UPOV
International Union for the Protection of New Varieties of Plants

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**Buenos Aires, Argentina, November 14 to 17, 2017**

**TWC/35/13 Add.**

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

*Document prepared by experts from the United Kingdom*

*Disclaimer: this document does not represent UPOV policies or guidance*

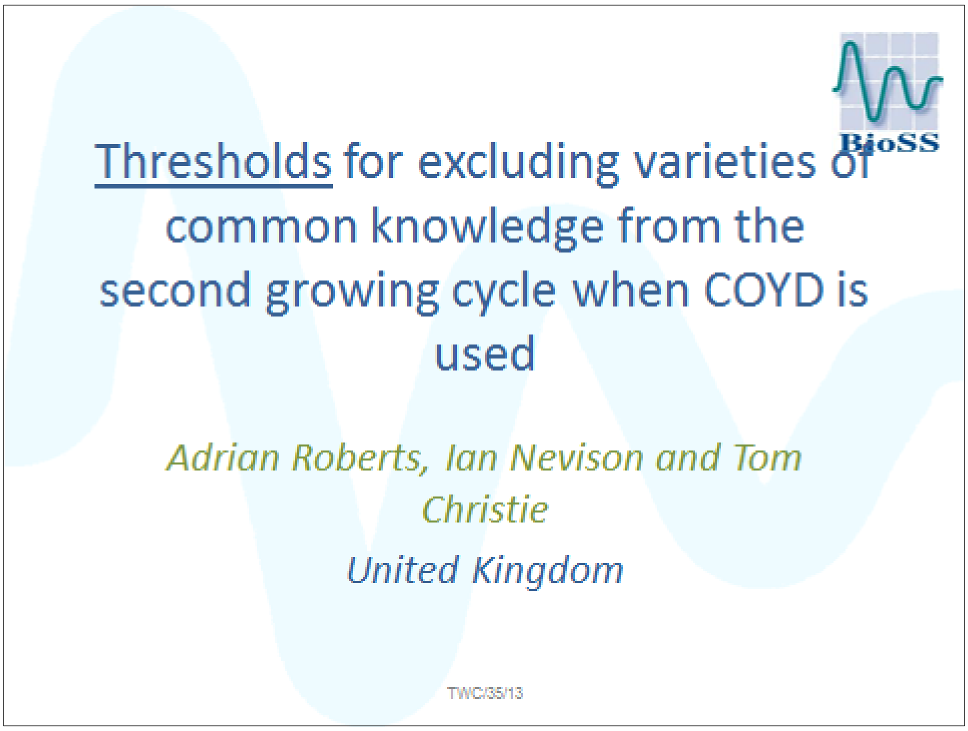
The Annex to this document contains a copy of a presentation on "Thresholds for Excluding Varieties of Common Knowledge from the Second Growing Cycle when COYD is Used", prepared by experts from the United Kingdom, to be made at the thirty-fifth session of the Technical Working Party on Automation and Computer Programs (TWC).

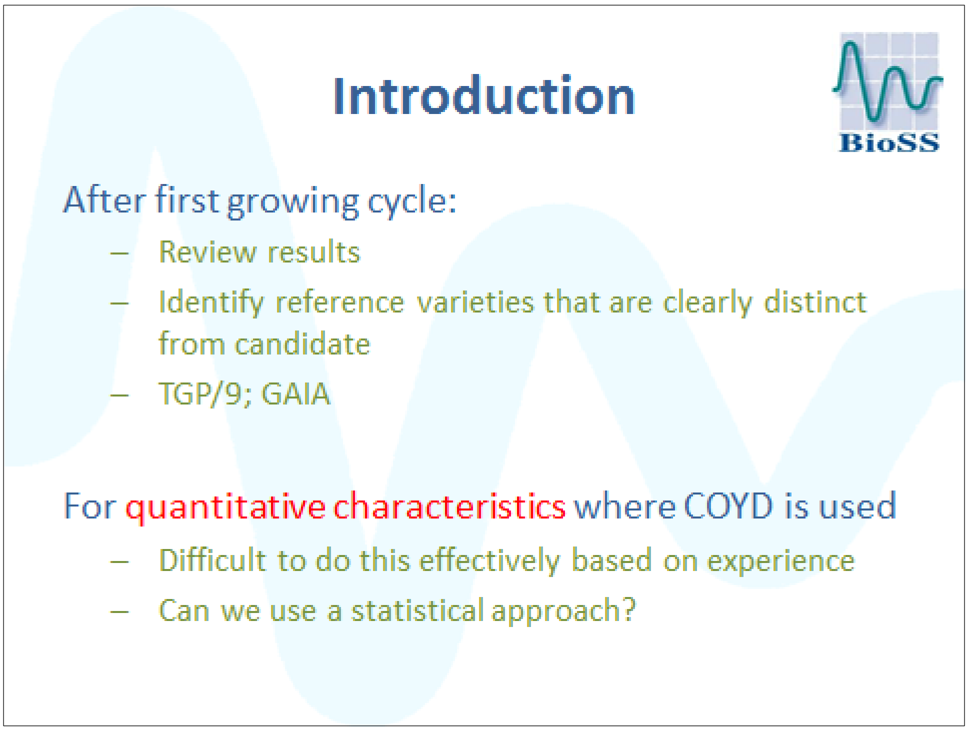
[Annex follows]

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

BioSS

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

BioSS

- 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)

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- 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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THANKS!

## Data sets

BioSS

| 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 $p_p$=0.95 | Threshold with $p_p$=0.98 | Threshold with $p_p$=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

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# Over Characteristics

BioSS

| Data set | 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 |
| 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

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| Data set | False positives (%) | | | False negatives (%) | | |
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| 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]