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INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

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TECHNICAL WORKING PARTY ON AUTOMATION AND COMPUTER PROGRAMS

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ADDENDUM TO
CALCULATED 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 “Calculated Thresholds for Excluding Varieties of Common Knowledge from the Second Growing Cycle when COYD is used”, which will to be made at the thirty-fourth session of the Technical Working Party on Automation and Computer Programs (TWC).

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ANNEX

First Year Thresholds

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Funded by the Scottish Government

Introduction

After first growing cycle:

- Review results
- Identify reference varieties that are clearly distinct from candidate
- TGP/9; GAIA

For quantitative characteristics where COYD is used

- Difficult to do this effectively based on experience
- Can we use a statistical approach?

Introduction

For quantitative characteristics where COYD is used

- New method proposed in TWC/25/14
- Shown in TWC/28/30 that this method needed improvement
- Improved method proposed in TWC/33/20
- Paper in Journal of Agricultural Science
  Roberts, Nevison & Christie (In press)

Basis

Calculate probability that a candidate will be distinct from a reference variety on 2-cycle COYD criterion,

- A prediction based on only first year results
- High probability → enough evidence that reference variety is distinct from candidate
- Reverse to get a threshold for a set probability (p_D)
- Method requires first year results plus historical data (>10 years)

How useful is this method in practice?

Evaluate on example data sets:

- **GB DUS data for field pea**

Results here

UPOV invitation for further example data sets

- **Slovakia: red fescue**
- **Finland: timothy, meadow fescue and red clover**
- **Denmark: oilseed rape?**

Will review for TWC/35

Example data

- Field pea
- United Kingdom
- 1995 to 2013
- Semi-leafless group
- 13 quantitative characteristics
- 222 varieties
- COYD at 2%

Characteristic (UPOV number)	Mean	Standard deviation	Minimum	Maximum	Over-cycle heterogeneity index
(5) Stem: number of nodes up to and including first fertile node	16.0	1.59	9.6	20.9	13.0
(15) Stipule: length (mm)	82.3	13.48	47.2	121.5	4.4
(16) Stipule: width (mm)	46.3	8.60	23.7	79.0	4.1
(21) Stipule: density of flecking (1-9)	5.3	0.90	2.5	8.0	4.3
(22) Petiole: length from axil to first leaflet or tendril (mm)	83.2	13.34	34.8	128.6	5.8
(28) Flower: width of standard (mm)	31.8	2.64	23.3	41.1	9.1
(29) Flower: shape of base of standard (1-9)	6.8	1.02	4.0	9.0	3.8
(34) Peduncle: length from stem to first pod (mm)	72.9	24.41	12.0	145.7	4.6
(37) Pod: length (mm)	79.1	6.24	63.3	105.6	4.3
(38) Pod: width (mm)	13.9	1.22	10.5	18.6	3.4
(42) Pod: curvature (1-9)	2.4	0.58	1.0	5.5	2.5
(46) Pod: number of ovules	8.2	0.54	6.0	10.0	7.5
(57) Seed: weight	28.1	5.19	12.2	49.1	5.7

Characteristic	Threshold with p_0=0.99	Threshold with p_0=0.95	Thresholds with p_0=0.9	Current GB tolerance	Proposed new tolerance	Change
5	4.1	1.8	1.4	3	4.1	↑
15	23.4	17.9	15.7	25	23.8	↓
16	14.2	11.2	9.9	20	14.2	↓
*21**	*2.0*	*1.6*	*1.4*	*3*	3	=
22	28.4	21.3	18.6	30	28.4	↓
28	6.0	4.2	3.6	12	6.0	↓
*29**	*2.0*	*1.5*	*1.4*	*2*	2	=
34	45.6	33.5	28.9	40	45.6	↑
37	12.6	9.8	8.60	20	12.6	↓
38	2.0	1.6	1.4	2	2.0	=
*42**	*1.7*	*1.3*	*1.2*	*2*	2	=
46	1.0	0.8	0.7	2	1.0	↓
57	9.7	7.0	6.0	8	9.4	↑

How does it work in practice?

Apply calculated thresholds in the data set

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

False positive rate for each characteristic:

first-year threshold distinct: COYD non-distinct.

False negative rate for each characteristic:

first-year threshold non-distinct: COYD distinct

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

How does it work in practice?

NOTES OF CAUTION:

Real data: reference varieties may be removed after first year

- Would make false negative rate lower than reality

Decisions are made over the set of characteristics

- Here by characteristic
- Will look at decisions over characteristics next

False positive rate

Characteristic	Calculated threshold with p_0=0.99	Calculated threshold with p_0 =0.95	Calculated threshold with p_0 =0.9	Current GB tolerance
5	0.00%	0.05%	0.40%	0.00%
15	0.07%	0.62%	1.34%	0.04%
16	0.17%	0.79%	1.59%	0.00%
21*	0.01%	0.16%	1.34%	0.00%
22	0.05%	0.41%	0.96%	0.03%
28	0.04%	0.54%	1.17%	0.00%
29*	0.15%	0.15%	0.99%	0.15%
34	0.03%	0.40%	1.05%	0.07%
37	0.02%	0.23%	0.57%	0.00%
38	0.04%	0.58%	1.17%	0.05%
42*	0.04%	0.56%	0.56%	0.04%
46	0.03%	0.33%	0.82%	0.00%
57	0.00%	0.23%	0.72%	0.08%

False negative rate

Characteristic	Calculated threshold with p_0=0.99	Calculated threshold with p_0 =0.95	Calculated threshold with p_0 =0.9	Current GB tolerance
5	82.8%	39.4%	24.5%	67.6%
15	86.8%	66.6%	54.3%	90.1%
16	76.8%	56.6%	46.2%	94.6%
21*	81.0%	60.8%	34.6%	88.8%
22	88.5%	67.5%	54.2%	91.3%
28	89.3%	65.4%	51.7%	99.9%
29*	57.3%	57.3%	34.4%	57.4%
34	84.7%	59.4%	46.2%	75.6%
37	81.2%	65.1%	54.4%	96.5%
38	77.1%	57.1%	47.4%	76.2%
42*	80.9%	58.2%	58.2%	81.1%
46	66.7%	44.1%	34.2%	97.5%
57	58.5%	34.6%	25.2%	43.7%

Results

- With p_D higher we get safer decisions (low false positive) but less varieties discriminated
- GB proposing to use p_D at 99% to achieve safe decisions (except scored characteristics)
- Results for scored characteristics give confidence in current thresholds
- Difficult to get useful thresholds with zero false positive rate due to COYD being inherently variable

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Future work

- Look at over-characteristic decisions in GB field pea example
- Apply to further example data sets
- Investigate methods for giving guidance to applicants after first year for COYD characteristics
- Consider development of software
- Wider discussion on one-year DUS decisions

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