UPOV
International Union for the Protection of New Varieties of Plants

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Technical Working Party for Agricultural Crops

TWA/51/8

Fifty-First Session
Cambridge, United Kingdom, May 23 to 27, 2022

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USING THE COYU-SPLINES METHOD IN DUS EXAMINATION

Document prepared by an expert from the United Kingdom

Disclaimer: this document does not represent UPOV policies or guidance

The annex to this document contains a copy of a presentation “COYU splines Path to implementation in the United Kingdom”, to be made by an expert from the United Kingdom, at the fifty-first session of the TWA.

[Annex follows]

COYU splines
Path to implementation
in the United Kingdom

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What is COYU?

Combined Over-Year Uniformity criterion (COYU)

A method for determining uniformity of candidate variety

- Mostly used for agricultural crops, but also some vegetables
- Characteristic-by-characteristic
- Quantitative characteristics, measured on single plants
- Two or more cycles
- More information in TGP/8

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- **About the change**
- **Historical testing**

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COYU key concepts

Compares uniformity with similar varieties

Measures uniformity through standard deviation (SD) of measurements within plots

- Log (SD+1)

Adjust for any relationship between variability (SD) and level of expression (mean)

- This is main element that we have changed

  Moving-average ➔ Spline

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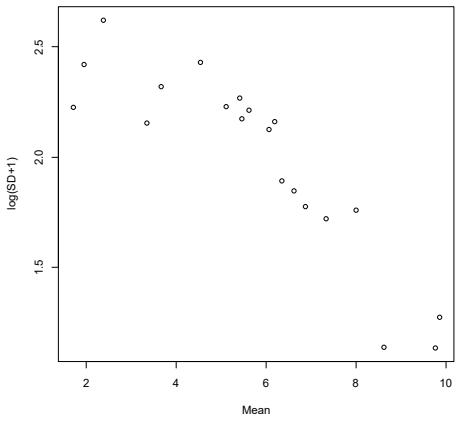
Relationship between uniformity & mean



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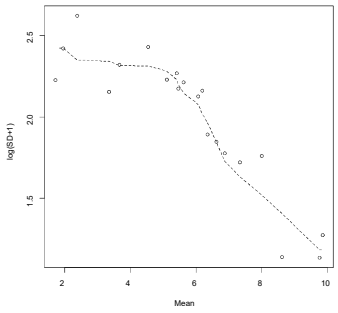
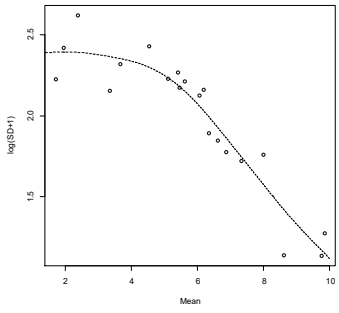
Moving average



Spline



Adjusted values

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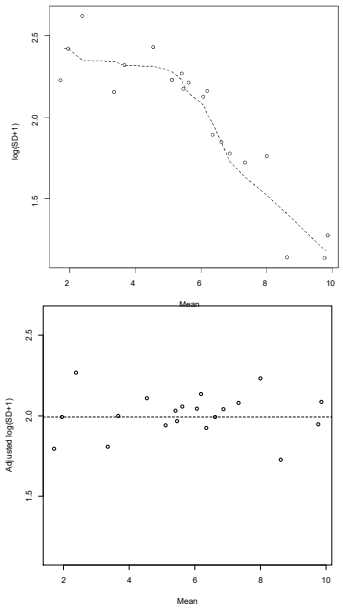
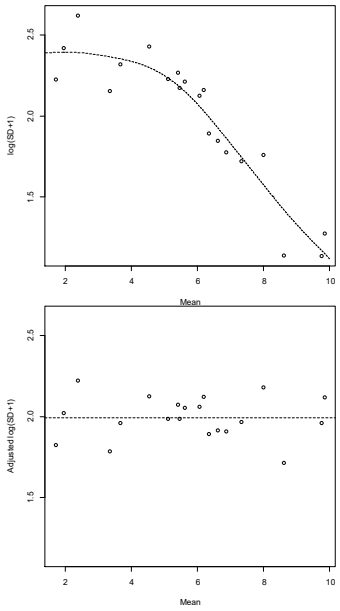
Moving average



Spline



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Why make a change?

Original reason dates back to 2008!

- Expert from Denmark notes an issue with COYU
- Technical but to do with incorrect error estimate
- The United Kingdom works with Denmark to propose way forward using splines
- Sequence of papers by the United Kingdom to develop and evaluate idea

Additional reason:

- Splines produce more sensible curves

In other words – it's an improvement!

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Current position

Software in evaluation phase by UPOV members – now complete

Guidance developed for TGP/8

- Will only be adopted once a member is using
- Likely to remove old method from TGP/8

TWC (TWM) asked for a paper on extrapolation in 2022

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Probability levels

Stringency for COYU criterion is controlled by probability level

In the United Kingdom, probability levels used for COYU moving average

- Generally 0.1% (=0.001)
- Can accept very uniform variety after two years in a three year test (herbage) with probability level of 1%

Study carried out (TWC/35/6). Probability levels for COYU splines:

- Generally 0.3%
- For early acceptance (herbage) 2%

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New Software

Two releases of software

- R package
- DUST9NT

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Test campaign for new software

Started with UPOV Circular on 4 August 2021

Report for next session of TWM

At least 8 members took part

No issues of concern reported on new method, some improvements identified for the software in DUST9NT

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- About the change

- Historical testing in the United Kingdom

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Historical Testing

Why? - to reassure ourselves (and breeders) that COYUs (at p=0.3%) gives similar results to COYU (at p=0.1%)

Steps for a crop in a year:-

- Run uniformity files (UX file, J & M files) thru COYU at p=0.1%
- Run uniformity files (UX file, J & M files) thru COYUs at p=0.3%
- Inspect output files **and summarise decisions on candidates into table**

Look at graphs for conflicting cases

Imaginary trial XYZ summary	Uniform COYU	Not uniform COYU
Uniform COYUs	10	1
COYUs extrapolated	2	0
Not uniform COYUs	1	3

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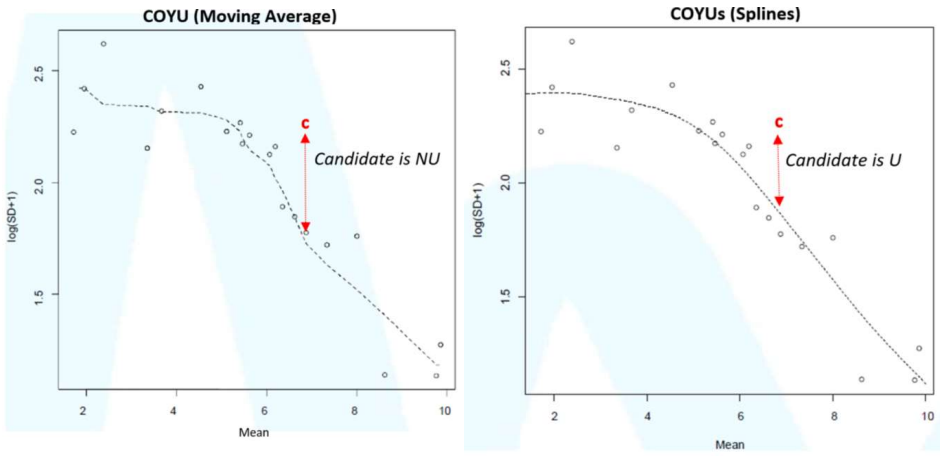
Conflicting Cases

Must check that these are borderline cases simply affected by the use of moving average vs splines (or vice versa) to adjust for relationship between uniformity & mean



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look at extrapolation cases too

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IRG (TET) N IRELAND 1992-93 summary	Uniform COYU	Not uniform COYU
Uniform COYUs	1	0
COYUs extrapolated	1	0
Not uniform COYUs	0	0

Candidate Afp 109 extrapolated on chars 8,10,15,24, 35 & 41

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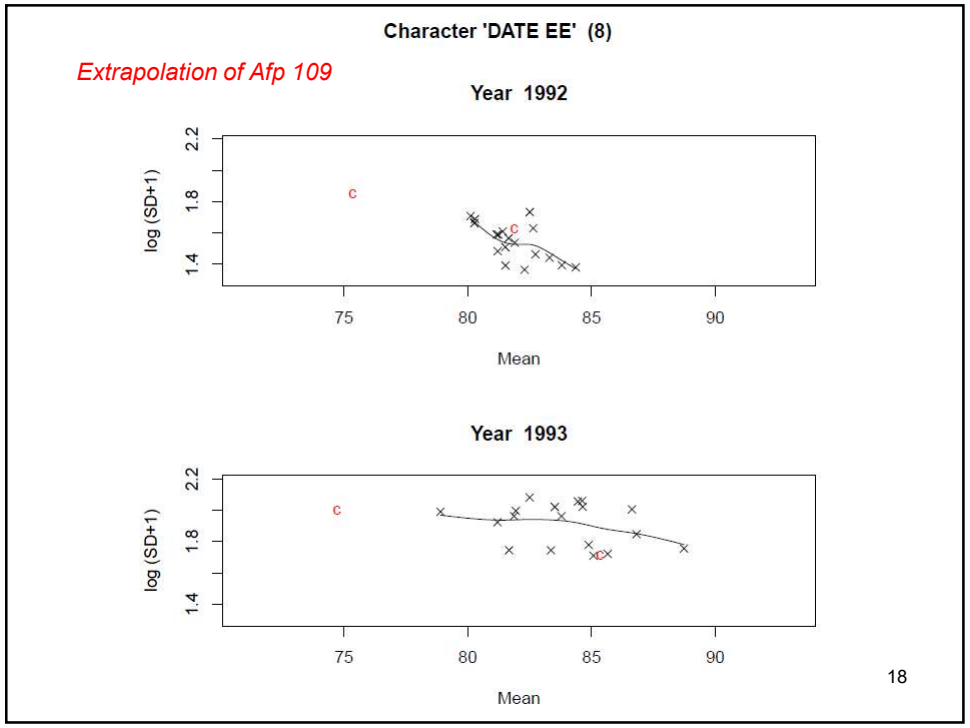

Extrapolation of Afp 109

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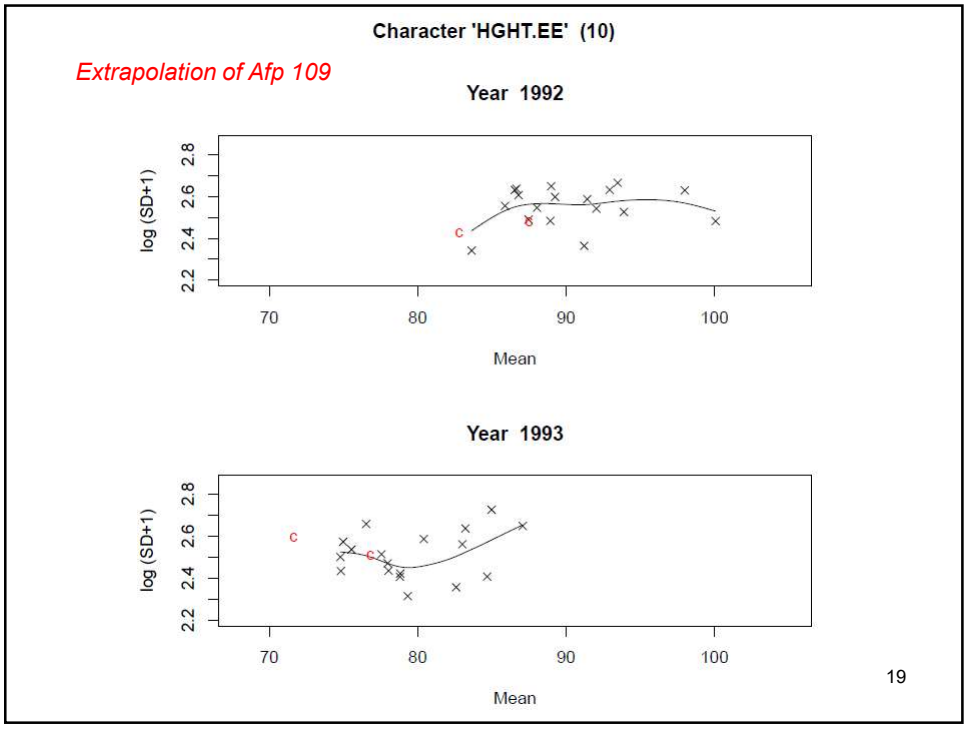
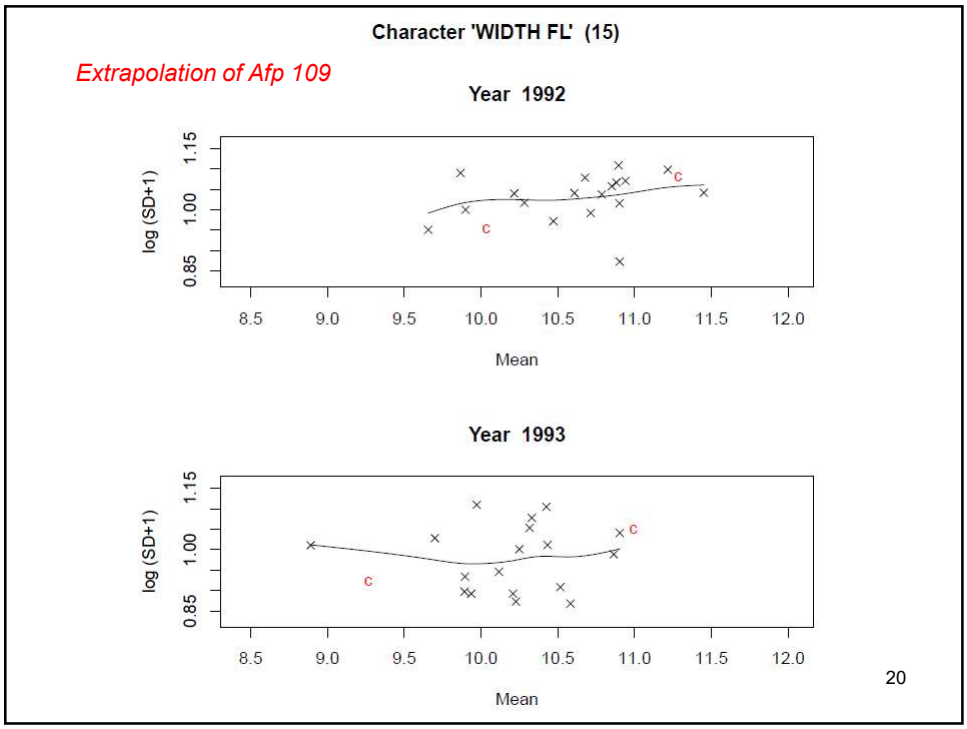
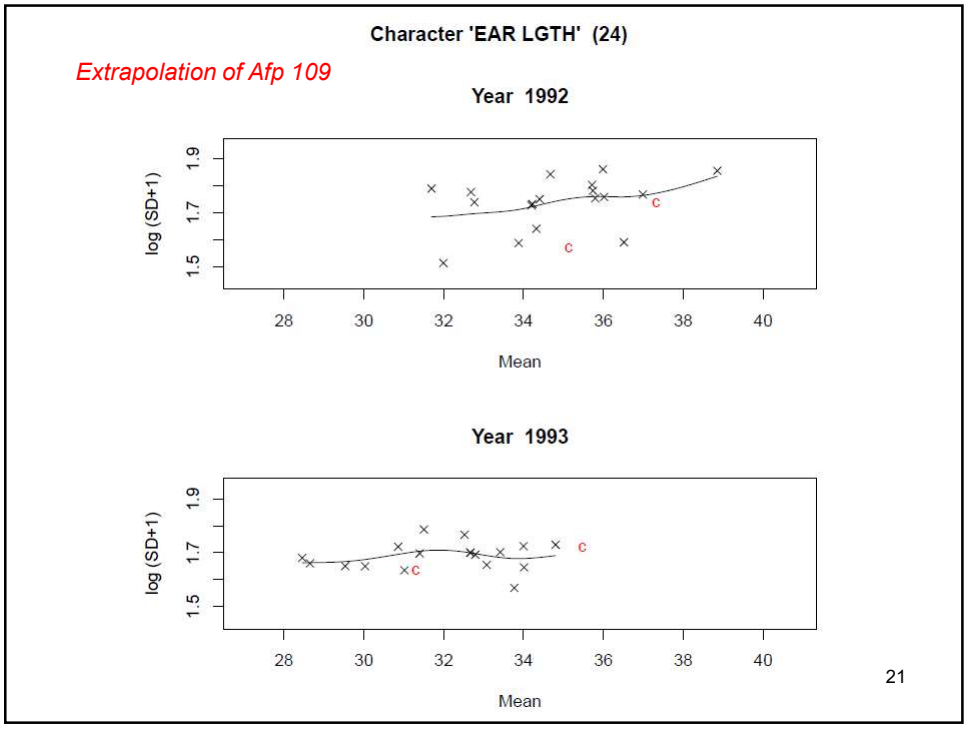
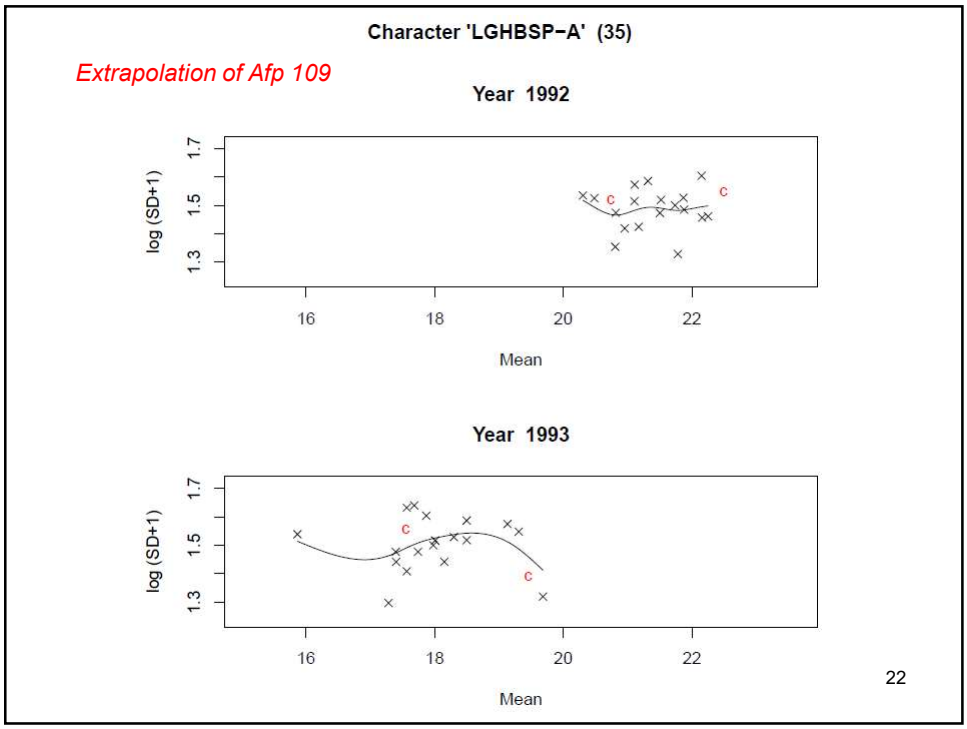
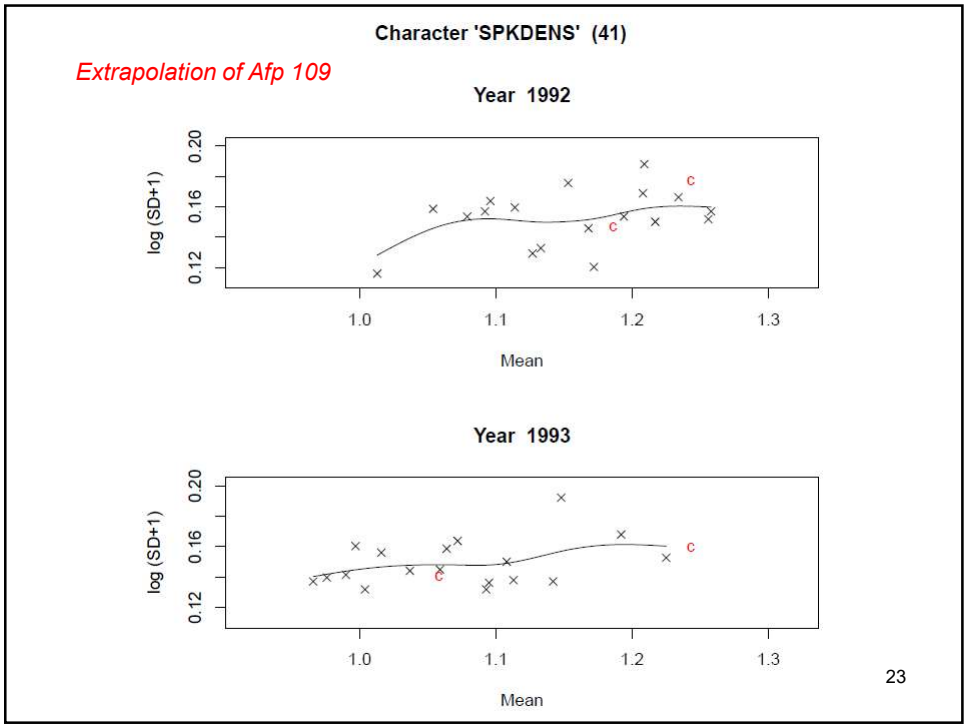

Character 'HGHT.EE' (10)
Extrapolation of Afp 109
Year 1992
log (SD+1)
2.2
2.4
2.6
2.8
70
80
90
100
Mean
Year 1993
log (SD+1)
2.2
2.4
2.6
2.8
70
80
90
100
Mean
19


Character 'WIDTH FL' (15)
Extrapolation of Afp 109
Year 1992
log (SD+1)
0.85
1.00
1.15
8.5
9.0
9.5
10.0
10.5
11.0
11.5
12.0
Mean
Year 1993
log (SD+1)
0.85
1.00
1.15
8.5
9.0
9.5
10.0
10.5
11.0
11.5
12.0
Mean
20


Character 'EAR LGTH' (24)
Extrapolation of Afp 109
Year 1992
log (SD+1)
1.5
1.7
1.9
28
30
32
34
36
38
40
Mean
Year 1993
log (SD+1)
1.5
1.7
1.9
28
30
32
34
36
38
40
Mean
21


Character 'LGHBSP−A' (35)
Extrapolation of Afp 109
Year 1992
log (SD+1)
1.3
1.5
1.7
16
18
20
22
Mean
Year 1993
log (SD+1)
1.3
1.5
1.7
16
18
20
22
Mean
22



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Extrapolation

Does it make sense to adjust when candidate is outside expression range for reference varieties?

- If extrapolation not too extreme
- New software produces an index to indicate how extreme
- Don't know yet what to do when extrapolation problematic
  - **expert opinion is key**
- Problem exists for old COYU as well as COYU-splines
- To present paper at TWM

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Inspection of extrapolation cases helps you to decide whether the candidate is U or NU by COYUs

i.e. is the uniformity of Afp 109 this, or this

IRG (TET) N IRELAND 1992-93 summary	Uniform COYU	Not uniform COYU
Uniform COYUs	1	0
COYUs extrapolated	1	0
Not uniform COYUs	0	0

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Historical Testing

Why? - to reassure ourselves (and breeders) that COYUs (at p=0.3%) gives similar results to COYU (at p=0.1%)

Steps for a crop in a year:-

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- Run uniformity files (UX file, J & M files) thru COYUs at p=0.3%
- Inspect output files and summarise decisions on candidates into table
- **Repeat for decisions made in two other years, and pool...**

IRG (TET) N IRELAND 1992-93, 93-94 & 94-95 summary	Uniform COYU	Not uniform COYU
Uniform COYUs	-	-
Not uniform COYUs	-	-

We expect (and hope for) only small numbers of conflicting cases

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Historical Testing

These summary tables by crop should provide the reassurance that we seek, and the breeders too, on the impact on decisions of using COYUs (and its recommended probability levels) in place of COYU for uniformity testing

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Summary table to compare COYU and COYUs in the 2-year tests of winter oilseed rape hybrids conducted in each of 2016, 2017 and 2018

	Uniform COYU	Not uniform COYU
Uniform COYUs	122	2
COYUs extrapolated	15	0
Not uniform COYUs	3	3

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Comparison of COYU and COYUs on 2 year test of winter oilseed rape hybrids CB 2017-2018

WOSR hybrids CB 2017-2018	Uniform COYU	Not uniform COYU
Uniform COYUs	45	1
COYUs extrapolated	6	0
Not uniform COYUs	1	1

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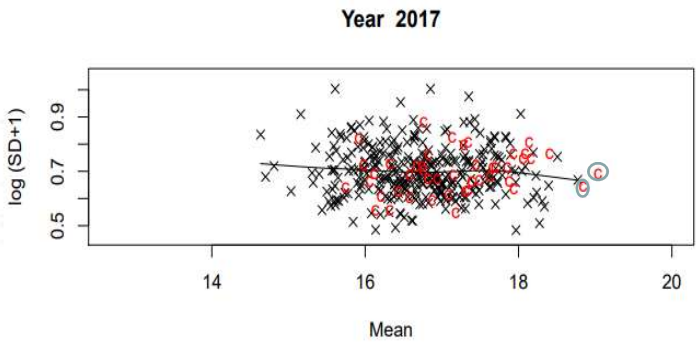
Character 14, Petal length



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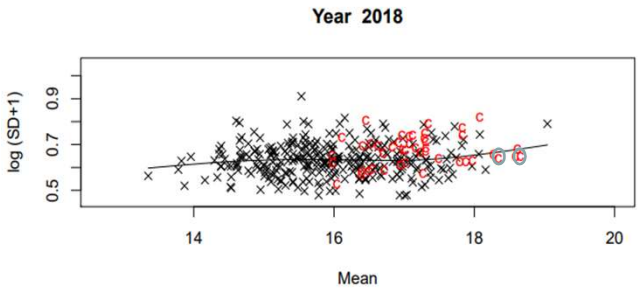
Character 14, Petal length



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Currently

- Analyses being finalised
- Outputs being scrutinised
- Results being summarised

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Acknowledgements

Animal & Plant Health Agency

Adrian Roberts
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Sally Watson

Haidee Philpott

BioSS

afbi

NIAB

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[End of Annex and of document]