UPOV
International Union for the Protection of New Varieties of Plants

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Technical Committee **TC/54/29**

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DEVELOPMENT OF CALCULATED THRESHOLDS FOR EXCLUDING VARIETIES OF COMMON KNOWLEDGE FROM THE SECOND GROWING CYCLE WHEN COYD IS USED

Document prepared by the Office of the Union

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EXECUTIVE SUMMARY

1. The purpose of this document is to report on developments concerning the development of calculated thresholds for excluding varieties of common knowledge from the second growing cycle when COYD is used.

2. The TC is invited to note that the TWC, at its thirty-fifth session, noted:

(a) the recent developments and the indications of COYD thresholds for excluding varieties of common knowledge from the second growing cycle on the basis of data sets of meadow fescue, red clover, timothy, perennial ryegrass, pea (semi-leafless) and pea (conventional), as set out in paragraphs 9 and 10 and the Annex to this document;

(b) the method was most applicable to crops with large numbers of varieties of common knowledge and where current trial sizes were large; and

(c) the plans of the United Kingdom to test the method on two large data set of oilseed rape.

3. The structure of this document is as follows:

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4. The following abbreviations are used in this document:

TC: Technical Committee
TWC: Technical Working Party on Automation and Computer Programs

BACKGROUND

5. The background to this matter is provided in document TC/53/23 “Development of calculated thresholds for excluding varieties of common knowledge from the second growing cycle when COYD is used”, paragraphs 9 to 13 and document TC/53/23 Add. “Addendum to document TC/53/23”.

DEVELOPMENTS IN 2017

Technical Committee

6. The TC, at its fifty-third session, held in Geneva, from April 3 to 5, 2015, considered document TC/53/23 “Development of calculated thresholds for excluding varieties of common knowledge from the second growing cycle when COYD is used” (see document TC/53/31 “Report”, paragraphs 190 to 192).

7. The TC received a presentation by the experts from the United Kingdom on excluding varieties of common knowledge from the second growing cycle when COYD was used, a copy of which is reproduced in document TC/53/23 Add..

8. The TC noted that further developments on calculated thresholds for excluding varieties of common knowledge from the second growing cycle when COYD was used would be reported to the TWC, at its thirty-fifth session.

Technical Working Party on Automation and Computer Programs

9. The TWC, at its thirty-fifth session, held in Buenos Aires, Argentina, from November 14 to 17, 2017, considered documents TWP/1/22 “Development of calculated thresholds for excluding varieties of common knowledge from the second growing cycle when COYD is used” and TWC/35/13 “Thresholds for Excluding Varieties of Common Knowledge from the Second Growing Cycle when COYD is used” and received a presentation by an expert from the United Kingdom, a copy of which is reproduced in the Annex to this document (see document TWC/35/21 “Report”, paragraphs 73 to 76).

10. The TWC noted the recent developments and the indications of COYD thresholds for excluding varieties of common knowledge from the second growing cycle on the basis of data sets of meadow fescue, red clover, timothy, perennial ryegrass, pea (semi-leafless) and pea (conventional).

11. The TWC noted that the method was most applicable to crops with large numbers of varieties of common knowledge and where current trial sizes were large. The TWC noted the plans of the United Kingdom to test the method on large data sets of oilseed rape.

12. The TWC noted that the code had been developed using “R” software and that it might be possible to link this to the GAIA software to support determining the thresholds for excluding varieties from the second growing cycle when COYD was used.

DEVELOPMENTS IN 2018

13. The TWC, at its thirty-sixth session, held in Hanover, Germany, from July 2 to 6, 2018, did not receive a document on this matter.

14. On July 24, 2018, the Office of the Union received information that the expert from the United Kingdom expects to be able to report on progress at the thirty-seventh session of the TWC, to be held in Hangzhou, China, from October 14 to 16, 2019.

15. The TC is invited to note that the TWC, at its thirty-fifth session, noted:

(a) the recent developments and the indications of COYD thresholds for excluding varieties of common knowledge from the second growing cycle on the basis of data sets of meadow fescue, red clover, timothy, perennial ryegrass, pea (semi-leafless) and pea (conventional), as set out in paragraphs 9 and 10 and the Annex to this document;

(b) the method was most applicable to crops with large numbers of varieties of common knowledge and where current trial sizes were large; and

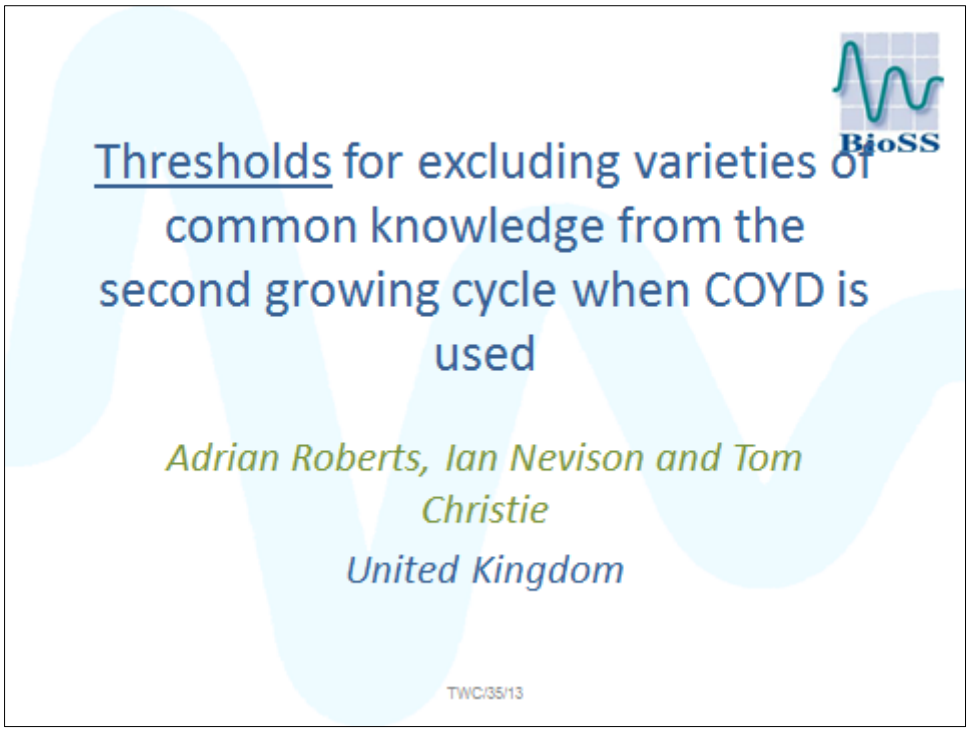
(c) the plans of the United Kingdom to test the method on two large data set of oilseed rape.

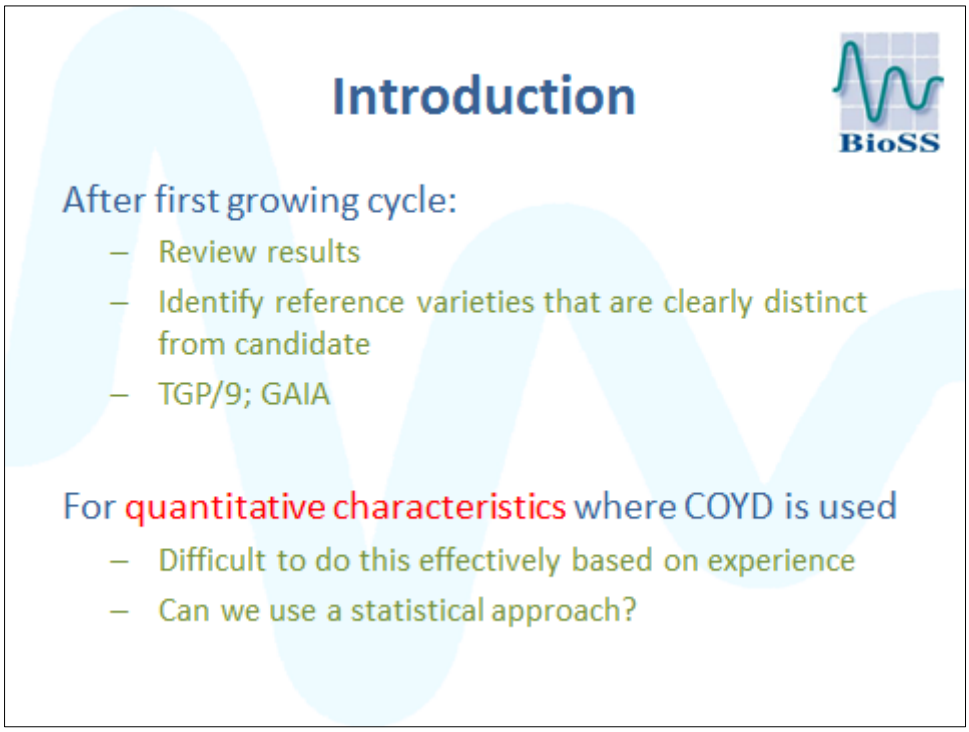
[Annex follows]

ANNEX

THRESHOLDS FOR EXCLUDING VARIETIES OF COMMON KNOWLEDGE FROM THE SECOND GROWING CYCLE WHEN COYD IS USED

Presentation prepared by experts from the United Kingdom





Introduction

For quantitative characteristics where COYD is used

- TWC/25/14: method first proposed
- TWC/28/30: shown that method needed improvement
- TWC/33/20: improved method proposed
- TWC/34/08: initial evaluation
- Paper in Journal of Agricultural Science
  Roberts, Nevison & Christie (2016)

Basis

- Calculate probability that a candidate will be distinct from a reference variety on 2-cycle COYD criterion
  - Predict what will happen using first cycle results only
  - High probability → sufficient evidence that reference variety is distinct from candidate
  - Set the probability required → threshold
  - Method requires first cycle results plus historical data (>10 cycles)

Basis

- Calculate probability that a candidate will be distinct from a reference variety on 2-cycle COYD criterion
  - Predict what will happen using first cycle results only
  - High probability → sufficient evidence that reference variety is distinct from candidate Distinct Plus
  - Set the probability required → threshold 99%,98%, 95%
  - Method requires first cycle results plus historical data (>10 cycles)

How useful is this method in practice?

Test with real data:

- Call by UPOV (thanks!)
- Data received from Finland, Slovakia and the United Kingdom
- Data from Slovakia not yet considered

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- Data from Slovakia not yet considered

THANKS!

Data sets

Country	Crop	Number of cycles	Probability level for COYD	Number of characters used here	Overall number of varieties	Overall number of candidates
Finland	Meadow fescue	12	0.01	5	64	23
Finland	Red Clover	11	0.01	6	39	10
Finland	Timothy	11	0.01	6	100	9
United Kingdom	Perennial ryegrass	11	0.01	16	232	146
United Kingdom	Pea – semi leafless	19	0.02	10	887	275
United Kingdom	Pea – conventional	20	0.02	12	405	58

United Kingdom pea Thresholds

Semi-Leafless Group

BioSS

UPOV no	Characteristic	Mean COYD criterion	Threshold with p_D=0.95	Threshold with p_D=0.98	Threshold with p_D=0.99
5	Stem: number of nodes up to and including first fertile node	0.86	1.81	2.73	4.13
15	Stipule: length (mm)	10.58	17.90	20.91	23.38
16	Stipule: width (mm)	6.72	11.15	12.84	14.18
22	Petiole: length from axil to first leaflet or tendril (mm)	12.26	21.31	25.16	28.38
28	Flower: width of standard (mm)	2.30	4.18	5.13	5.99
34	Peduncle: length from stem to first pod (mm)	19.49	33.46	40.00	45.63
37	Pod: length (mm)	5.91	9.79	11.33	12.56
38	Pod: width (mm)	0.96	1.59	1.82	2.00
46	Pod: number of ovules	0.45	0.77	0.91	1.03

How useful is this method in practice?

BioSS

Next step: assessing performance

- Do we get first cycle decisions correct?
- What reductions could be achieved?

How useful is this method in practice?

BioSS

Apply calculated thresholds to the data sets

- compare first cycle decisions using thresholds with 2-cycle COYD decisions

False positive rate for each characteristic:
first-cycle threshold distinct: COYD non-distinct.

False negative rate for each characteristic:
first-cycle threshold non-distinct: COYD distinct

Want very low false positive rate to avoid poor decisions
but need low false negative rate to make it worthwhile

How useful is this method in practice?

BioSS

NOTES OF CAUTION:

Real data: reference varieties may have been removed after first cycle

- false negative rate over-estimated?

Decisions are made over the set of characteristics

- Here we only included characteristics with thresholds
- May be other characteristics (qualitative) that can contribute to decisions (⇨ GAIA?)

United Kingdom pea Thresholds

Semi-Leafless Group

BioSS

Characteristic No.	False positives (%)			False negatives (%)		
	p_D=0.99	p_D=0.98	p_D=0.95	p_D=0.99	p_D=0.98	p_D=0.95
5	0.0	0.0	0.4	85.8	64.0	40.0
15	0.3	0.7	1.8	86.0	78.4	65.2
16	0.5	0.8	2.1	74.2	66.3	54.1
22	0.1	0.4	1.4	89.0	81.8	69.1
28	0.0	0.3	1.0	89.0	81.3	66.0
34	0.0	0.1	0.8	85.1	76.8	61.6
37	0.0	0.2	0.7	79.5	73.3	61.7
38	0.2	0.6	1.6	76.5	67.7	56.0
46	0.1	0.4	1.4	63.8	55.3	41.7
57	0.0	0.1	0.6	61.1	50.1	37.3

United Kingdom pea Thresholds

Semi-Leafless Group

BioSS

Characteristic No.	False positives (%)			False negatives (%)		
	p_D=0.99	p_D=0.98	p_D=0.95	p_D=0.99	p_D=0.98	p_D=0.95
5	0.0	0.0	0.4	85.8	64.0	40.0
15	0.3	0.7	1.8	86.0	78.4	65.2
16	0.5	0.8	2.1	74.2	66.3	54.1
22	0.1	0.4	1.4	89.0	81.8	69.1
28	0.0	0.3	1.0	89.0	81.3	66.0
34	0.0	0.1	0.8	85.1	76.8	61.6
37	0.0	0.2	0.7	79.5	73.3	61.7
38	0.2	0.6	1.6	76.5	67.7	56.0
46	0.1	0.4	1.4	63.8	55.3	41.7
57	0.0	0.1	0.6	61.1	50.1	37.3

Over Characteristics

BioSS

Data set	False positives (%)			False negatives (%)		
	p_0=0.99	p_0=0.98	p_0=0.95	p_0=0.99	p_0=0.98	p_0=0.95
Meadow fescue	0.0	0.7	2.7	95.2	87.3	66.4
Red Clover	0.0	0.0	4.8	100.0	73.5	37.1
Timothy	0.1	0.1	1.0	96.2	90.1	72.0
Perennial ryegrass	0.2	1.0	7.7	69.2	48.3	22.6
Pea – semi-leafless without groups	0.5	0.5	8.1	45.6	29.7	15.0
Pea – conventional	0.0	0.0	2.4	85.2	71.4	26.3

Over Characteristics

BioSS

Data set	False positives (%)			False negatives (%)		
	p_0=0.99	p_0=0.98	p_0=0.95	p_0=0.99	p_0=0.98	p_0=0.95
Meadow fescue	0.0	0.7	2.7	95.2	87.3	66.4
Red Clover	0.0	0.0	4.8	100.0	73.5	37.1
Timothy	0.1	0.1	1.0	96.2	90.1	72.0
Perennial ryegrass	0.2	1.0	7.7	69.2	48.3	22.6
Pea – semi-leafless without groups	0.5	0.5	8.1	45.6	29.7	15.0
Pea – semi-leafless with groups	0.8	0.8	9.4	65.7	45.9	24.2
Pea – conventional	0.0	0.0	2.4	85.2	71.4	26.3

Additional findings

See TWC/35/13 for details

Quality of thresholds depends on:

- Size of historic data set
- Number of cycles
- Number of reference varieties
- Number of varieties in common between cycles

For conventional pea group, looked at effect of restricting data set to varieties with 2,3, 4, 5 or 6 cycles present

- Threshold at 99% much more sensitive

Utility of method depends on size of current trials

- Smaller trials lead to larger thresholds (esp 99%)

Conclusions

Method is most applicable to crops with large numbers of varieties of common knowledge and where current trial sizes are large

Utility will depend on crop and DUS assessment framework

- Works for pea in UK – measured characteristics in combination with groups
- May also work where similar varieties are planted together in second cycle
- Combination with GAIA?
- Would like to try in other crops – UK oilseed rape?

Method developed for 2 cycle decisions

- Need for use in 3-cycle systems?

Code developed in R software

[End of Annex and of document]