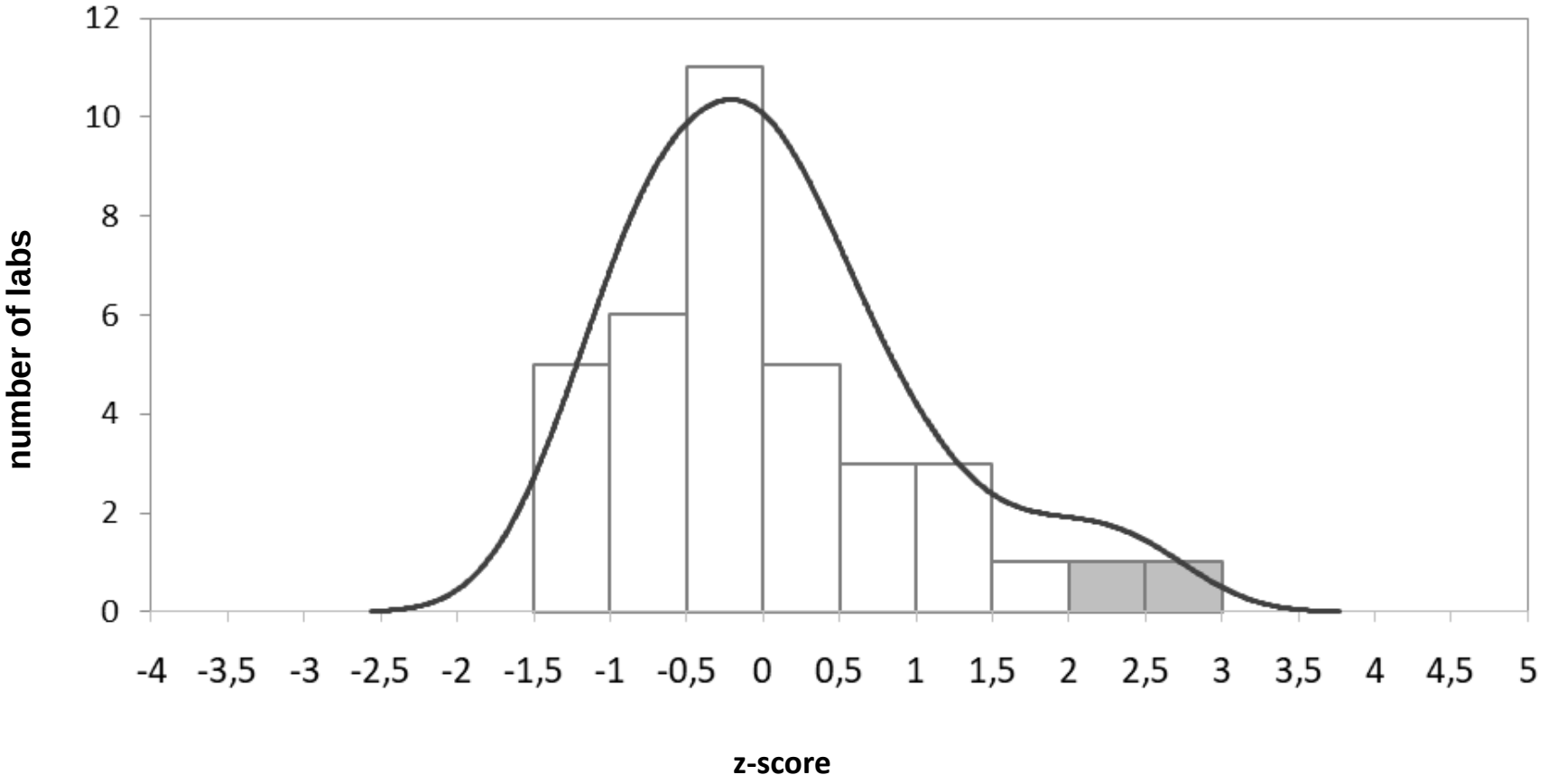
Results	36
False Neg.	0
AV	0.198 [mg/kg]
CV*	22.4%
MRRL	0.01 [mg/kg]
UAV-test	passed



OXYMATRINE

Oxymatrine

Results	36
False Neg.	0
AV	0.198 [mg/kg]
CV*	22.4%
MRRL	0.01 [mg/kg]
UAV-test	passed



EURL-SRM

ANALYSIS OF MATRINE/OXYMATRINE

Analytical Observations Report in Preparation

EU Reference Laboratories for Residues of Pesticides
Single Residue Methods

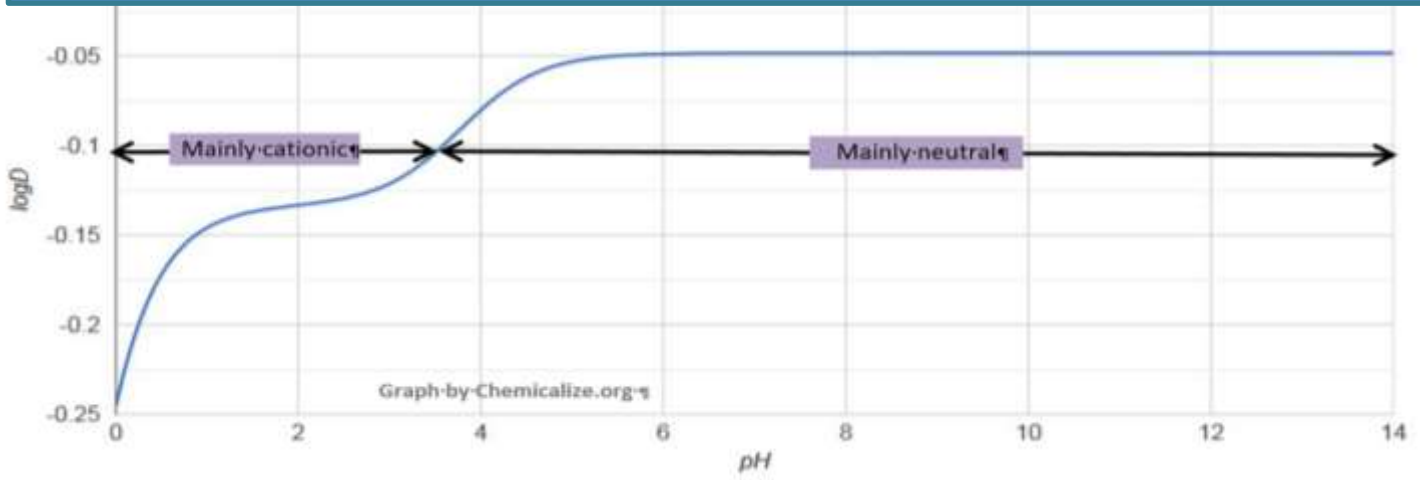
EURL-SRM·-·Analytical·Observations·Report¶

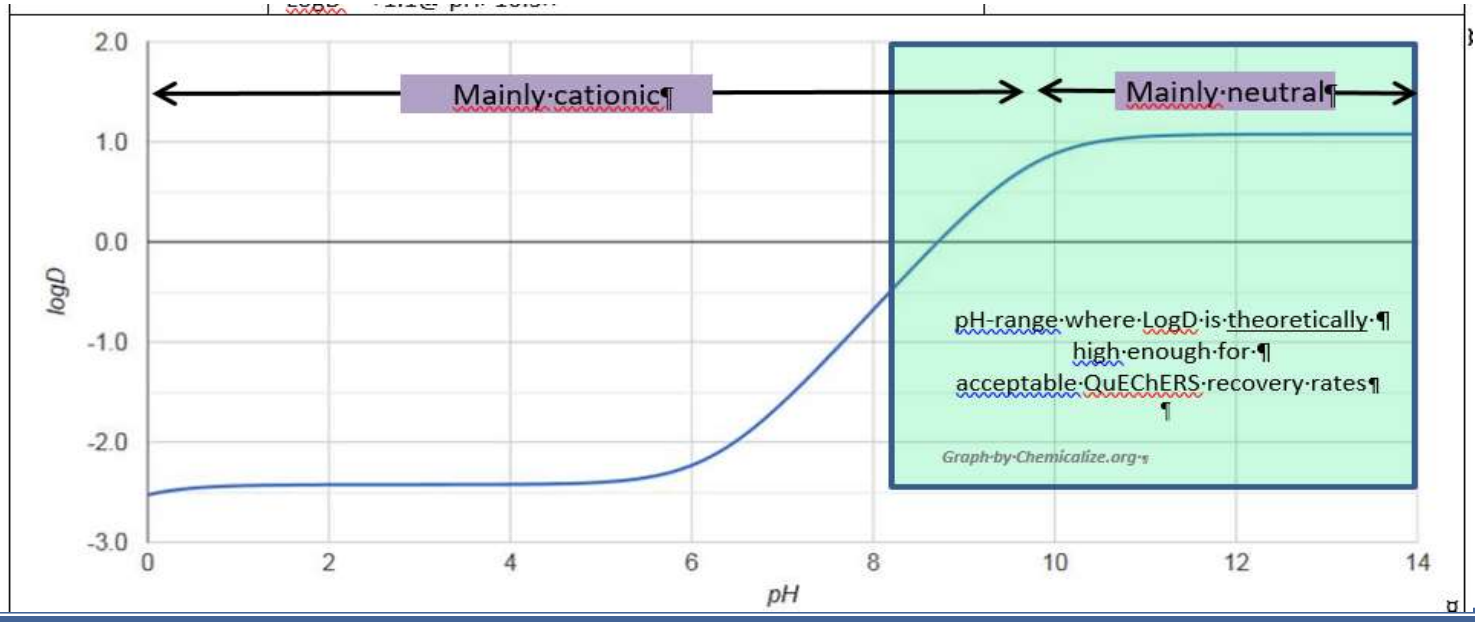
concerning·the·following…¶

- **Compound(s)**:·Matrine·and·Oxymatrine¶
- **Commodities**:·Fruit·and·vegetables,·cereals¶
- **Extraction·Method(s)**:·QuEChERS,·alkaline·QuEChERS·("nicotine·method"),·QuPPe¶
- **Instrumental·analysis**:·GC-Orbitrap·screening·and·LC-MS/MS·¶

Analysis·of·Matrine·and·Oxymatrine·in·Food·

Impact of pH on logD and partitioning behavior





Impact of pH on logD and partitioning behavior

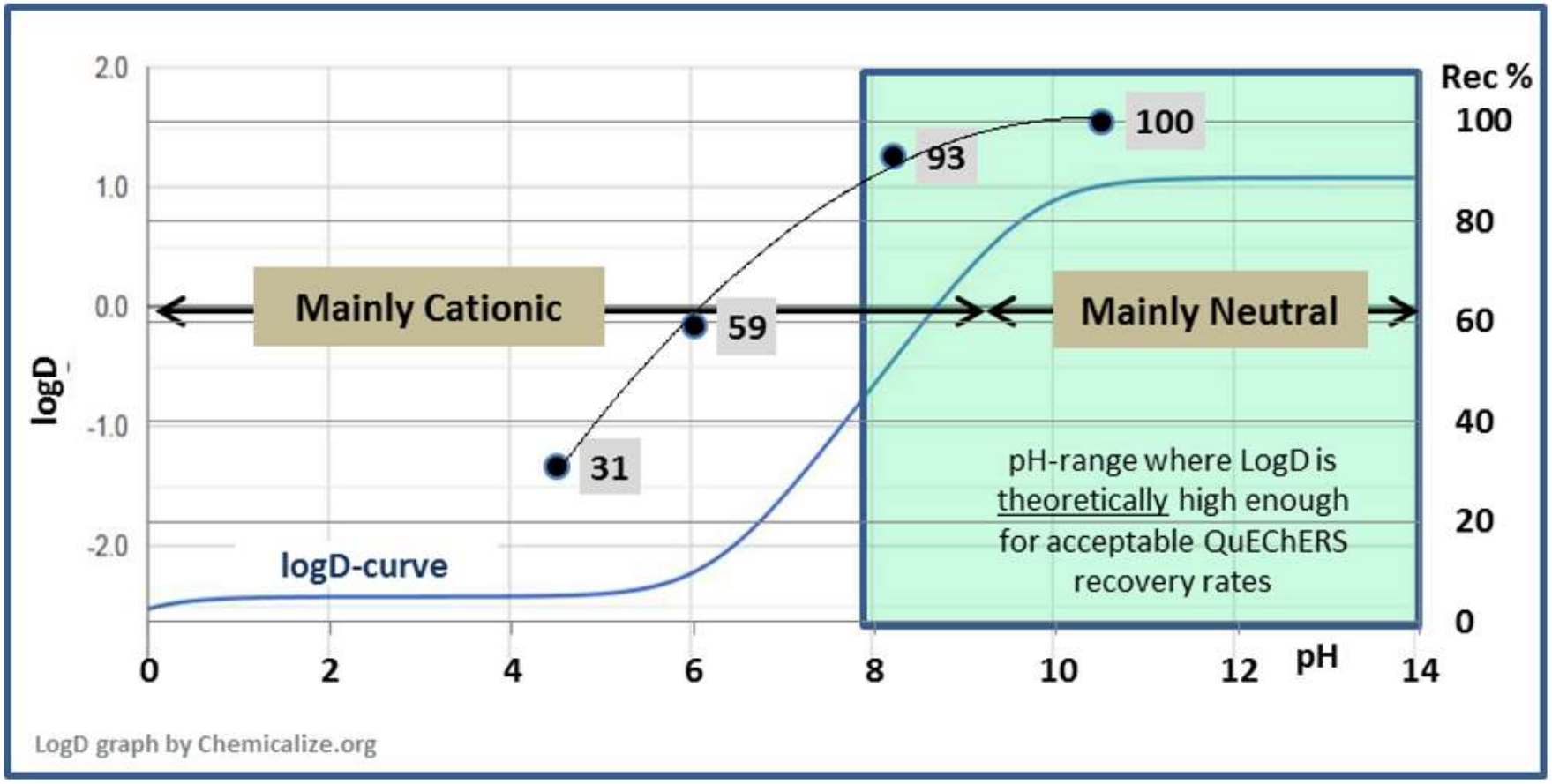


Figure 5: Correlation between recovery rates and logD at different pH values in the case of matrine

EURL-SRM

ANALYSIS OF MATRINE/OXYMATRINE

QuPPe Recoveries

Table 10: *Average recoveries and RSDs (n = 5) of matrine and oxymatrine in various commodities after extraction by QuPPe and measured by M4.2 (Quats & Co BEH Amide" method), see* ***Table 6***

Matrix	Sample Weight	Spiking Level (mg/kg)	Compound	MRM-transition	Calc. without IS-Matrix Calibration		Calc. using ILIS D_3-Solvent Calibration		Calc. using ILIS D_4-Matrix Calibration	
					Mean Rec. %	RSD %	Mean Rec. %	RSD %	Mean Rec. %	RSD %
Cucumber	10 g	0.01	matrine	249/148	92%	5	**101%**	4	**95%**	3
				249/150	96%	5	**99%**	1	**99%**	1
				249/110	96%	5	**101%**	5	**99%**	5
			oxymatrine	265/247	***125%***	***21***	**107%**	0.3	**101%**	0.3
				265/205	***124%***	***23***	**102%**	3	**100%**	3
				265/148	***129%***	20	**104%**	4	**104%**	4
Grape	10 g	0.01	matrine	249/148	93%	4	**100%**	1	**97%**	1
				249/150	93%	5	**98%**	3	**97%**	3
				249/110	91%	5	**99%**	4	**94%**	3
			oxymatrine	265/247	80%	17	**103%**	5	**99%**	4
				265/205	81%	16	**101%**	4	**100%**	4
				265/148	80%	13	**100%**	4	**99%**	4
Lemon	10 g	0.01	matrine	249/148	89%	5	**106%**	3	**98%**	3
				249/150	89%	8	**102%**	3	**98%**	3
				249/110	96%	13	**101%**	8	**106%**	8
			oxymatrine	265/247	114%	12	**104%**	3	**100%**	2
				265/205	118%	14	**102%**	1	**104%**	1
				265/148	112%	14	**97%**	4	**98%**	4

EURL-SRM

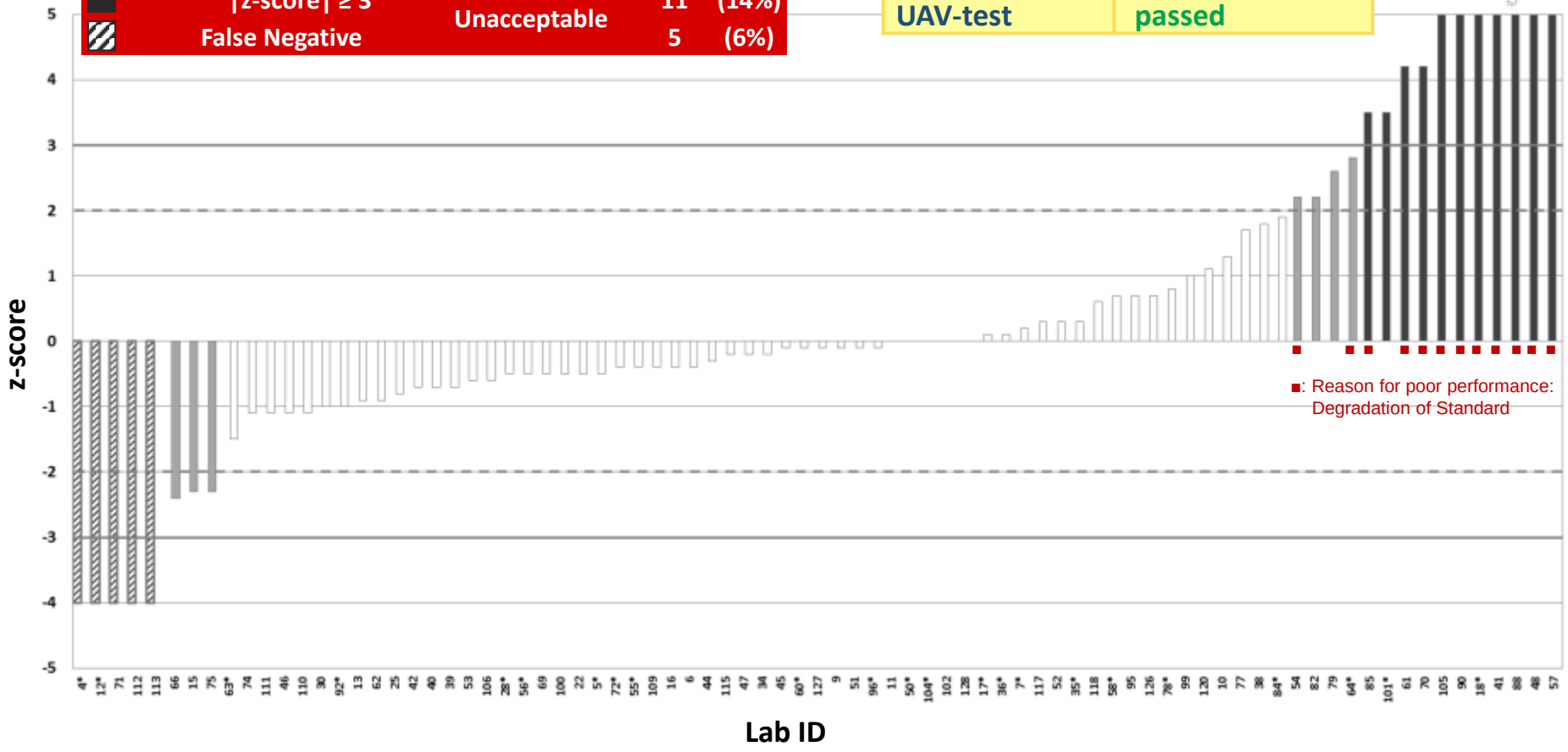
FORMETANATE-HCL

Formetanate-HCl

|z-score| ≤ 2	Acceptable	58	(72%)
2 < |z-score| < 3	Questionable	7	(9%)
|z-score| ≥ 3	Unacceptable	11	(14%)
False Negative		5	(6%)

Results	76
False Neg.	5
AV	0.873 [mg/kg]
CV*	25.5%
MRRL	0.01 [mg/kg]
UAV-test	passed

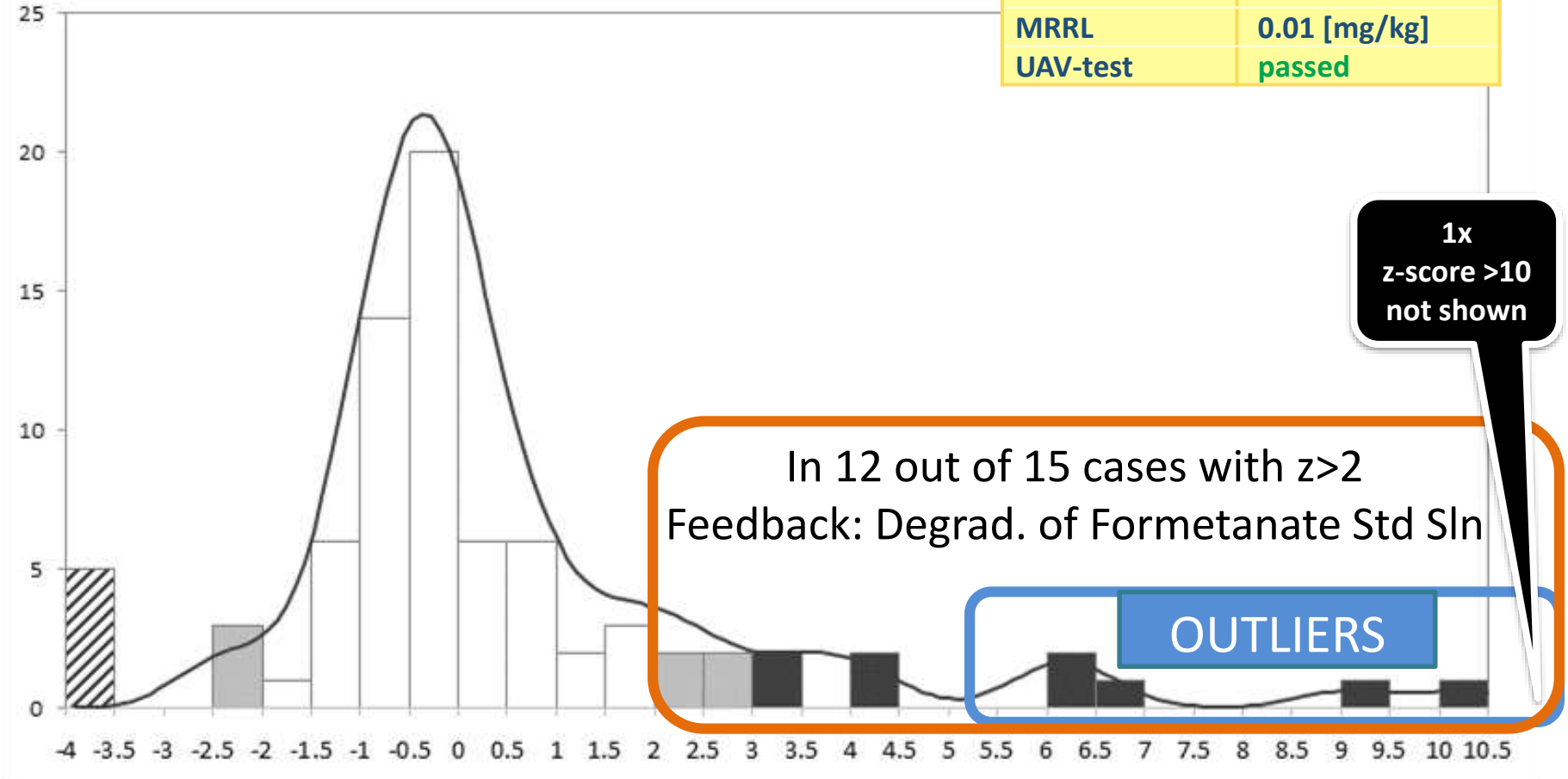
7x z>5



EURL-SRM FORMETANATE

Formetanate-HCl

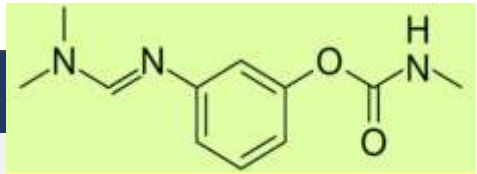
Results	76
False Neg.	5
AV	0.873 [mg/kg]
CV*	25.5%
MRRL	0.01 [mg/kg]
UAV-test	passed



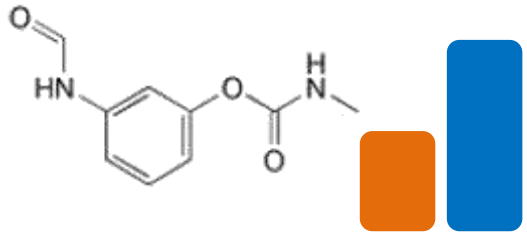
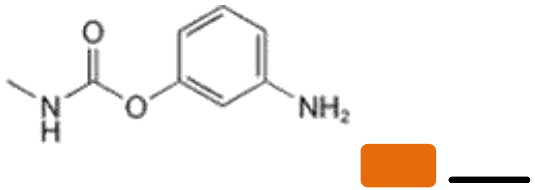
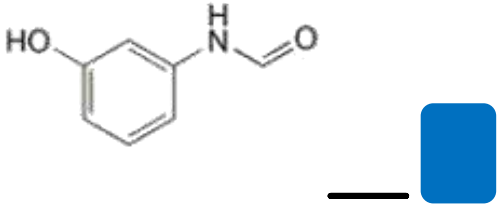
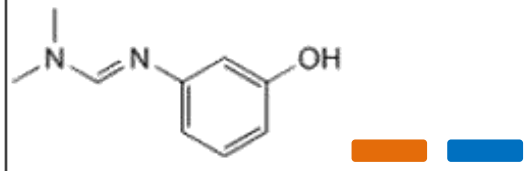
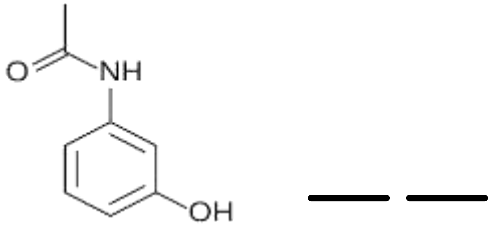
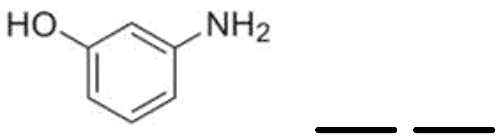
FORMETANATE DEGRADANTS IN EXTRACTS

Detected in Stored QuEChERS Extract

Detected in Stored QuPPe Extract

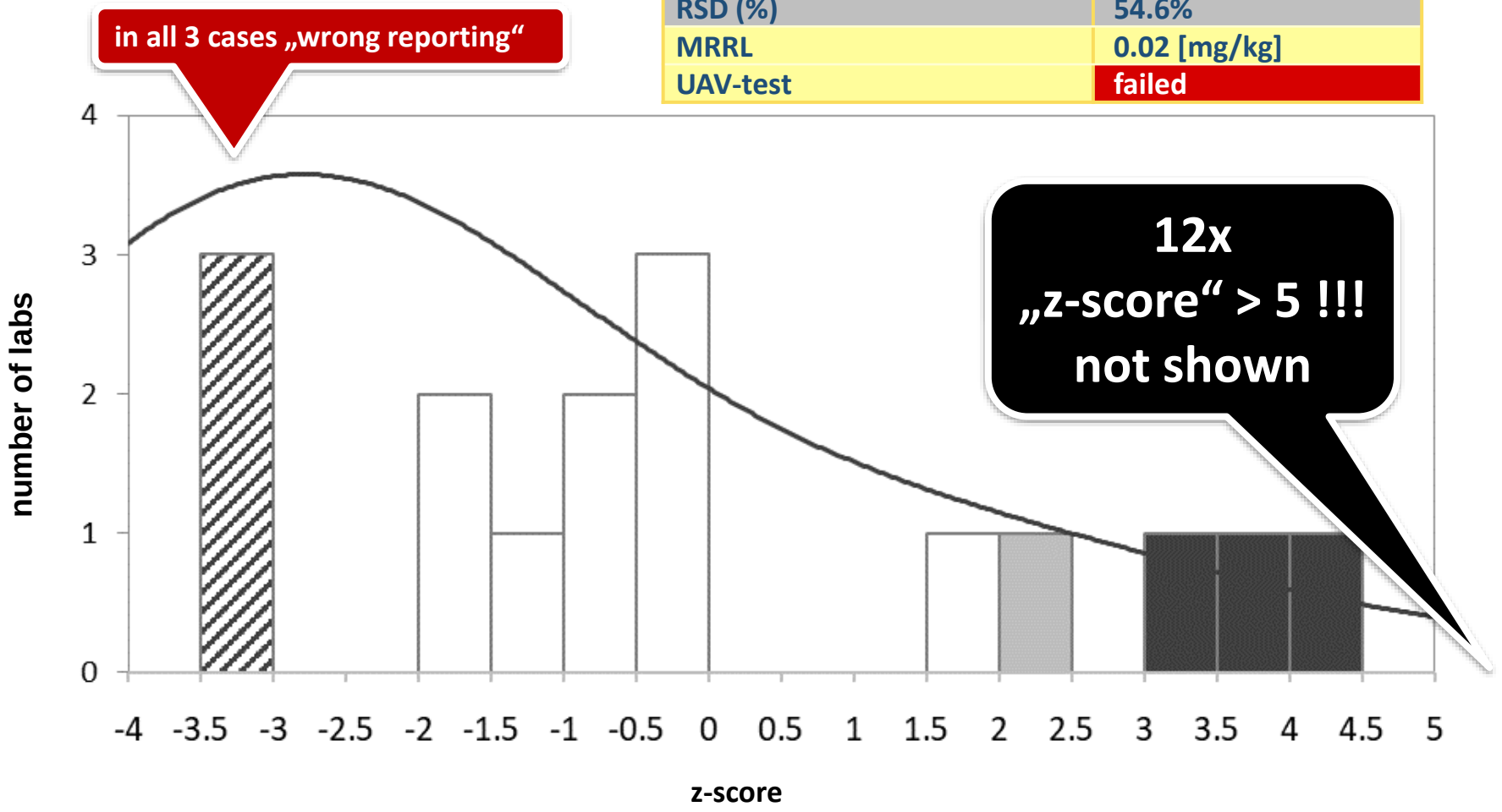


Formetanate

Compound	3-Formamidophenyl methylcarbamate	3-Aminophenyl-N-methylcarbamate	3-Hydroxyformanilide
CAS	24891-34-7	25635-94-3	24891-35-8
MW (g/mol)	194	166	137
			
	N'-(3-Hydroxyphenyl)-N,N-dimethyl-formamidine	**3-Acetamidophenol**	**3-Aminophenol**
CAS	2656-08-8	621-42-1	591-27-5
MW (g/mol)	164	151	109
			

Meptyldinocap

Results	25
False Neg.	3
SPIKING LEVEL AS REFERENCE („AV“ for information only)	*0.100 [mg/kg]*
RSD (%)	54.6%
MRRL	0.02 [mg/kg]
UAV-test	failed



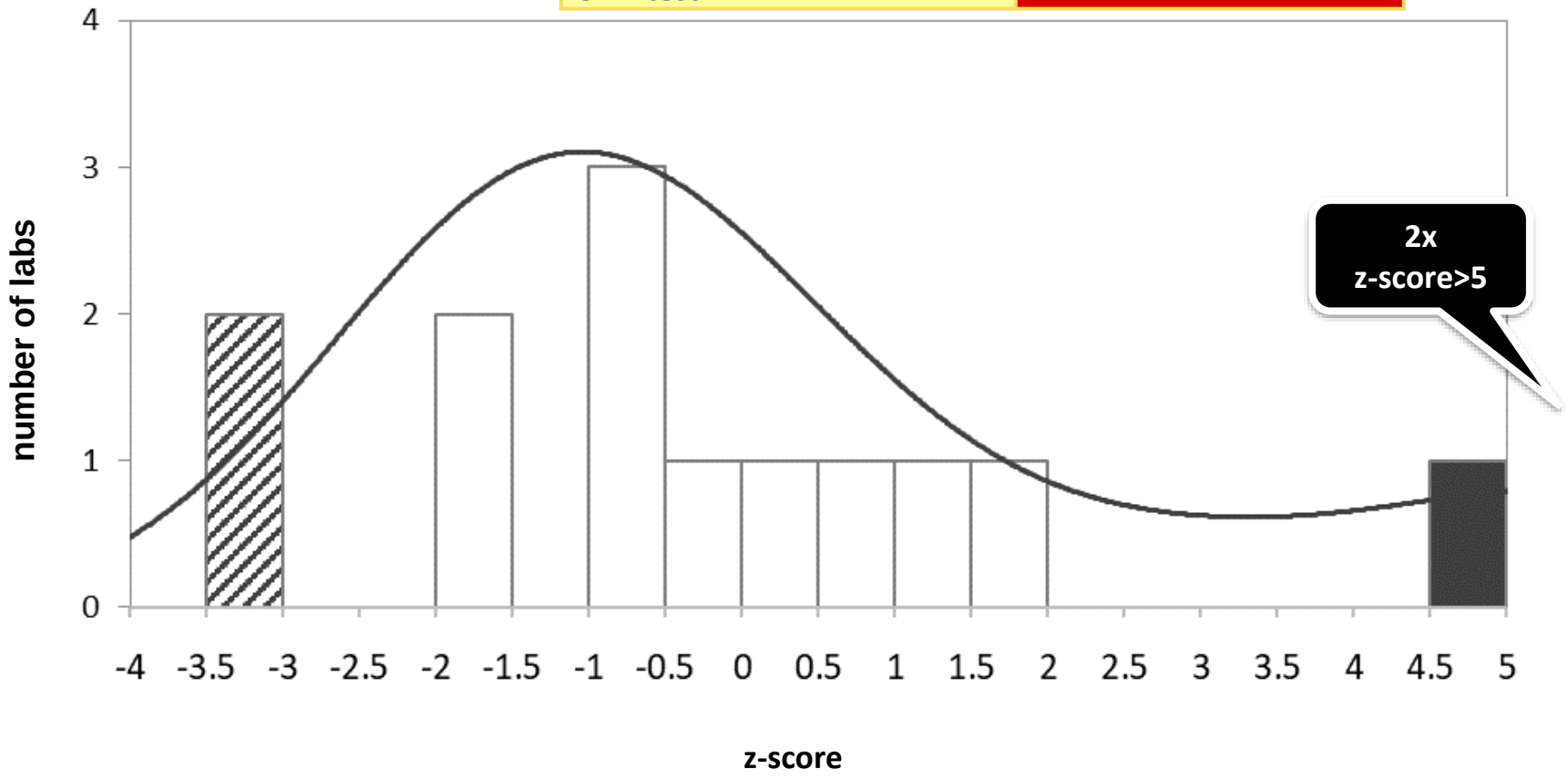
EURL-SRM

2,4-DNOP

2,4-DNOP

Results	11 (2 outliers)
False Neg.	2
SPIKING LEVEL AS REFERENCE („AV“ for information only)	*0.056 [mg/kg]*
RSD (%)	45.1%
MRRL	0.01 [mg/kg]
UAV-test	failed

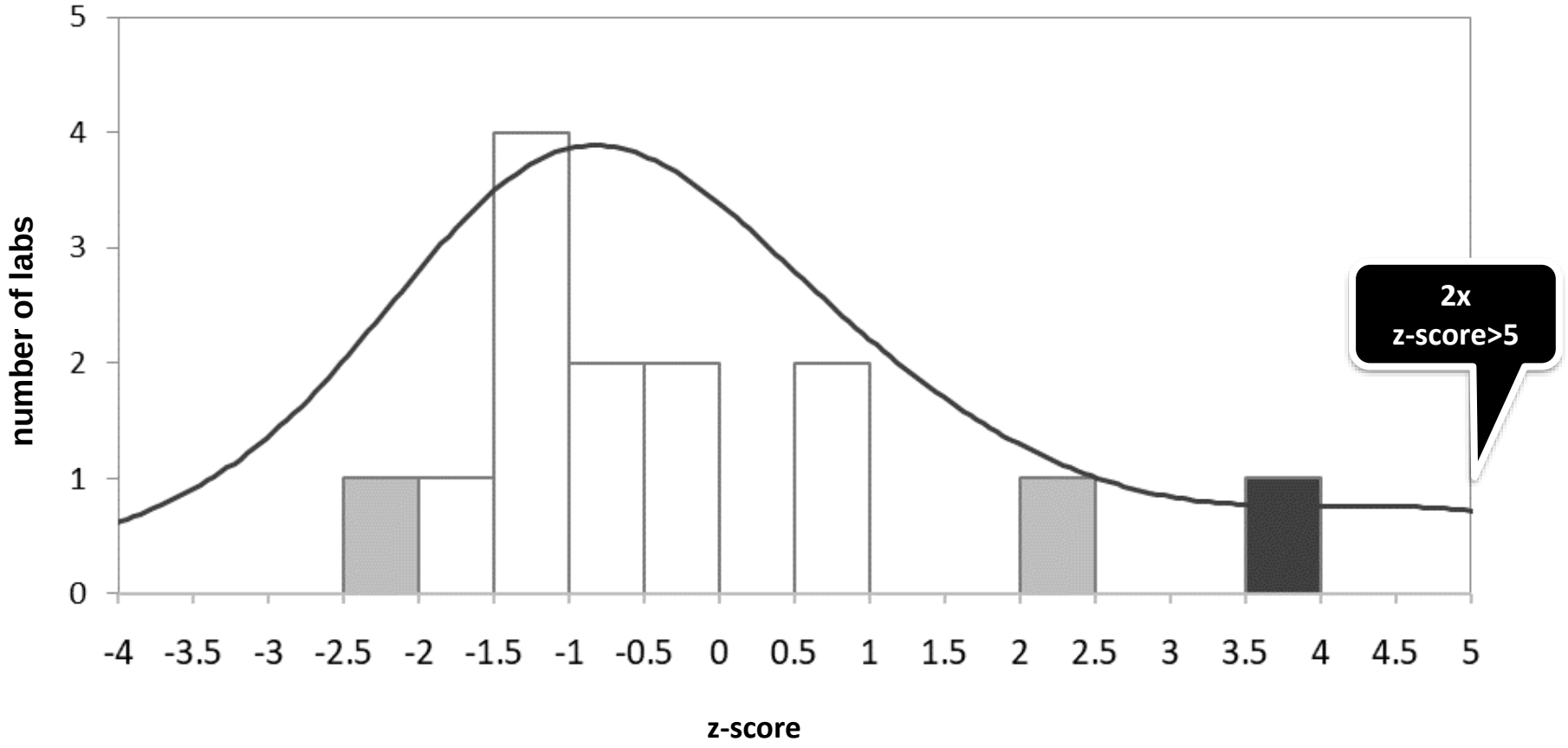
No. of results too small for reliable statistical evaluation



Meptyldinocap (sum)

(AV based on Spiking Level)

Results	14 (2 outliers)
False Neg.	0
AV	*0.169 [mg/kg]*
RSD %	50.5%
MRRL	0.01 [mg/kg]
UAV-test	failed

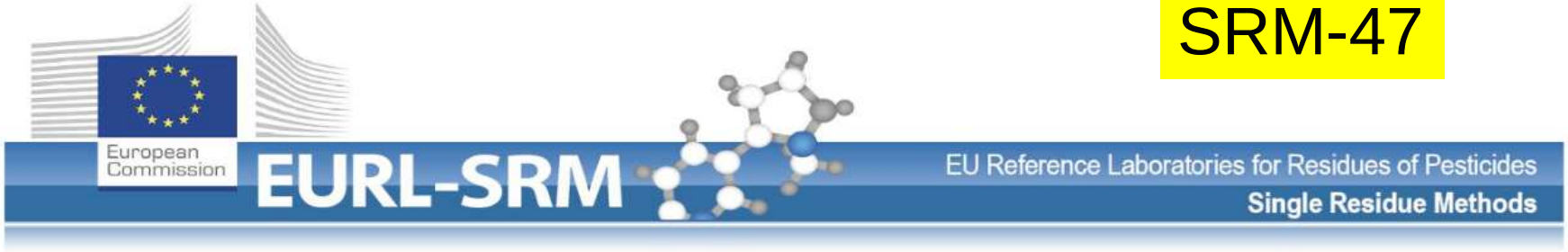


EURL-SRM

MEPTYLDINOCAP (SUM)

Analytical Observations Report on Meptydinocap (sum)

SRM-47



EURL-SRM - Analytical Observations Report

Concerning the following…

- **Compound(s)**: Meptyldinocap
- **Commodities**: Plant origin, animal origin
- **Extraction Method(s)**: CEN-QuEChERS, QuOil
- **Instrumental analysis**: LC-MS/MS

Analysis of Meptyldinocap by QuEChERS

followed by alkaline hydrolysis and LC-MS/MS measurement

EURL-SRM MEPTYLDINOCAP (SUM)

Weigh 10.0 g sample homogenate into 50 mL falcon tube
(5.0 g for dry commodities)

Add 100 µL internal standard solution

Adjust water content of sample to approx. 10 mL

Add 10 mL ACN

Shake thoroughly for 15 min.

Add QuEChERS salts and shake for 1 min.

QuEChERs salts:
4 g $MgSO_4$,
1 g NaCl,
1 g Na_3-Citrat-dihydrate,
0.5 g Na_2-hydrogenecitrate-sesquihydrate

Centrifuge e. g. at 4000 rpm for 5 min.

Cleanup for commodities of high lipid content:
Option 1: freeze-out and filter or decant the extract
Option 2: dSPE w. 25 mg C18-sorbent + 150 mg MgSO4 per mL extract, (shake for 1 min. and centrifuge at 4000 rpm for 5 min).
NOTE: Do not use PSA-sorbent to avod losses of phenol component!)

Transfer 1 mL of the extract into a vial

Add 25 µL (**75 µL** in case of dry commodities) **of 25% aqueous ammonia and put vial aside for 12-24 h at room temperature**

Add 25 µL (**75 µL** in case of dry commodities)
of conc. acetic acid for neutralization

In case of turbidity ► Filter or Centrifuge
In case of a well separated precipitate at vial bottom with a clear hydrolysate either proceed directly with measurement or decand into a separate vial.

LC-MS/MS

SRM-47

Simple alkaline hydrolysis step following Citrate buffered QuEChERS (EN 15662)

EURL-SRM

MEPTYLDINOCAP (SUM)

Meptyldinocap (sum)

Results of Homogeneity Test of EURL-SRM

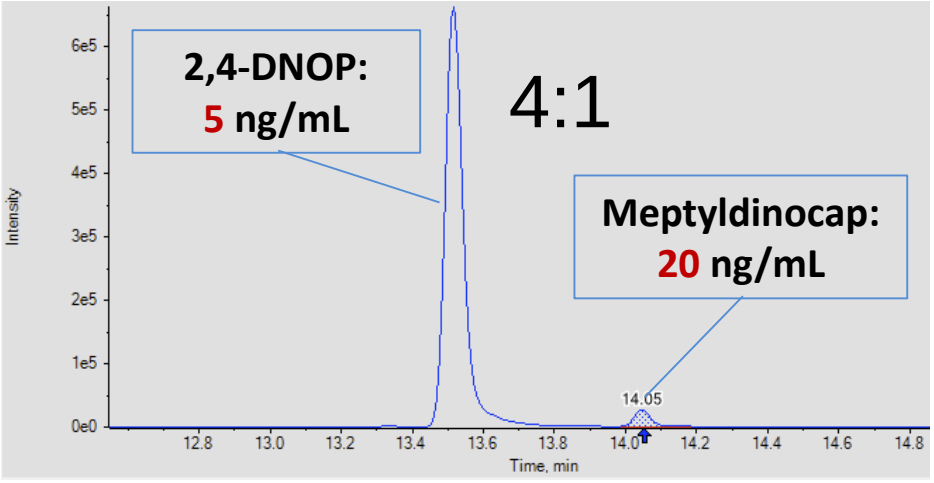
Results after Hydrolysis comparable to Results of calculated sum

	Meptyldinocap (sum) calculated	Meptyldinocap (sum) after alk. Hydrolysis
Sample	Concentration [mg/kg]	Concentration [mg/kg]
No. 011	0.172 / 0.172	0.165 / 0.167
No. 034	0.169 / 0.159	0.154 / 0.167
No. 050	0.165 / 0.162	0.158 / 0.165
No. 073	0.168 / 0.159	0.155 / 0.158
No. 096	0.164 / 0.163	0.164 / 0.167
No. 112	0.164 / 0.165	0.158 / 0.158
No. 143	0.167 / 0.161	0.155 / 0.166
No. 156	0.169 / 0.166	0.157 / 0.164
No. 183	0.163 / 0.170	0.158 / 0.164
No. 200	0.161 / 0.158	0.161 / 0.153
Mean (AV)	**0.165** *(0.169)*	**0.161** *(0.169)*
RSD (%)	**1.99**	**1.97**
$S_{sam}^2 < (c)$?	3.3E-6 < 0.012	0 < 0.012
Homogeneity test	**passed**	**passed**

Meptyldinocap Analysis– ERROR SOURCES

- **Instability of Meptyldinocap in solution (standard solutions, sample extracts):**
  Degradation slows down at low pH → Acidify standards
- **Risk of Peak-Mismatch between Meptyldinocap and 2,4-DNOP:**

- **LC-MS/MS : ESI (pos.)**
  - Parent → poor sensitivity;
  - 2,4-DNOP → X
- **LC-MS/MS : ESI (neg.)**
  - Parent → moderate sensitivity (in-source fragmention to 2,4-DNOP);
  - 2,4-DNOP → **very high sensitivity** (~ 80-Fold more sensitive than parent !!)



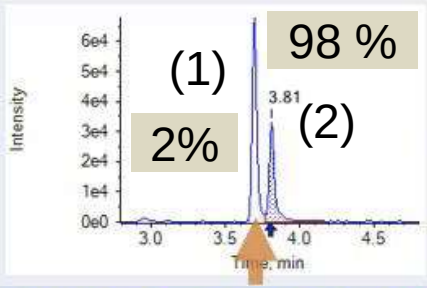
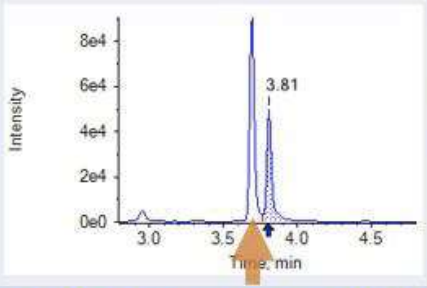
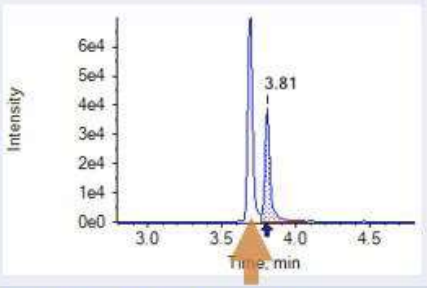
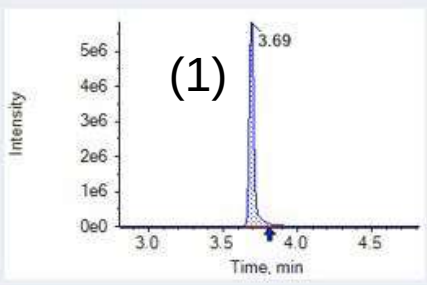
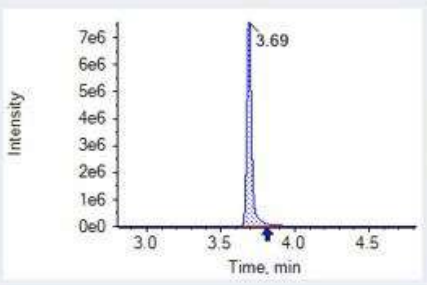
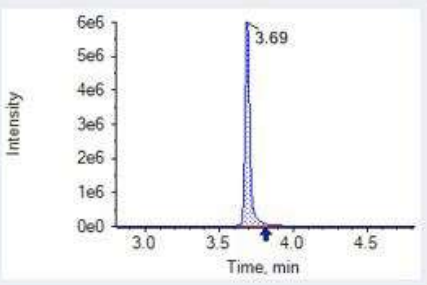
Conc. Ratio of Meptyldinocap: 2,4-DNOP

- Here 4:1
- In PT-sample: ~ 2:1

➢ **High Risk of Peak-Mismatch**
(Meptyldinocap-peak could be overlooked)

Meptyldinocap – Error Sources

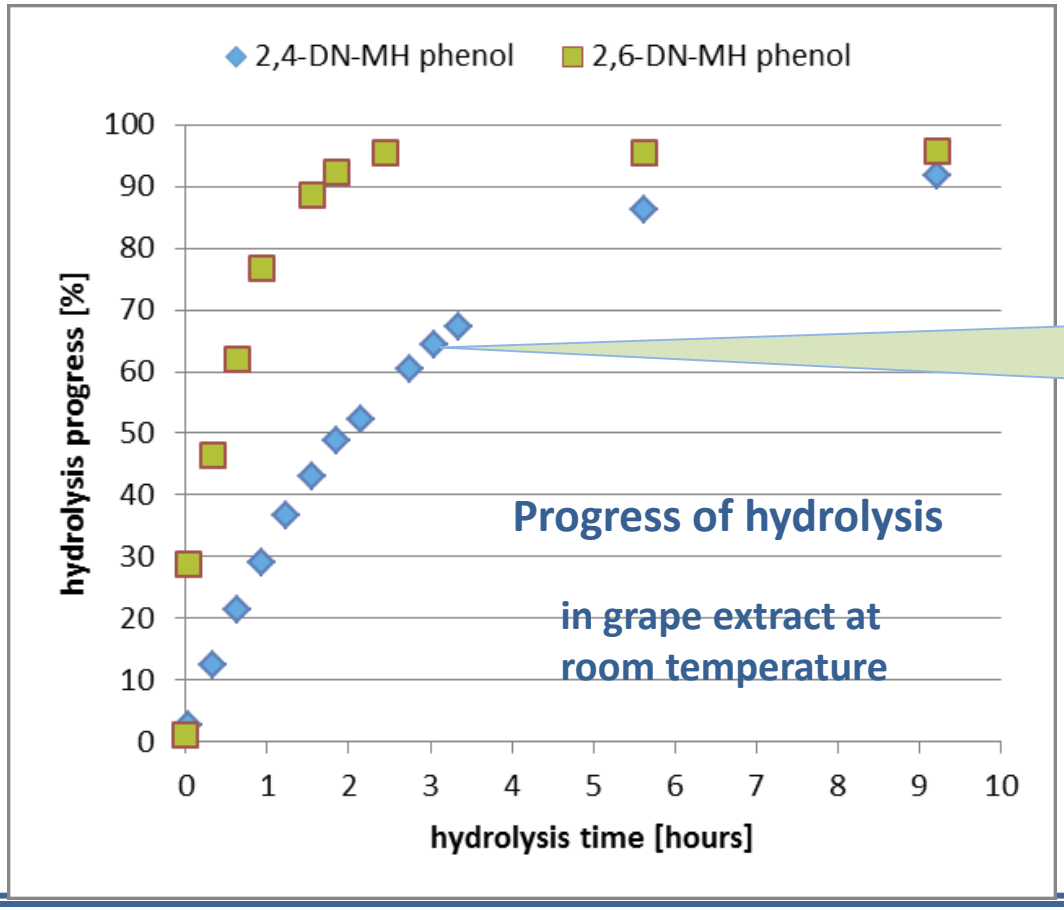
- Meptyldinocap standards typically contain **1-2% 2,4-DNOP (as impurity):**
- Meptyldinocap: In-source fragmentation to 2,4-DNOP in LC-MS/MS
- Two peaks within same mass-trace:
  - **(1) 2,4-DNOP; (typically the larger peak despite being present at 1-2%)**
  - **(2) In-source fragment of Meptyldinocap**

Measured solution	Detected mass traces of 2,4-DNOP		
	295/194	295/193	295/134
Meptyldinocap standard (0.06 µg/mL)			
2,4-DNOP standard (0.06 µg/mL)			

Meptyldinocap (sum) – Error Sources

Incomplete Hydrolysis

+ 500µL QuEChERS extract (spiked with Meptyldinocap (and its 2,6-analogon))
+10 µl of 25% aqueous ammonia solution



2,4-DNOP more resistant to hydrolysis than its 2,6-DNOP analogon

EURL-SRM

METHODS USED IN EUPT-SRM17

Compounds	QuEChERS variants	SweEt-Type	Mini-Luke	"QuEChERS"-OtherSolv	ChemElut	S-19	Other-LLP	QuPPe-Like	QuPPe-Style	Other	DTC-LLP	DTC-HS	DTC-HS-SPME	DTC-Spec-Xanth	DTC-Spec-CuAc	DTC-unspecified	SUM	QuEChERS (%)	QuPPe (%)
Dodine	90	3	2	1	2			2									100	90%	2%
Emamectin B1a	86	3	2	1	2			2									96	90%	2%
Chlorothalonil	81	7	9	5		1	1			1							105	77%	0%
Folpet	75	7	6	2		1	1										92	82%	0%
Phthalimide	69	4	3	4		1		1									82	84%	1%
Captan	72	6	5	2		1	1										87	83%	0%
THPI	72	4	3	3		1		1									84	86%	1%
Formetanate-HCl	70	3			2			3									78	90%	4%
Bifenazate (sum)	52	3	1	1	2			1									60	87%	2%
Meptyldinocap	24				1												25	96%	0%
2,4-DNOP (free phenol)	13																13	100%	0%
Meptyldinocap (sum)	15									1							16	94%	0%
Pymetrozine	87	3	1	1	2			9	2								105	83%	9%
Oxymatrine	24				1			12		1							38	63%	32%
Cyromazine	47	1			1			45	2								96	49%	47%
Chloridazon-desphenyl	14	1			1			10									26	54%	38%
ETU	5							13		1							19	26%	68%
Maleic hydrazide	2							45	1								48	4%	94%
Dithiocarbamates (expr. as CS2)											44	27	8	12	6	3	100	0%	0%
SUM	898	45	32	20	14	5	3	144	5	4	44	27	8	12	6	3	1270		

EURL-SRM

UNCERTAINTY OF ASSIGNED VALUE

COMPULSORY / OPTIONAL Compounds

EU+EFTA

Compound	No. of FNs | Outlier	No. of Numerical Results	Result Population for AV-Establishment	AV [mg/kg]	CV* [%]	Uncertainty of AV (UAV) [mg/kg]	UAV-Tolerance [mg/kg]	Judgement
Captan	7 | 5	84	EU/EFTA-OfLs	0,174	32,9%	0,0083	0,0129	passed
Chlorothalonil	1 | 1	102	EU/EFTA-OfLs	0,151	24,4%	0,0046	0,0113	passed
Cyromazine	0 | 0	92	EU/EFTA-OfLs	0,154	20,3%	0,0041	0,0116	passed
DTCs (expr. as CS2)	2 | 2	97	EU/EFTA-OfLs	0,187	28,4%	0,0068	0,014	passed
Dodine	0 | 0	96	EU/EFTA-OfLs	0,100	23,1%	0,0029	0,0075	passed
Emamectin B1a	0 | 2	91	EU/EFTA-OfLs	0,0461	21,5%	0,0013	0,0035	passed
Folpet	1 | 2	89	EU/EFTA-OfLs	0,249	34,5%	0,0115	0,0187	passed
Phthalimide	5 | 7	78	*EU/EFTA-OfLs*	*0,098*	*36,8%*	*0,0071*	*0,0101*	passed
Pymetrozine	1 | 1	100	EU/EFTA-OfLs	0,150	28,2%	0,0053	0,0113	passed
THPI	0 | 1	80	EU/EFTA-OfLs	0,590	23,2%	0,0193	0,0443	passed
Bifenazate (sum)	0 | 2	59	EU/EFTA-OfLs	0,296	26,0%	0,0127	0,0222	passed
Chloridazon-desphenyl	8 | 1	25	EU/EFTA-OfLs	0,0616	23,7%	0,0043	0,0046	passed
ETU	1 | 0	18	EU/EFTA-OfLs	0,0629	33,1%	0,0061	0,0047	failed
Formetanate-HCl	5 | 7	76	EU/EFTA-OfLs	0,873	25,5%	0,0336	0,0655	passed
Maleic hydrazide	1 | 0	46	EU/EFTA-OfLs	0,544	16,6%	0,0167	0,0408	passed
Oxymatrine	0 | 0	36	EU/EFTA-OfLs	0,198	22,4%	0,0093	0,0149	passed
2,4-DNOP (free phenol)	2 | 2	14	*Spiking Level*	*0,056*	*36,5%*	*0,0087*	*0,0042*	failed
Mepthyldinocap	3 | 7	25	*Spiking Level*	*0,100*	*89,8%*	*0,0161*	*0,0075*	failed
Mepthyldinocap (sum)	0 | 1	16	*Spiking Level*	*0,169*	*44,0%*	*0,0275*	*0,0127*	failed

EURL-SRM

OVERALL PERFORMANCE I

COMPULSORY / OPTIONAL Compounds

EU+EFTA

Compound	No. of Labs (all)	FNs (therein)	AAZ	CV* [%]	☺ 0% 20%	😐 40% 60%	☹ 80% 100%
Captan	91	7	1.5	32.9%			
Chlorothalonil	103	1	0.9	24.4%			
Cyromazine	92	0	0.7	20.3%			
DTCs (expr. as CS2)	99	2	1.1	28.4%			
Dodine	96	0	0.8	23.1%			
Emamectin B1a	91	0	0.8	21.5%			
Folpet	90	1	1.4	34.5%			
Phthalimide	83	5	1.5	51.5%			
Pymetrozine	101	1	0.9	28.2%			
THPI	80	0	0.8	23.2%			
Bifenazate (sum)	59	0	1.0	26.0%			
Chloridazon-desphenyl	33	8	1.5	23.7%			
ETU	19	1	1.1	33.1%			
Formetanate-HCl	81	5	1.5	25.5%			
Maleic hydrazide	47	1	0.6	16.6%			
Oxymatrine	36	0	0.7	22.4%			
2,4-DNOP (free phenol)	15	2	*2.1*	*45.1%*			
Mepthyldinocap	28	3	*3.3*	*54.6%*			
Mepthyldinocap (sum)	16	0	*1.8*	*50.5%*			

EURL-SRM

OVERALL PERFORMANCE II

Rules for Category A:

EU+EFTA

- Analysed for at least 15 out of 17 compulsory pesticides
- Correctly found at least 9 out of 10 compulsory pesticides present in test item
- No FPs among compulsory analytes

	No. of Labs	[%]
Category A	66	56 %
Category B	52	44 %

Poor performance feedback

***POOR RESULTS: Prelim. |z|>2 (incl. FNs) OR if FPs**

- **82 EU/EFTA OfLs reported POOR RESULTS* in 225 cases (incl 37 FNs and 4 FPs)**
- **Labs asked to give feedback on measures to localize error sources**
- **Prelim. z-scores calculation**
  (1) using **robust mean** as reference
  (2) using spiking level as reference (if robust mean was too uncertain)

Examples:

a. *Mepthyldinocap & Co.* -> based on spiking levels (robust statistics could not be applied due to variable results or small population)
b. Phthalimide -> based on spiking levels (z-scores will be shown for info. only)

- **As of end of Juli: 73 labs reported reasons for 181 cases (80%), in some cases multiple reasons (total=322 reasons)**

Poor performance Reasons Reported by Labs	Phthalimide	THPI	Folpet	Captan	Formetanate-HCl	Meptyldinocap	Dithiocarbamates (expr. as CS2)	Chloridazon-desphenyl	Emamectin B1a	Chlorothalonil	2,4-DNOP (free phenol)	Cyromazine	Dodine	Meptyldinocap (sum)	Pymetrozine	Bifenazate (sum)	ETU	Oxymatrine	BAC-C12 (chloride)	DDAC-C10 (chloride)	Maleic hydrazide	Matrine	Paraquat (dication)	TFNA	Gesamtergebnis
NO REACTION	14	2	6	5	1	3	4	1		2		2			2	2					1		1		46
E) Measurement problems (e.g. poor chromatographic separation, poor sensitivity, signal interfered by matrix)	8	1	7	11	3	2	1	3			1	2	1					1							41
J) Erroneous analytical standard (e.g. due to degradation, wrong purity, wrong dilution)	2		2	4	10	3	1	1	5	1	1	2		1	1	1	1	1							37
M) other, please describe briefly in Details	6	1	5	5	4	3	2			3		1	2		2	2									36
A) Lack of experience	6	2	2	2	1	5	2	3			2		1	4		2						1			33
B) Anal. procedure was inappropriate (e.g. hydrolysis cond. too weak; recov. too low; sensitiv. too poor, RL<AV)	8		2	3	2	3	1			2			2		2	2						1			28
D) Analyte losses during the procedure (e.g due to degradation, unfavorable partitioning, adsorption)	2	1	5	9	2		1			3					2		1								26
F) Misinterpretation / Misevaluation of measurement data	3		2	3	3		1	1		2	1					1			1	1					19
H) Result not properly corrected for recovery	2			1	1		2			2		1	3		2		1								15
L) Transcription- / documentation-/ communication-/ error					1	4	1	4			2														12
I) Calculation error (e.g. use of wrong factor, to express residue as required in PT; to address dilutions etc.)					3		3		1				1			1	1								10
C) Analytical procedure was appropriate but it was not properly performed	1		1	2			1						1								1			3	10
G) Inappropriate / erroneous calibration approach (e.g. Matrix effects not properly compensated)	1				1	1	2			1							1								7
F) Misinterpretation / Misevaluation of measurement data / Misunderstanding of the target pesticide	1																								1
K) Deficient QC-measures not noticing that method leads to FNs, FPs or strongly biased results (e.g. no recov. test)														1											1
Gesamtergebnis	54	7	32	45	32	24	22	13	6	16	7	8	11	6	11	11	5	2	1	1	2	2	1	3	322

QuPPe-Method

European Commission EURL-SRM EU Reference Laboratories for Residues of Pesticides Single Residue Methods

Quick Method for the Analysis of Highly Polar Pesticides in Food Involving Extraction with Acidified Methanol and LC- or IC-MS/MS Measurement

I. Food of Plant Origin (QuPPe-PO-Method)

Version 12 (22.07.2021, Document History, see page **98**)

Check for latest version of this Method under www.quppe.eu ; older versions: obsolete versions

Authors: M. Anastassiades; A.-K. Wachtler; D. I. Kolberg; E. Eichhorn; H. Marks; A. Benkenstein; S. Zechmann; D. Mack; C. Wildgrube; A. Barth; I. Sigalov; S. Görlich; D. Dörk; G. Cerchia

EU Reference Laboratory for pesticides requiring Single Residue Methods (EURL-SRM)

Contact: CVUA Stuttgart, Schaflandstr. 3/2, DE-70736 Fellbach, Germany, www.eurl-pesticides.eu; EURL@cvuas.bwl.de

Note: Changes from V11.1 to V12 are highlighted in yellow

EURL-SRM

Topics

EURL-SRM Network
NRL-SRM Network

Proficiency Tests
EUPT-SRM Overview
EUPT-SRM17 (Tomatoes)
EUPT-SRM16 (Sesame)
EUPT-SRM15 (Rice)
EUPT-SRM14 (Bovine Liver)

Workshops
Workshop Overview
Joint Workshop 2015
Workshop AO/SRM 2014

Services
ILISs Distribution
CheckYourScope
SRM-PinBoard
EURL-SRM Methods
Analytical Observations
Residue Observations

Relevance of QuPPe

Findings of QuPPe-compounds in Routine Samples

Relevance of QuPPe

Findings of QuPPe-compounds in Routine Samples

Compilation of Residue Observations Reports

The table below compiles various observation notes and reports related to residue findings of SRM-pesticides in food. Laboratories within the NRL/OL-Network are encouraged to submit their own notes and reports on residue findings. The idea is to gradually build up a large collection of with the aim to conserve knowledge and to offer laboratories a useful and practical source of information. A link to the EURL-DataPool is planned.

Compounds covered / Title of Study	Date of reports / version	Link
QuPPe-Compounds (2021 data)	01.04.2022 / V1	View Document
QuPPe-Compounds (2020 data)	30.03.2021 / V1	View Document
QuPPe-Compounds (2019 data)	30.01.2020 / V1	View Document
QuPPe-Compounds (2018 data)	30.04.2019 / V1	View Document
TFA (Trifluoroacetic acid) and DFA (Difluoroacetic acid)	19.06.2017 / V1	View Document
Determination of Triazole Derivative Metabolites (TDMs) in Fruit and Vegetables using the QuPPe Method and Differential Mobility Spectrometry (DMS) and Survey of the Residue Situation in Organic and Conventional Produce	CVUA Stuttgart eJournal, May 2016	View Document
Triazole derivative metabolites (TDMs) - Poster	EPRW 2014 (Dublin)	View Document

Residue Findings in food of plant origin (2021)

Table 3: Residue findings of QuPPe-compounds (CVUA Stuttgart 2021)

NR: Not Regulated as Pesticide

Compound		# samples	# pos.	% pos.	Max (mg/kg)	Mean[1] (mg/kg)	Median[1] (mg/kg)	# >MRL[2]	%>MRL	RL[3]
Cyanuric acid	NR	2445	941	38	6.5	0.059	0.013	0	0	0.005
Phosphonic acid		2449	589	24	192	3.8	0.97	15	0.6	0.05
Perchlorate	Contaminant	2446	463	19	2.6	0.062	0.014	1	0.04	0.005
Chlorate		2446	384	16	8.7	0.13	0.015	10	0.4	0.005
Melamine	Contaminant	2445	255	10	3.3	0.13	0.04	0	0	0.005
Thiocyanate	No MRLs needed	2446	208	8.5	214	8.4	4.0	0	0	0.1
Propamocarb		2445	88	3.6	9.5	0.20	0.023	3	0.1	0.005
Propamocarb-N-oxide	NR	2445	73	3	0.46	0.042	0.019	0	0	0.005
Bromide		2446	70	2.9	392	39.8	18.0	5	0.2	5
Trimesium		2445	68	2.8	1.2	0.098	0.032	15	0.6	0.005
Nicotine		2445	56	2.3	0.36	0.071	0.041	22	0.9	0.005
Ethephon metabolite HEPA	NR	2445	47	1.9	2.5	0.19	0.050	0	0	0.005
Propamocarb-N-desmethyl		2445	47	1.9	0.4	0.022	0.009	0	0	0.005
Chlormequat chloride		2445	43	1.8	0.68	0.095	0.044	11	0.4	0.005
Ethephon		2445	36	1.5	5.6	0.30	0.089	3	0.1	0.02
Ammelide	NR	2445	30	1.2	1.6	0.21	0.11	0	0	0.005
Chloridazon-desphenyl		2445	22	0.9	0.18	0.032	0.007	0	0	0.01
Diquat		217	2	0.9	0.02	0.013	0.013	0	0	0.01
Maleic hydrazide		2445	20	0.8	18.6	4.3	1.45	0	0	0.01
Dimethoate-O-desmethyl	NR	2445	18	0.7	0.58	0.053	0.016	0	0	0.005
Glufosinate met. MPPA		2445	15	0.6	0.14	0.042	0.028	0	0	0.01
Mepiquat chloride		2445	15	0.6	0.14	0.025	0.011	0	0	0.005
Cyromazine		2445	12	0.5	0.84	0.14	0.026	1	0.04	0.01
Fosetyl		2446	13	0.5	0.35	0.12	0.066	0	0	0.01
ETU	NR	2445	10	0.4	0.39	0.15	0.11	0	0	0.02
Glyphosate		2445	8	0.3	0.87	0.20	0.10	2	0.08	0.02
Nereistoxin	NR	2445	4	0.2	0.053	0.031	0.032	0	0	0.005
Morpholine	Additive	2447	3	0.1	0.67	0.25	0.041	0	0	0.02
Mepiquat, 4-hydroxy	NR	2445	2	0.08	0.026	0.017	0.017	0	0	0.005
Amitrole		2445	1	0.04	0.006	0.006	-	0	0	0.005
Daminozide		2445	1	0.04	0.007	0.007	-	0	0	0.02

Residue Findings in food of plant origin (2021)

Table 5: Top 15 residue levels of most frequently found QuPPe-compounds (with > 50 findings in total)

Compound	Commodity	Country of origin	Residue level (mg/kg)
Cyanuric acid *(non-regulated pesticide metabolite and contaminant in fertilizers)*	Vegetable products, chlorella	Germany	6.5
	Asparagus	Mexico	3.3
	Juices, orange juice	Unknown	1.7
	Juices, orange juice	Unknown	1.5
	Juices, orange juice	Unknown	1.5
	Strawberry (frozen)	Unknown	1.5
	Shiitake (dried)	China	1.2
	Avocado	Israel	1.1
	Spices, paprika	Spain	0.83
	Pineapple	Costa Rica	0.81
	Pineapple	Costa Rica	0.64
	Cultivated mushroom (dried)	China	0.51
	Dill (dried)	Unknown	0.51
	Juices, pineapple juice	Unknown	0.50
	Pineapple	Costa Rica	0.50
Phosphonic acid *(Metabolite of Fosetyl but also used as such. Shows high persistence in plants, and residues in crops of perennial plants may originate from previous seasons)*	Almond	Unknown	192
	Beer ingredients, hop	Germany	96
	Batavia lettuce	Germany	57
	Rucola	Italy	52
	Strawberry	Germany	49
	Pear	Italy	48
	Rucola	Italy	47
	Dill (dried)	Unknown	47
	Almond	Unknown	39
	Avocado	South Africa	32
	Wine grapes	Germany	27
	Pear	Italy	23
	Chives	Ethiopia	23
	Almond	USA	22
	Sultana	South Africa	22
	Algae (dried)	Germany	2.6

MRL-Exceedaces 2021-(1)

Compound	Commodity	Country of Origin	Conc. (mg/kg)	>2x MRL**	Note
Bromide	Algae (dried)	Poland	392	X	organic
	Algae (dried)	South Korea	56		
	Algae (dried)	unknown	297	X	organic
	Hop	Germany	32		
	Spinach	France	54		
Chlorate *(herbicide, but chlorinated water used in irrigation or sanitation mostly responsible for levels found in food)*	Bell pepper (frozen)	Portugal	0.31		
	Chives (frozen)	Germany	0.79		
	Cucumber	Spain	0.60	X	
	Okra (frozen)	Egypt	0.20		
	Okra (frozen)	Egypt	4.8	X	
	Romaine lettuce	Spain	1.9	X	
	Sesame	unknown	0.055		organic
	Paprika (spice)	Poland	8.7	X	
	Strawberry	Spain	0.31	X	
	Vegetable products, chlorella	Germany	0.64		organic
Chlormequat chloride	Asparagus (frozen)	unknown	0.015		
	Bell peppers	Spain	0.012		
	Cucumber	Turkey	0.64	X	
	Garlic (dried)	unknown	0.059		
	Peanut, roasted	Turkey	0.039	X	
	Paprika (spice)	Spain	0.25	X	
	Paprika (spice)	unknown	0.13		
	Paprika (spice)	unknown	0.14		
	Dill (dried)	unknown	0.68	X	
	Strawberry	Germany	0.021		
	Strawberry (frozen)	unknown	0.023	X	

MRL-Exceedaces 2021-(2)

Compound	Commodity	Country of Origin	Conc. (mg/kg)	>2x MRL**	Note
Cyromazine	Pomegranate	Turkey	0.062		
Ethephon	Medlar	Spain	0.051		
	Bell peppers	Turkey	5.6	X	
	Melon	Turkey	0.28	X	
Fosetyl, sum *(phosphonic acid was the only detected compound in most cases)*	Asparagus	Germany	3.2		
	Asparagus	Germany	6.0	X	
	Asparagus	Germany	6.7	X	
	Asparagus	Germany	8.3	X	
	Asparagus	Germany	9.3	X	
	Broad beans with pod	Turkey	14.0	X	
	Cherry	Turkey	2.7		
	Cherry	Turkey	7.4	X	
	Ginger	China	2.4		
	Green beans	Egypt	3.4		
	Green beans	Morocco	3.5		
	Green beans	Morocco	7.7	X	
	Papaya	Brazil	4.2	X	
	Passion fruit	Colombia	2.8		
	Peanut	Egypt	6.3	X	
	Plum	Germany	8.5	X	
	Pomegranate	Turkey	2.1		
	Pomegranate	Turkey	2.1		
	Pomegranate	Turkey	5.0	X	
	Pomegranate	Turkey	5.1	X	
	Pomegranate	Turkey	6.4	X	
	Pomegranate	Turkey	6.8	X	
	Pomegranate	Turkey	8.7	X	
Glyphosate	Plum	Republic of Moldova	0.11		
	Pomegranate	Turkey	0.18		

MRL-Exceedaces 2021-(3)

Compound	Commodity	Country of Origin	Conc. (mg/kg)	>2x MRL**	Note
Nicotine *(insecticide, but tobacco-related contamination mostly responsible for levels found in food)*	Algae. dried	Norway	0.16		organic
	Algae. dried	unknown	0.14		
	Borecole	Germany	0.012		
	Borecole	Germany	0.055	X	
	Borecole	unknown	0.017		
	Fruiting vegetables (dried)	unknown	0.079		
	Oyster mushroom	Poland	0.026	X	
	Oyster mushroom	unknown	0.011		
	Passion fruit	South Africa	0.014		
	Pear	The Netherlands	0.013		
	Plum	Germany	0.011		organic
	Rucola	Germany	0.012		
	Rucola	Germany	0.013		
	Rucola	Italy	0.013		
	Spices	Spain	0.12		organic
	Spices	Hungary	0.25	X	
	Spinach	Germany	0.027	X	
	Spinach	Germany	0.03	X	
	White button mushroom	Poland	0.011		
	Wine leaves (in brine)	Turkey	0.019		
	Wine leaves (in brine)	Turkey	0.029	X	
	Wine leaves (in brine)	Turkey	0.048	X	
Perchlorate *(contaminant in fertilizers)*	Potato	Egypt	0.055		

MRL-Exceedaces 2021-(3)

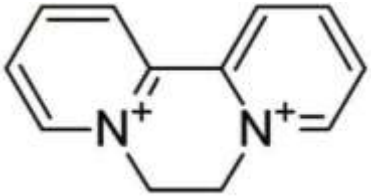
Compound	Commodity	Country of Origin	Conc. (mg/kg)	>2x MRL**	Note
Propamocarb	Celery, prepared	Spain	0.021		
	Vegetable powder	Kenya	0.10		organic
	Wine leaves (in brine)	Egypt	0.017		
Trimesium *(Counter ion of glyphosate but also natural formation during drying process of crops)*	Black tea	India	0.10		
	Black tea	Sri Lanka	0.08		
	Black tea	Sri Lanka	0.16	X	
	Black tea	Sri Lanka	0.20	X	
	Black tea	Sri Lanka	0.27	X	
	Food supplement	Germany	0.21	X	organic
	Green tea	China	0.055		organic
	Green tea	China	0.16	X	organic
	Green tea	China	0.29	X	organic
	Green tea	China	0.055		
	Jasmine tea	Taiwan	0.47	X	
	Dill (dried)	unknown	0.40		
	Dill (dried)	unknown	1.2	X	
	Vegetable powder	Kenya	0.10		organic
	Vegetable powder	unknown	0.55		organic

* >1xMLR

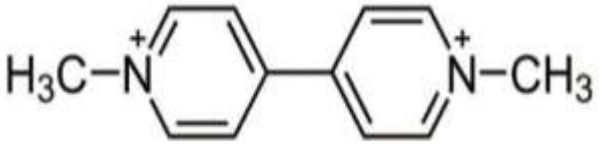
** >2xMRL means that the sample exceeded MRL even after deducting measurement uncertainty of 50%

Analysis of Diquat (DQ) and Paraquat (PQ) – Critical Points

- Both are non-selektive herbicides



Diquat (DQ)



Paraquat (PQ)

- Both are banned in the EU
- Still widely used elswhere, e.g. as crop-desiccants (e.g. potatoes, oilseeds, cereals)

Analysis of Diquat (DQ) and Paraquat (PQ) – Critical Points

- MRLs mostly at the LOQ with some exeptions

e.g.:

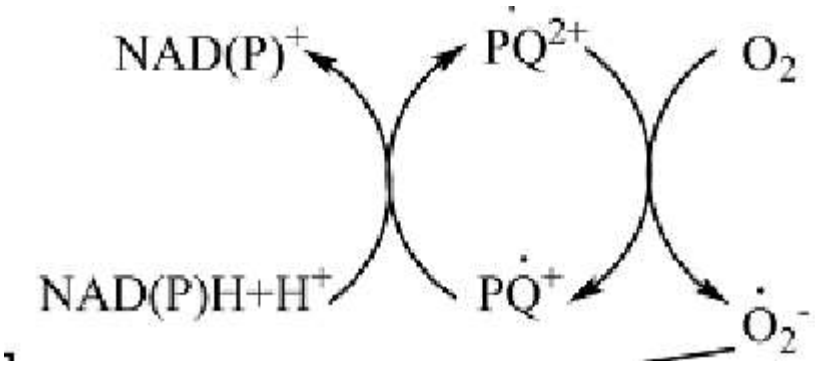
- **PARAQUAT**
  - Rice (0.05 ppm)

Vázquez C (2015)

- **DIQUAT**
  - Oats: 2 ppm
  - Potatoes: 0.1 ppm
  - Oil seeds; Linseed 5 ppm, Rapeseed: 1.5 ppm, Sunflower seed 0.9 ppm, Soy 0.3 ppm, Oat 2 ppm
  - Pulses: 0.2 ppm (Peas 0.3 ppm),
  - Tree nuts: 0.2 ppm
  - Tree fruits (Citrus, Pome fruit, Stone fruit …): 0.02 ppm
  - Other fruits: Strawberries: 0.05 ppm; Bananas 0.02 ppm

Mechanism of action (also toxicologically Critical)

- PQ / DQ react with O_2 forming PQ / DQ radicals and **Oxigen Radicals**
- PQ/DQ radicals react w. NADPH and **PQ/DQ are regenerated**
- Organism looses all ist reduction power and dies

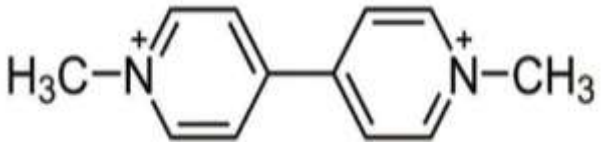


→ HO• (Hydroxy radicals)
H_2O_2

NADPH (reduction cofactor in cells)

Diquat and Paraquat – ANALYTICAL CHALLENGES:

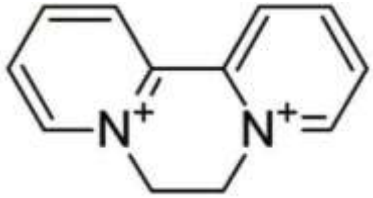
Variability of MRM-Ion-Ratios



Paraquat (PQ)

DQ and PQ form various precursor ions:

- **Dications $[M]^{2+}$**
- **Radical cations $[M]^{+*}$**
- **Deprotonated cations $[M\text{-}H^{+}]^{+}$**

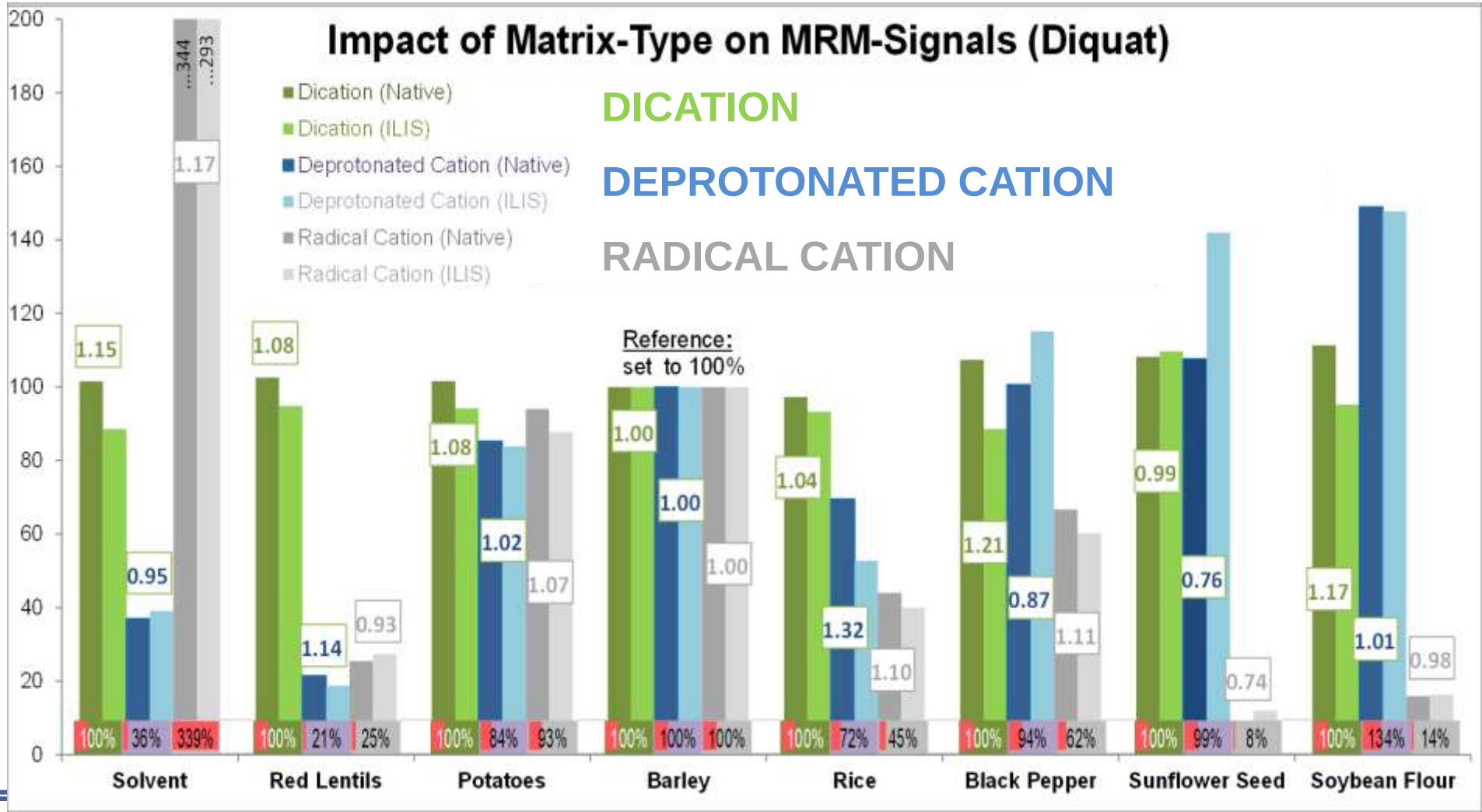


Diquat (DQ)

The relative generation rate of the precursor ions depends on:

- Composition of mobile phase (including co-eluting matrix)
- Design and condition of the LC-MS/MS interface

Diquat and Paraquat – Analytical Challenges: Variability of MRM-Ion-Ratios depending on matrix



Diquat and Paraquat – Variability of MRM-Ion-Ratios

Variability of relative area ratios against ILIS (using matching MRM)

DICATION (M^{2+}): RSD 3.5%

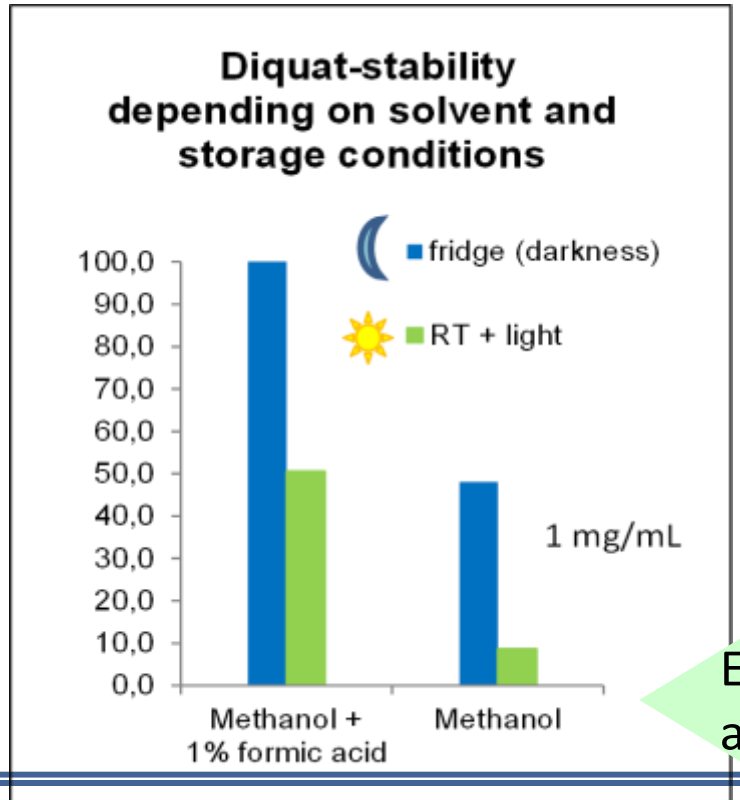
DEPROTONATED CATION ($[M-H]^+$): RSD 9.5%

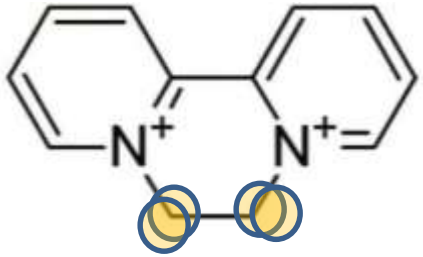
RADICAL CATION ($[M^{\bullet}]^+$: RSD 11.5%

- Calculations need to be made with **ILIS-MRMs matching to those of native analyte**
- MRMs based on **dication-precusors provide the least fluctuating signals**

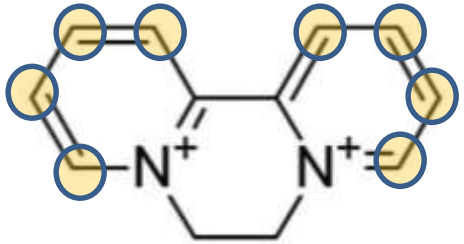
Diquat and Paraquat – Standard stability

- DQ / PQ (and ILISs) are **sensitive to degradation** (especially if exposed to **sunlight**)
- **Water containing 10 % ACN** proved suitable for stock and working solutions (even when exposed to sunlight)
- **Ring-labelled DQ-D8** is much more stable than **DQ-D4**





Diquat-D4



Diquat-D8

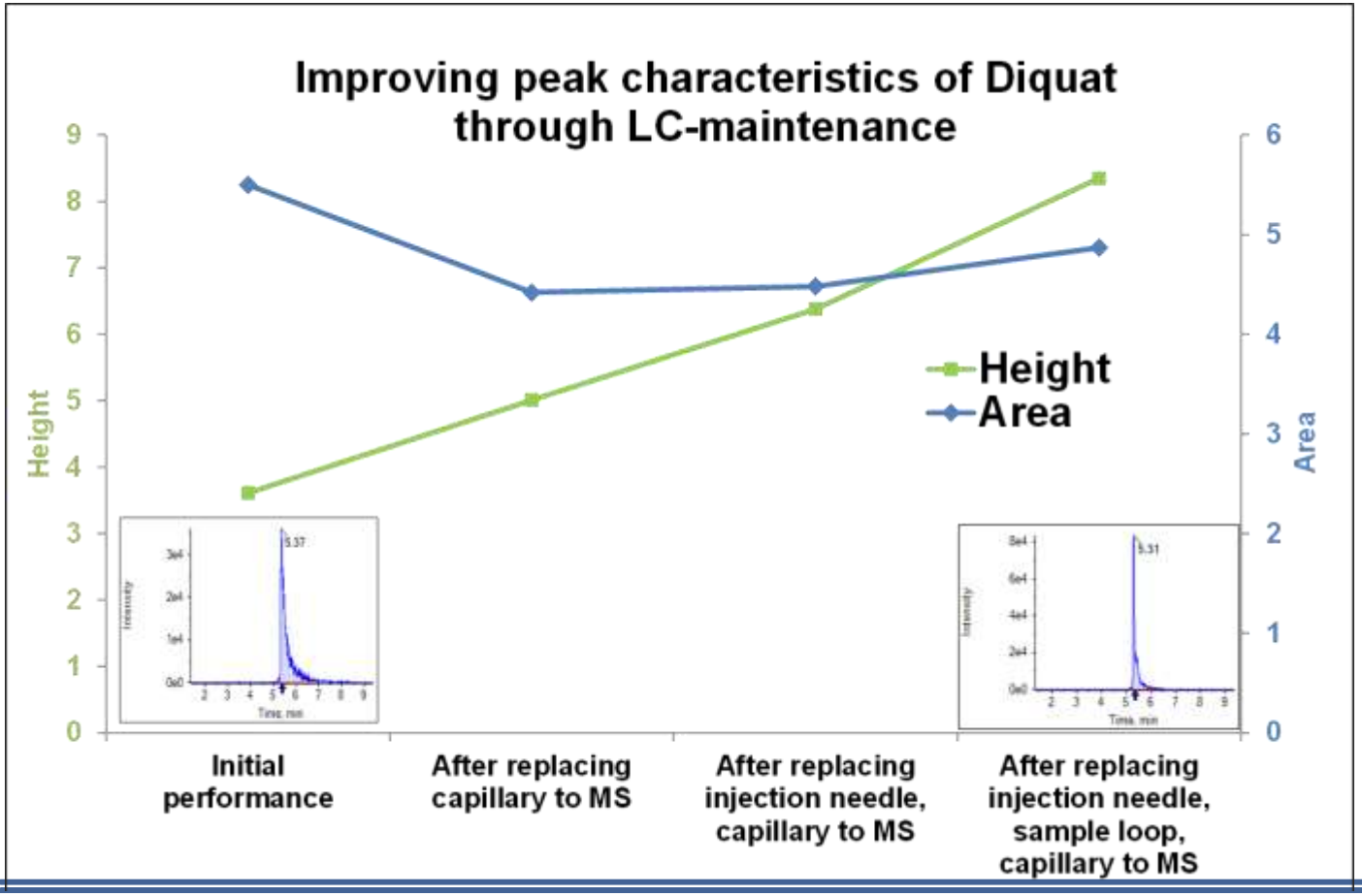
The EURL-SRM has synthesized this ILIS

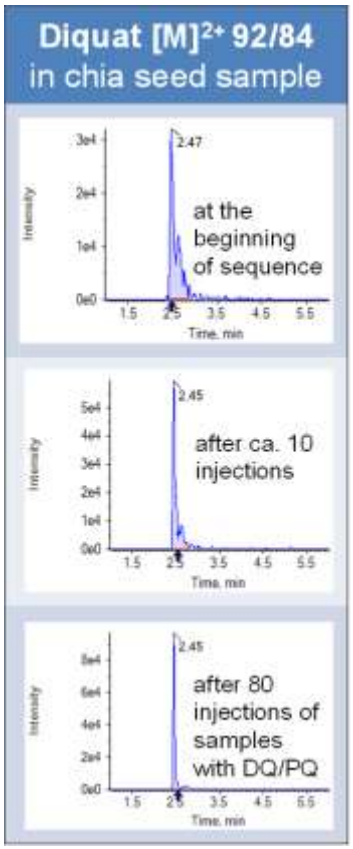
Example for DQ-stability at different storage conditions

Diquat and Paraquat – Chromatography

- DQ / PQ tend to interact with surfaces → tailing peaks and carry-over effects

- Different parts of the LC-system contribute to peak broadening:





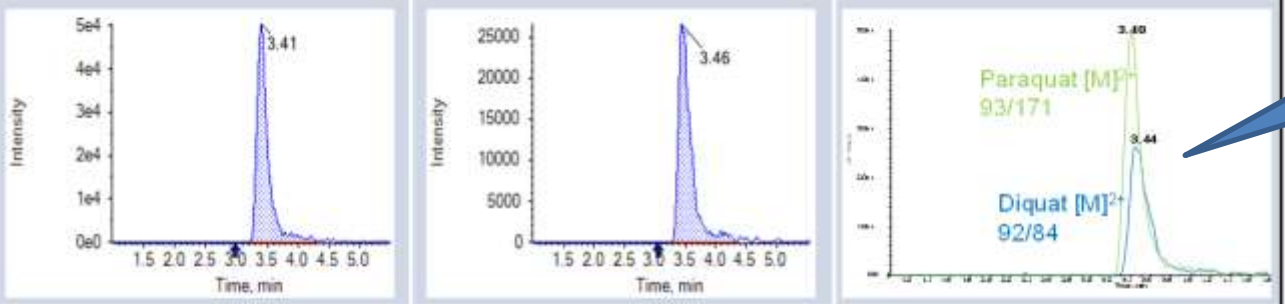
Priming with DQ and PQ helps to sharpen peaks:

Diquat and Paraquat - Chromatography

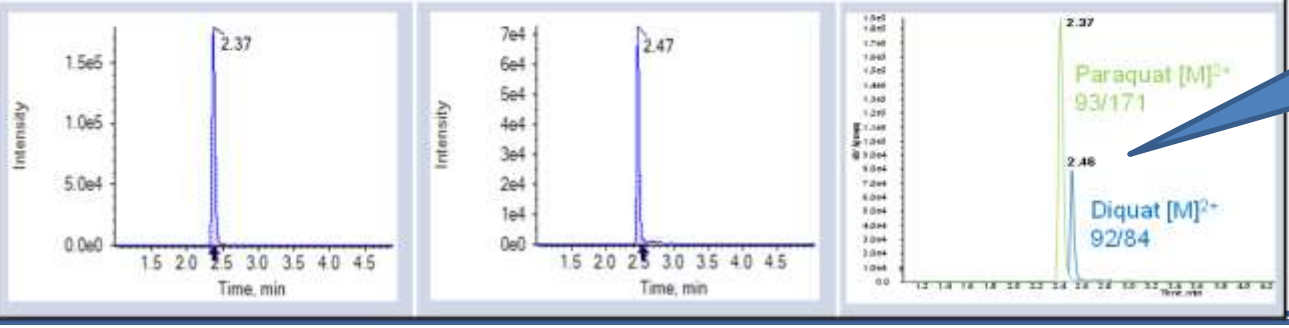
Paraquat $[M]^{2+}$ 93/171	Diquat $[M]^{2+}$ 92/84	Separation on column

Soybean flour 0.01 µg/mL (QuPPe extract with MeOH/1M HCl (1/1))

ObeliscR, 10 µL inj.vol.



HILIC-Z (=zwitterionic sulfobetaine stationary phase), 5 µL inj.vol.



Peaks using different collumns:

Poor Separation
Broader Peak

Better separation
Sharp peak

Diquat and Paraquat - Extractability

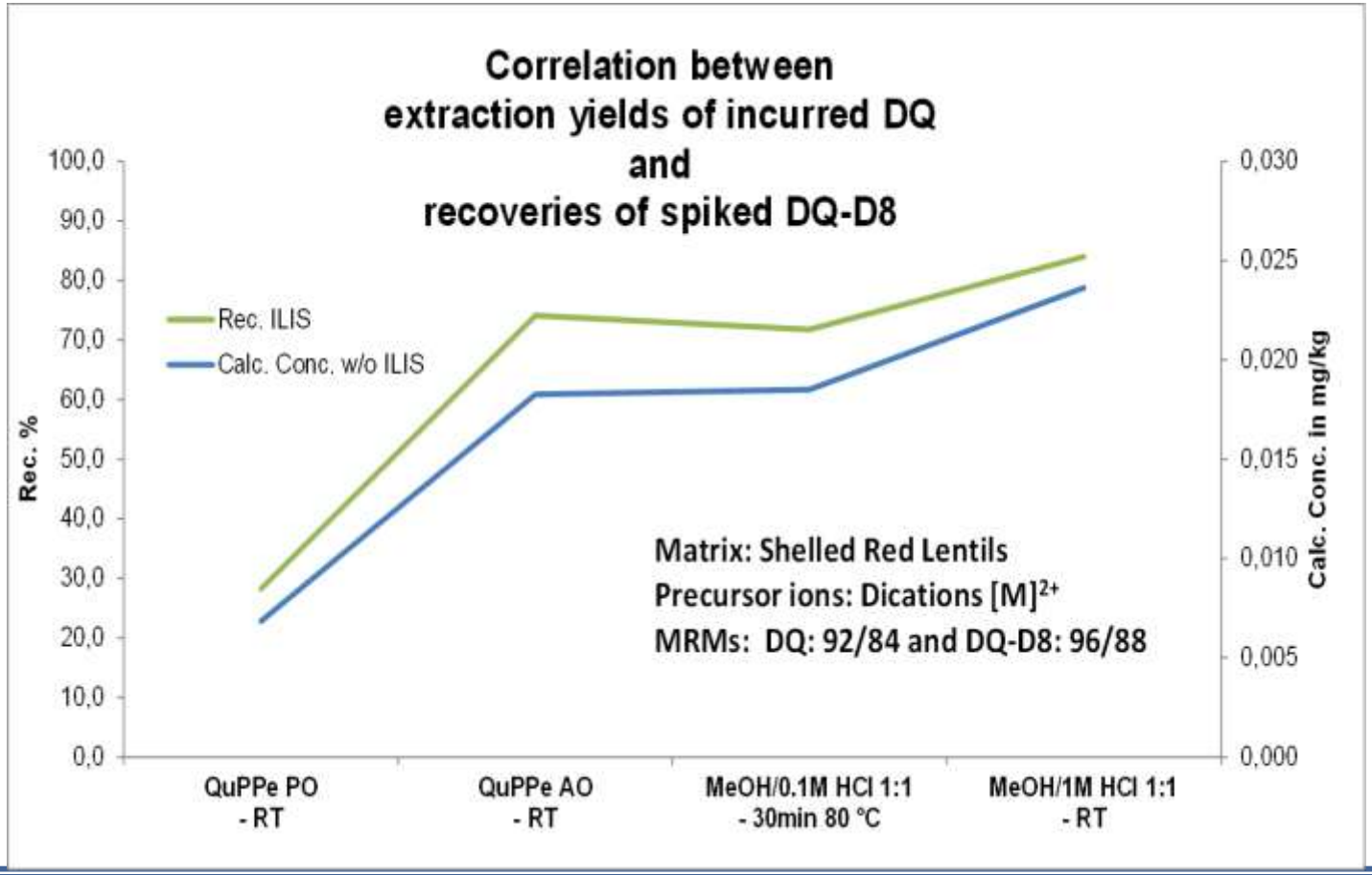
- DQ / PQ tend to **interact with matrix** during extraction
- **Poor recoveries for oily seeds** (e.g. flax, chia) and **pulses**
- Acidity helps in cases of strong interactions

Absolute and ILIS-corrected recovery rates of spiked DQ and PQ (level 0.2 mg/kg)		QuPPe AO (EDTA /1% FA / RT)	QuPPE PQ/DQ **1M** HCl / RT	QuPPE PQ/DQ 0,1M HCl / **80 °C**	QuPPE PQ/DQ **1M** HCl / **80 °C**	QuPPe AO (EDTA /1% FA / RT)	QuPPE PQ/DQ **1M** HCl / RT	QuPPE PQ/DQ 0,1M HCl / **80 °C**	QuPPE PQ/DQ **1M** HCl / **80 °C**
		no ILIS				**with ILIS**			
Rice	**DQ**	95	87	81	95	109	105	108	99
	PQ	89	88	85	91	105	97	109	102
Chia	**DQ**	15	74	3	99	108	102	81	99
	PQ	12	60	9	88	107	102	102	96
Lentils (brown, unshelled)	**DQ**	12	50	28	74	110	104	113	100
	PQ	10	15	15	41	114	99	109	97

- **ILIS-based correction works well**, even at poor abs. recoveries
- **Increased acidity (0.1N HCl → 1 N HCl)** improves extraction yields for difficult matrices (also **helps to avoid FNs**)

Diquat and Paraquat - Extractability

- yields of incurred residues correlate well with the recoveries of spiked DQ/PQ
  → incurred residues and spiked residues are subject to the same equilibria



Diquat and Paraquat – Analysis of market samples

- various market samples were analyzed for DQ and PQ
- exemplary data concerning linseeds and chia :

	Analyzed	PQ		DQ	
		> LOQ	> MRL	> LOQ	> MRL
	# samples (thereof organic)				
Linseeds (flax)	11 (9)	-	-	2 (1)	-
Chia seeds	13 (8)	5 (1)	3 (1)	-	-

→ Residues also found in organic samples, sometimes exeeding MRLs !!

Thank You
for Your Attention

www.eurl-pesticides.eu