UPOV

International Union for the Protection of New Varieties of Plants

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**Technical Committee** **TC/54/27**

**Fifty-Fourth Session** **Original:** English
**Geneva, October 29 and 30, 2018** **Date:** October 3, 2018

# NUMBER OF GROWING CYCLES

*Document prepared by the Office of the Union*

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

## EXECUTIVE SUMMARY

1. The purpose of this document is to report on the consideration of the number of growing cycles in DUS examination.

2. The TC is invited to note the discussions by the TWPs, at their sessions in 2017 and 2018, on the impact of using different numbers of growing cycles on DUS decisions using actual data.

3. The structure of this document is as follows:



4. The following abbreviations are used in this document:

| | |
|---|---|
| TC: | Technical Committee |
| TC-EDC: | Enlarged Editorial Committee |
| TWA: | Technical Working Party for Agricultural Crops |
| TWC: | Technical Working Party on Automation and Computer Programs |
| TWF: | Technical Working Party for Fruit Crops |
| TWO: | Technical Working Party for Ornamental Plants and Forest Trees |
| TWPs: | Technical Working Parties |
| TWV: | Technical Working Party for Vegetables |

BACKGROUND

5. The TC, at its fifty-second session, held in Geneva from March 14 to 16, 2016, received the following presentations on variety descriptions and the role of plant material, including minimum number of growing cycles for DUS examination (in order of presentation) (see document TC/52/29 Rev. "Revised Report", paragraph 204):

| | |
|---|---|
| Variety descriptions and the role of plant material, including minimum number of growing cycles for DUS examination | France (Mr. Richard Brand) |
| Development and use of variety descriptions | Germany (Ms. Beate Rücker) |
| Minimum number of growing cycles | Netherlands (Mr. Kees van Ettekoven) |
| Using variety descriptions and length of testing – A New Zealand perspective | New Zealand (Mr. Chris Barnaby) |

6. The TC considered the discussion on the number of growing cycles in DUS examination and agreed to invite members of the Union to simulate the impact of using different numbers of growing cycles on DUS decisions using actual data and to report on their results at the TWP sessions in 2016 and at the fifty-third session of the TC.

7. The TC, at its fifty-third session, held in Geneva from April 3 to 7, 2017, considered document TC/53/21 "Number of growing cycles" (see document TC/53/31 "Report", paragraphs 183 to 187).

8. The TC considered the presentations made by experts at the TWP sessions in 2016, simulating the impact of using different numbers of growing cycles on DUS decisions using actual data, as set out in the Annexes to document TC/53/21.

9. The TC noted the offers by members of the Union to make presentations to the TWPs, at their sessions in 2017, on the impact of using different numbers of growing cycles on DUS decisions using actual data and agreed to invite the TWPs to report to the TC, at its session in 2018.

10. The TC noted the expression of interest by Authorities to reduce the costs associated with DUS examination and agreed that the number of growing cycles for DUS examination should be the minimum necessary for a robust DUS decision and the establishment of a reliable variety description.

11. The TC agreed that it was not appropriate to generalize that ornamental varieties should be examined in a single growing trial while other types of crops should be examined in two growing cycles and agreed that the typical number of growing cycles should be established on a crop-by-crop basis.

PRESENTATIONS TO THE TWPS AT THEIR SESSIONS IN 2017

Technical Working Party for Agricultural Crops

12. The TWA, at its forty-sixth session, held in Hannover, Germany, June 19 to 23, 2017, considered documents TWP/1/21 "Number of growing cycles", TWA/46/8 and TWA/46/8 Add "Impact of using different numbers of growing cycles on DUS decisions using actual data" (see document TWA/46/10 "Report", paragraphs 36 to 41).

13. The TWA received the following presentations, as reproduced in documents TWA/46/8 and TWA/46/8 Add. :

| |
|---|
| (a) "Impact of number of growing cycles on variety descriptions and discrimination power in wheat and barley", prepared by an expert from Germany |
| (b) "Number of Growing Cycles in Potato", prepared by an expert from the Netherlands |
| (c) "Number of growing cycles in potato varieties - DUS examination of lightsprouts", prepared by an expert from Poland |

(d) "Number of growing cycles: the impact on cereal variety descriptions", prepared by an expert from the United Kingdom

14. The TWA agreed that discussions on the number of growing cycles in DUS examination for agricultural crops should continue and welcomed the offers by Australia, Denmark, France, Germany, the United Kingdom and ISF to make presentations at its forty-seventh session.

Technical Working Party on Fruit Crops

15. The TWF considered documents TWP/1/21 "Number of growing cycles" (see document TWF/48/13 "Report", paragraphs 81 to 84)

16. The TWF noted that the TC had agreed that it was not appropriate to generalize that ornamental varieties should be examined in a single growing trial while other types of crops should be examined in two growing cycles. It noted further that the TC had agreed that the typical number of growing cycles should be established on a crop-by-crop basis. However the TWF agreed to clarify to the TC that, in some cases in the fruit sector, the normal number of growing cycles needed to be established on variety-type by variety-type basis (for example rootstock varieties, male-female varieties).

Technical Working Party on Automation and Computer Programs

17. The TWC considered document TWP/1/21 "Number of growing cycles" (see document TWC/35/21 "Report", paragraphs 45 to 51).

18. The TWC considered document TWC/35/7 "Number of Growing Cycles in Potato" and received a presentation by an expert from the Netherlands containing the results of the simulation on the impact of using different numbers of growing cycles on DUS decisions using actual data for potato. A copy of the presentation is reproduced in the Annex to document TWC/35/7.

19. The TWC noted that the results demonstrated that from the 37 characteristics observed, 73% would have had the same score and 24% would have had differences of only one note between the first growing cycle and the note from the first and second growing cycles combined.

20. The TWC noted that the Netherlands was exploring the possibility of using molecular marker information to reduce the number of growing cycles for DUS examination of potato varieties.

PRESENTATIONS TO THE TWPS AT THEIR SESSIONS IN 2018

Technical Working Party for Agricultural Crops

21. The TWA, at its forty-seventh session, held in Naivasha Kenya from May 21 to 25, 2018, considered document TWA/47/5 "Impact of the number of growing cycles on variety descriptions and discrimination power in potato" and received a presentation by an expert from Germany, a copy of which would be provided as document TWA/47/5 Add. (see document TWA/47/7 "Report", paragraphs 35 to 38).

22. The TWA agreed that variety descriptions generated over two growing cycles were more robust than those generated over a single growing cycle. The TWA also agreed that two growing cycles allowed a more robust assessment of individual characteristics.

23. The TWA agreed that a robust decision on distinctness could be reached after a single growing cycle on the basis of a sufficiently large difference in characteristics.

24. The TWA noted that DNA-marker information could provide supporting information in the DUS examination, as set out in document TGP/15 "Guidance on the Use of Biochemical and Molecular Markers in the Examination of Distinctness, Uniformity and Stability (DUS)". The TWA noted the experience reported by the Netherlands that DNA-marker information was also used for enforcing plant breeders' rights in combination with side-by-side verification of conformity of plant material to a protected variety.

Technical Working Party on Automation and Computer Programs

25. The TWC considered documents TWC/36/6 and TWC/36/6 Add. “Impact of the number of growing cycles on variety descriptions and discrimination power” and received a presentation by an expert from Germany (see document TWC/36/15 “Report”, paragraphs 24 to 28).

26. The TWC welcomed the statistical analysis quantifying the genotype-by-environment interaction for descriptions generated over years.

27. The TWC agreed that variety descriptions generated over two growing cycles were more robust than those generated in one growing cycle only.

28. The TWC agreed that it should be clarified that documents TWC/36/6 and TWC/36/6 Add. analyzed differences in individual characteristics over cycles and did not assess differences of varieties over all characteristics.

29. The TWC noted the oral report by the Netherlands that a study was being conducted on the use of DNA-markers as supporting information for decisions on distinctness and the TWC agreed to invite the Netherlands to report their work in a future meeting.

*30. The TC is invited to note the discussions by the TWPs, at their sessions in 2017 and 2018, on the impact of using different numbers of growing cycles on DUS decisions using actual data.*

[Annexes follow]

ANNEXE I / ANNEX I / ANLAGE I / ANEXO I
[in English only / en anglais seulement / nur auf Englisch / solamente en inglés]

IMPACT OF NUMBER OF GROWING CYCLES ON VARIETY DESCRIPTIONS AND DISCRIMINATION POWER IN WHEAT AND BARLEY

Presentation by an expert from Germany at the forty-sixth session of the Technical Working Party for Agricultural Crops

Bundessortenamt

**UPOV TECHNICAL WORKING PARTY FOR AGRICULTURAL CROPS**
Forty-sixth Session, Hanover, Germany, June 19 to 23, 2017

## Impact of number of growing cycles on variety descriptions and discrimination power in wheat and barley

Beate Rücker, Germany

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1

Bundessortenamt

**Discrimination power of characteristics calculated in three steps**:

(a) '1 cycle': Comparison of all varieties in the growing trial (year 0)
(b) '2 cycles': For all varieties which were also grown in the year before, distinctness was assessed in both years (year 0 / -1). Two varieties are considered to be distinct if a clear difference in the same direction was observed in both years.
(c) '2 out of 3 cycles': For all varieties which were also grown the two previous years, distinctness was assessed in all 3 years (year 0 / -1 / -2). Two varieties are considered to be distinct if a clear difference in the same direction was observed in at least 2 out of 3 years

The same analysis was performed for 2014, 2015 and 2016.

2

Bundessortenamt

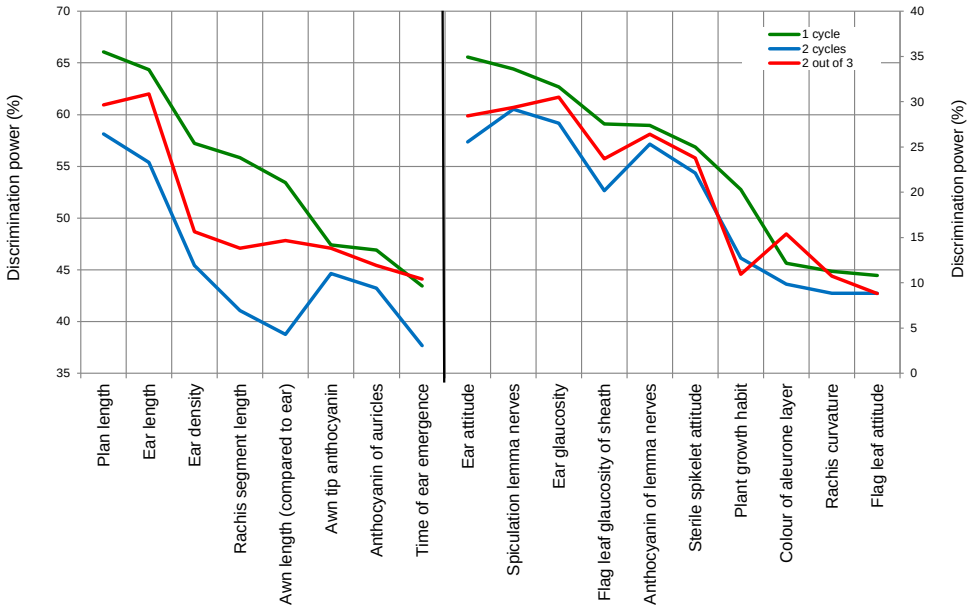
**Data for analysis of discrimination power from DUS growing trials:**

- Trials comprise about 600 varieties in winter wheat and 300 varieties in winter barley.
- Two year data are available for about 70% of the varieties and three year data for about 50% of the varieties.
- Every year, the distinctness test included
  - (a) 1-cycle-comparisons: 40,000 in wheat and 30,000 in barley
  - (b) 2-cycle-comparisons: 25,000 in wheat and 15,000 in barley
  - (c) 2 out of 3 comparisons: 15,000 in wheat and 6,000 in barley



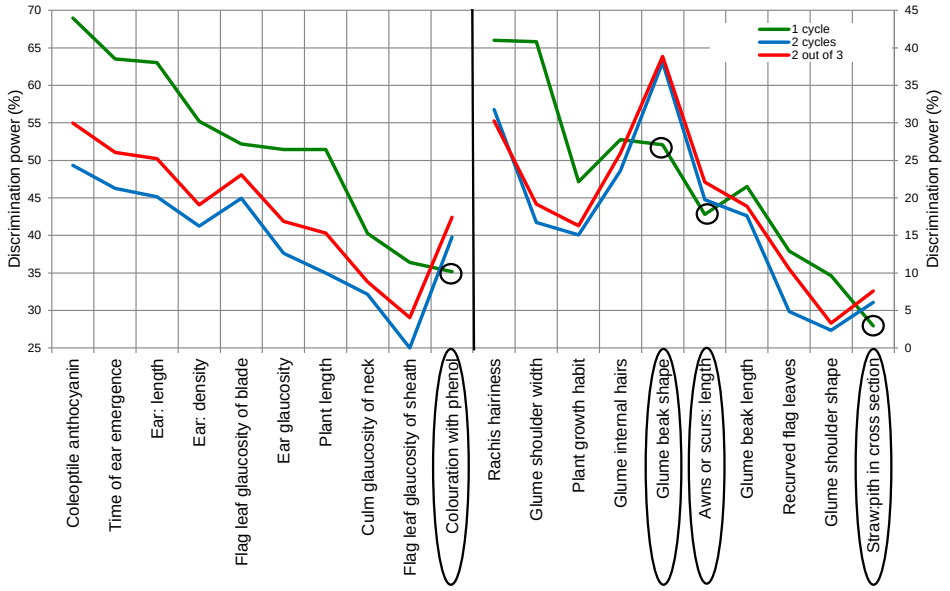
Bundessortenamt

Impact of the number of growing cycles on discrimination power – Barley



Bundessortenamt

Impact of the number of growing cycles on discrimination power – Wheat

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Bundessortenamt

**Data for analysis of variety descriptions:**

- DUS observations for 77 winter wheat varieties and 47 winter barley varieties in 6 successive growing cycles were used to establish
  - annual descriptions (year 0)
  - descriptions over 2 cycles (year 0 / -1)
  - descriptions over 3 cycles (year 0 / -1 / -2)

- The variation of descriptions over one, two and three cycles was calculated

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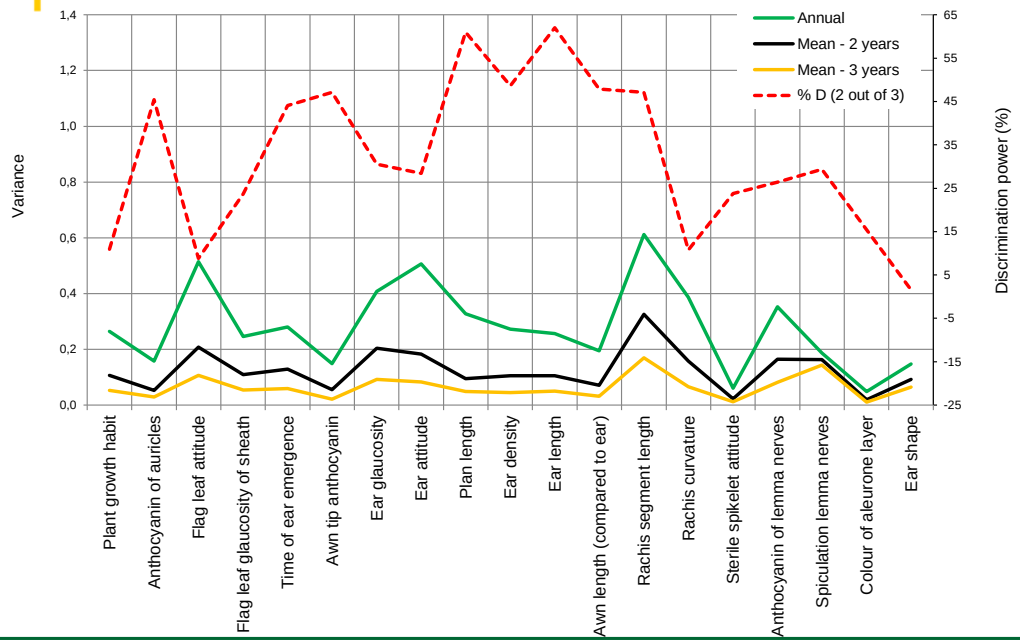
## Variance of variety descriptions over testing periods – Barley



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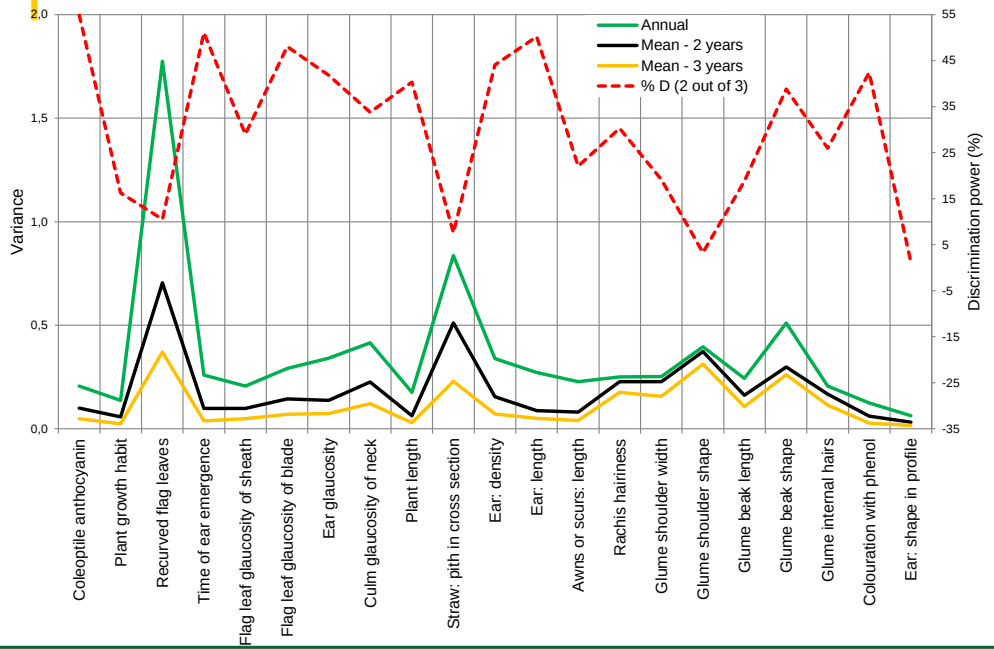
## Variance of variety descriptions over testing periods – Wheat



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**Conclusions:**

- number of growing cycles has significant impact on distinctness decisions and variety descriptions
- Current recommendation in TG Barley and TG Wheat is appropriate: “The minimum duration of test should normally be two independent growing cycles”.
- Minimum duration of test should be followed to establish
  - official variety description – precondition for enforcement
  - “working description” – precondition for management of reference collection, in particular when databases are used
- Descriptions in a database should be based at least on the recommended minimum number of growing cycles. Any additional cycle can improve the quality of the description

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Bundessortenamt


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[L’annexe II suit /
Annex II follows /
Anlage II folgt /
Sigue el Anexo II]

ANNEXE II / ANNEX II / ANLAGE II / ANEXO II
[in English only / en anglais seulement / nur auf Englisch / solamente en inglés]

NUMBER OF GROWING CYCLES: THE IMPACT ON CEREAL VARIETY DESCRIPTIONS

Presentation by an expert from United Kingdom at the forty-sixth session of the Technical Working Party for Agricultural Crops

NIAB TAG

# Number of growing cycles:
## the impact on cereal variety descriptions

Presentation to UPOV TWA June 2017

NIAB TAG

## Summary

- Background
- Examples
  - Barley
  - Wheat
- Do all varieties react the same?
- Summary of observations

| UPOV No. | Characteristic | 2015 Note | 2016 Note |
|---|---|---|---|
| 1 | PLANT: GROWTH HABIT | 5 | 6 |
| 2 | LOWER LEAVES: HAIRINESS OF LEAF SHEATHS | 1 | 1 |
| 4 | FLAG LEAF: INTENSITY OF ANTH. COLOUR. OF AURICLES | 6 | 7 |
| | FLAG LEAF: ATTITUDE | 4 | 5 |
| 6 | FLAG LEAF: GLAUCOSITY OF SHEATH | 6 | 7 |
| 7 | TIME OF EAR EMERGENCE (1st spk. vis. on 50% ears) | 6 | 5 |
| 9 | AWNS: INTENSITY OF ANTHOCYANIN COLOUR. OF TIPS | 5 | 6 |
| 10 | EAR: GLAUCOSITY | 5 | 6 |
| 11 | EAR: ATTITUDE | 2 | 2 |
| 12 | PLANT: LENGTH (stem, ears and awns) | 4 | 4 |
| 13 | EAR: NUMBER OF ROWS | 1 | 1 |
| 14 | EAR: SHAPE | 3 | 3 |
| 15 | EAR: DENSITY | 4 | 4 |
| 16 | EAR: LENGTH (excluding awns) | 4 | 5 |
| 17 | AWN: LENGTH (compared to ear) | 7 | 7 |
| 18 | RACHIS: LENGTH OF FIRST SEGMENT | 4 | 4 |
| 19 | RACHIS: CURVATURE OF FIRST SEGMENT | 5 | 3 |
| | EAR: DEVELOPMENT OF STERILE SPIKELETS | 1 | 1 |
| 20 | STERILE SPIKELET: ATTITUDE (in mid-third of ear) | n/a | n/a |
| 21 | MEDIAN SPIKELET: LENGTH OF GLUME+AWN cf GRAIN | 2 | 2 |
| 22 | GRAIN: RACHILLA HAIR TYPE | 1 | 1 |
| 23 | GRAIN: HUSK | 9 | 9 |
| 24 | GRAIN: ANTHOCYANIN COLOURATION OF NERVES OF LEMMA | 6 | 4 |
| 25 | GRAIN: SPICULATION OF INNER LATERAL NERVES OF DORSAL | 1 | 1 |
| 26 | GRAIN: HAIRINESS OF VENTRAL FURROW | 1 | 1 |
| 27 | GRAIN: DISPOSITION OF LODICULES | 2 | 2 |
| 28 | KERNEL: COLOUR OF ALEURONE LAYER | 1 | |
| 29 | SEASONAL TYPE | 3 | |

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## Example: barley variety

**Key:**

- 2 notes difference between years
- 1 note difference between years

| UPOV No. | Characteristic | 2015 Note | 2016 Note |
|---|---|---|---|
| 1 | COLEOPTILE: ANTHOCYANIN COLOURATION | 3 | - |
| 2 | PLANT: GROWTH HABIT | 6 | 5 |
| 4 | PLANT: FREQ. OF PLANTS WITH RECURVED FLAG LEAVES | 1 | 1 |
| 5 | TIME OF EAR EMERGENCE (first spkt visible on 50% of ears) | 8 | 7 |
| 6 | FLAG LEAF: GLAUCOSITY OF SHEATH | 6 | 7 |
| | FLAG LEAF: GLAUCOSITY OF BLADE (lower side) | 5 | 6 |
| 7 | EAR: GLAUCOSITY | 6 | 6 |
| 8 | CULM: GLAUCOSITY OF NECK | 6 | 6 |
| 9 | PLANT: LENGTH (stem, ears, awns and scurs) | 2 | 3 |
| 10 | STRAW: PITH IN CROSS SECTION | 1 | 1 |
| 11 | EAR: SHAPE IN PROFILE | 2 | 2 |
| 12 | EAR: DENSITY | 6 | 6 |
| 13 | EAR: LENGTH (excluding awns and scurs) | 4 | 5 |
| 14 | AWNS OR SCURS: PRESENCE | 2 | 2 |
| 15 | AWNS OR SCURS AT TIP OF EAR: LENGTH | 9 | 9 |
| 16 | EAR: COLOUR | 1 | 1 |
| 17 | APICAL RACHIS SEGMENT: HAIRINESS OF CONVEX SURFACE | 4 | 4 |
| 18 | LOWER GLUME: SHOULDER WIDTH | 3 | 3 |
| 19 | LOWER GLUME: SHOULDER SHAPE | 6 | 6 |
| 20 | LOWER GLUME: BEAK LENGTH | 5 | 5 |
| 21 | LOWER GLUME: BEAK SHAPE | 4 | 4 |
| 22 | LOWER GLUME: EXTENT OF INTERNAL HAIRS | 4 | 3 |
| 24 | GRAIN: COLOUR | 2 | - |
| 25 | GRAIN: COLOURATION WITH PHENOL | 6 | - |
| 26 | SEASONAL TYPE | 1 | 1 |

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## Example: wheat variety

**Key:**

- 2 notes difference between years
- 1 note difference between years

| UPOV No. | Characteristic | 2015 Note | 2016 Note | 2015 Note | 2016 Note |
|---|---|---|---|---|---|
| | | Variety A | | Variety B | |
| 1 | COLEOPTILE: ANTHOCYANIN COLOURATION | 2 | | 3 | |
| 2 | PLANT: GROWTH HABIT | 4 | 5 | 5 | 5 |
| 4 | PLANT: FREQ. OF PLANTS WITH RECURVED FLAG LEAVES | 5 | 5 | 7 | 5 |
| 5 | TIME OF EAR EMERGENCE | 3 | 5 | 8 | 8 |
| 6 | FLAG LEAF: GLAUCOSITY OF SHEATH | 5 | 7 | 8 | 8 |
| | FLAG LEAF: GLAUCOSITY OF BLADE (lower side) | 5 | 5 | 9 | 7 |
| 7 | EAR: GLAUCOSITY | 5 | 6 | 8 | 6 |
| 8 | CULM: GLAUCOSITY OF NECK | 5 | 7 | 8 | 7 |
| 9 | PLANT: LENGTH (stem, ears, awns and scurs) | 9 | 7 | 2 | 3 |
| 10 | STRAW: PITH IN CROSS SECTION | 1 | 1 | 2 | 2 |
| 11 | EAR: SHAPE IN PROFILE | 1 | 1 | 2 | 2 |
| 12 | EAR: DENSITY | 3 | 3 | 4 | 3 |
| 13 | EAR: LENGTH (excluding awns and scurs) | 6 | 5 | 4 | 4 |
| 14 | AWNS OR SCURS: PRESENCE | 2 | 2 | 2 | 2 |
| 15 | AWNS OR SCURS AT TIP OF EAR: LENGTH | 9 | 8 | 7 | 7 |
| 16 | EAR: COLOUR | 1 | 1 | 1 | 1 |
| 17 | APICAL RACHIS SEGMENT: HAIRINESS OF CONVEX SURFACE | 6 | 6 | 7 | 7 |
| 18 | LOWER GLUME: SHOULDER WIDTH | 3 | 3 | 5 | 5 |
| 19 | LOWER GLUME: SHOULDER SHAPE | 7 | 6 | 4 | 5 |
| 20 | LOWER GLUME: BEAK LENGTH | 5 | 5 | 4 | 4 |
| 21 | LOWER GLUME: BEAK SHAPE | 3 | 3 | 3 | 3 |
| 22 | LOWER GLUME: EXTENT OF INTERNAL HAIRS | 7 | 7 | 7 | 7 |
| 24 | GRAIN: COLOUR | 2 | | 2 | |
| 25 | GRAIN: COLOURATION WITH PHENOL | 7 | | 7 | |
| 26 | SEASONAL TYPE | 3 | 3 | 3 | 3 |

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Do all varieties react the same way to environmental changes?

Key:

2 notes difference between years

1 note difference between years

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# Summary of observations

- The state of expression can be variable over two years
- Quantitative characteristics are more variable
- Some QN characteristics are more variable than others
- Change in the environment does not affect all varieties the same way

**Two growing cycles produce more robust variety descriptions**

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ANNEXE III / ANNEX III / ANLAGE III / ANEXO III
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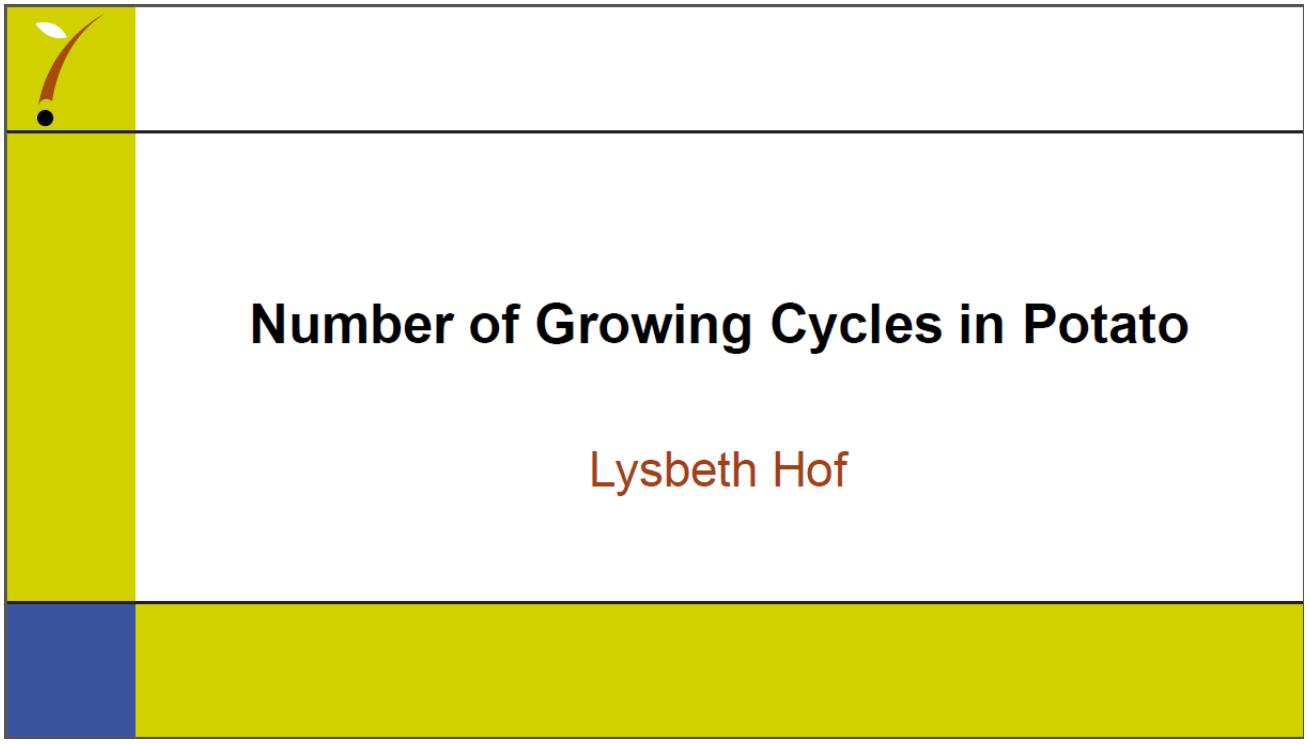
NUMBER OF GROWING CYCLES IN POTATO

Presentation by an expert from Netherlands at the forty-sixth session of the Technical Working Party for Agricultural Crops and at the thirty-fifth session of the Technical Working Party on Automation and Computer Programs

# Introduction

- Question: Is it possible to reduce the number of growing cycles in potato to 1 without loss of quality?

  – Effect on variety description
  – Other practical issues

# Effect on Variety Description

- Comparison of description after 1 cycle with description after 2 cycles
- All new applications in period 2013-2016
- All observations by 1 person
- Observations in 2nd year independent of 1st year
- All withdrawn applications deleted
- End total of 117 varieties

# Effect on Variety Description

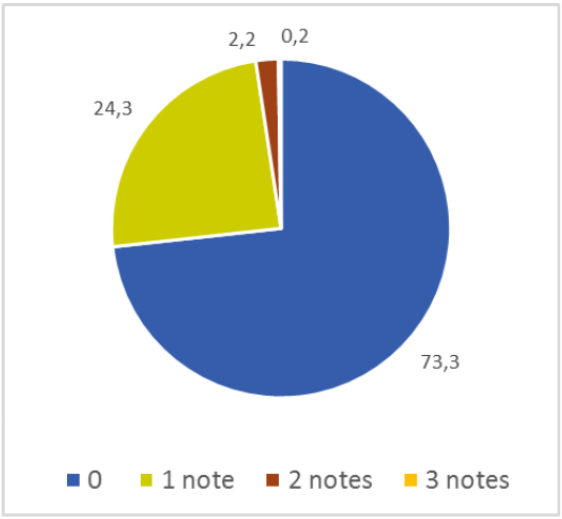
- Descriptions according to CPVO TP/23/2 (similar to UPOV TG/23/6, minus 5 characteristics)
- 37 char. (33 QN and 4 PQ)
- Nr observations per variety can be smaller than 37:
  - Char 29 and 30 only observed if flowers not white
  - Char 37 only observed if tuber is yellow

5

# QN characteristics

Difference between scores after 1st cycle and final scores.
(QN char. only, 3673 obs., 117 var.)

| Difference between 1st – final score | number of observations | % |
|---|---|---|
| 0 | 2691 | 73,3 |
| 1 note | 894 | 24,3 |
| 2 notes | 79 | 2,2 |
| 3 notes | 9 | 0,2 |
| | 3673 | |

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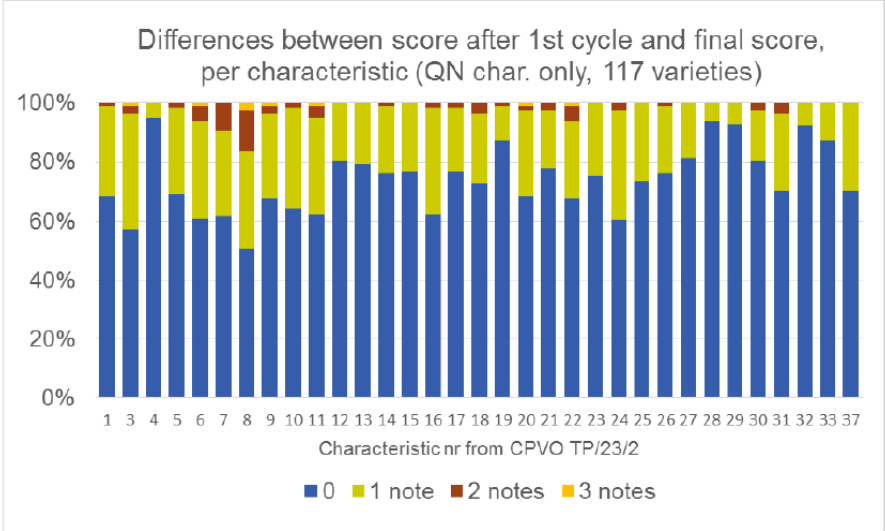
# QN characteristics

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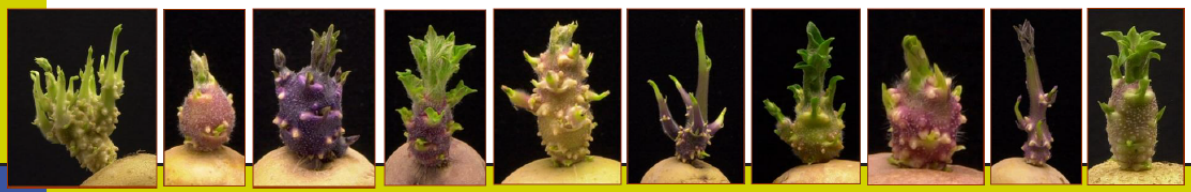
# QN characteristics

- Char. 4 (colour of base of lightsprout), 28 (flower colour intensity) and 29 (flower colour) are very stable
- Char 8 (colour of tip of lightsprout) is less stable



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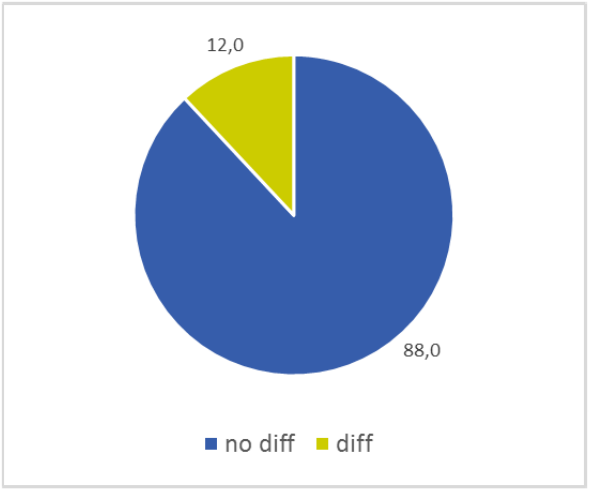
# PQ characteristics

Difference between scores after 1st cycle and final scores. (PQ char. only, 468 obs., 117 var.)

| Difference between 1st – final score | number of observations | % |
|---|---|---|
| No difference | 412 | 88,0 |
| Difference | 46 | 12,0 |
| | 468 | |

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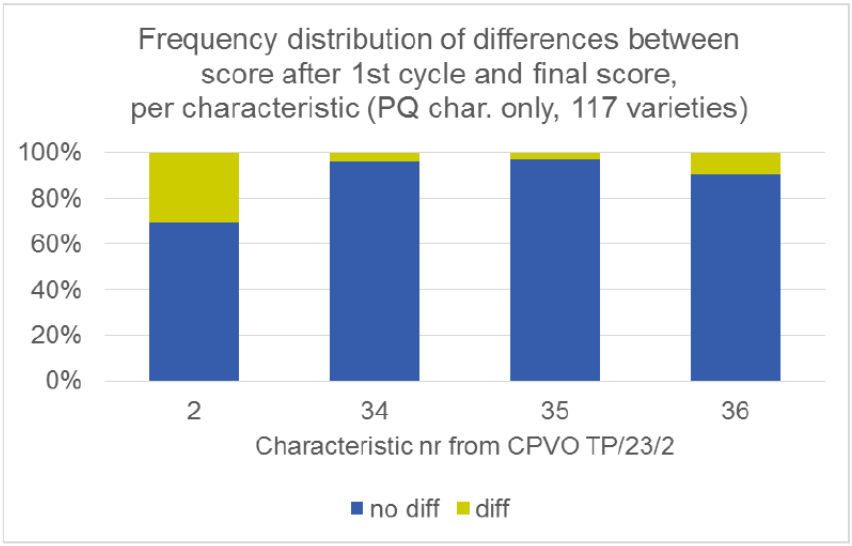
# PQ characteristics

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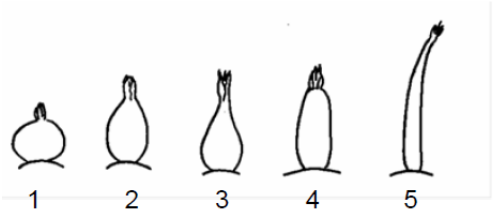
# PQ characteristics

- Char. 34 (Tuber skin colour), and 35 (Tuber base of eye colour) are very stable
- Char 2 (Shape of lightsprout) is less stable

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# Effect on Variety Description

- Variety descriptions of potato are slightly adjusted when a second testing year is added
- But how significant/important are those adjustments?

12

# Variety Descriptions across Europe

In 2005, a ringtest for potato was carried out in Europe:

- 12 varieties
- 12 countries
- Plant material (tubers) of same origin

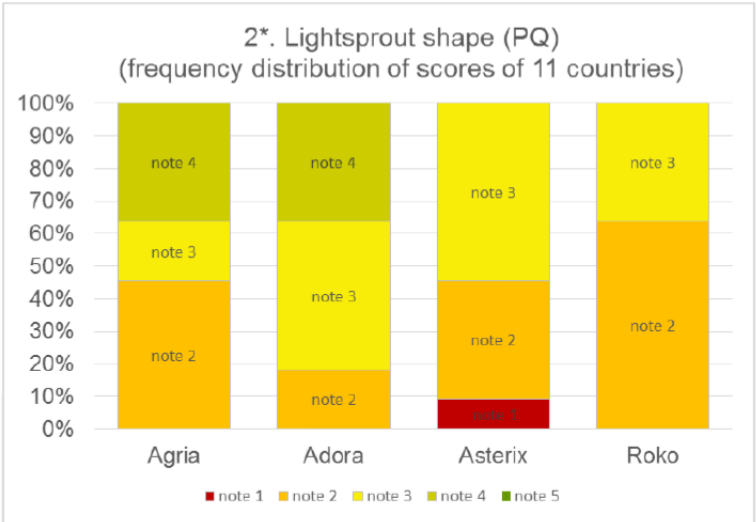
- Main sources of variation in observations:
  - Location (weather, soil, nutrition etc.)
  - Observer
  - Interactions

13

# Variety Descriptions across Europe

Legend:
note 5 = narrow cylindrical
note 4 = broad cylindrical
note 3 = conical
note 2 = ovoid
note 1 = spherical

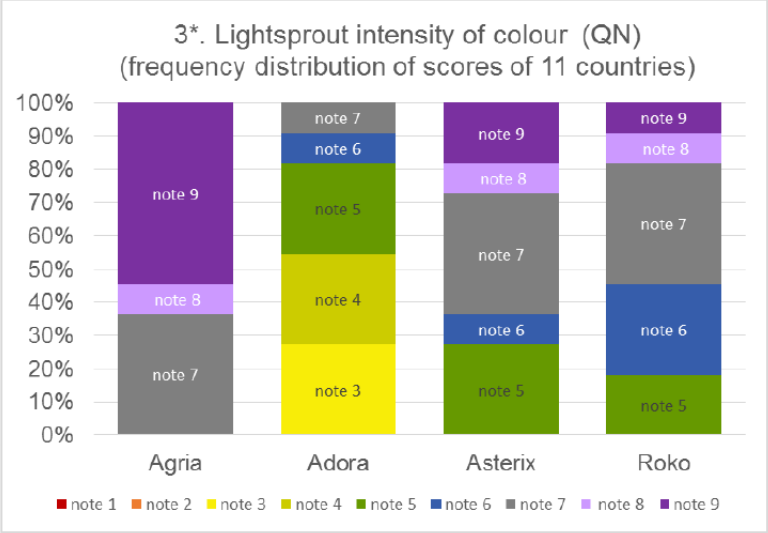
1 2 3 4 5




14

# Variety descriptions across Europe

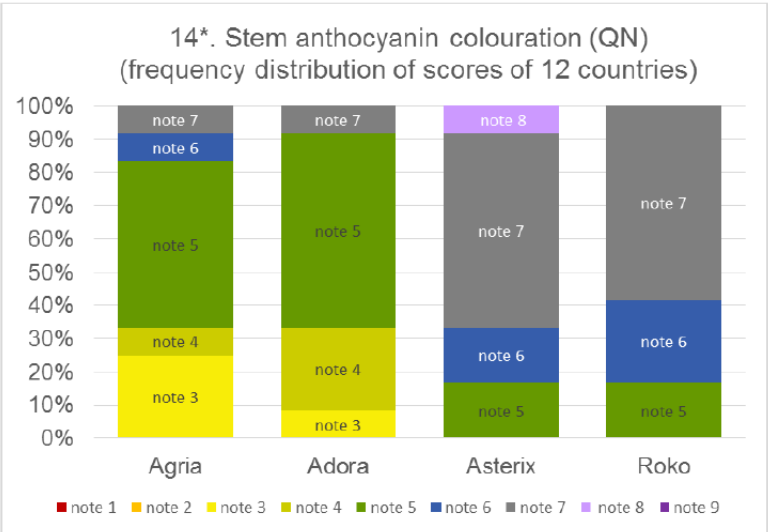
Legend
note 9 = very strong
note 1 = absent or
very weak




15

# Variety Descriptions across Europe

Legend
note 9 = very strong
note 1 = absent or
very weak

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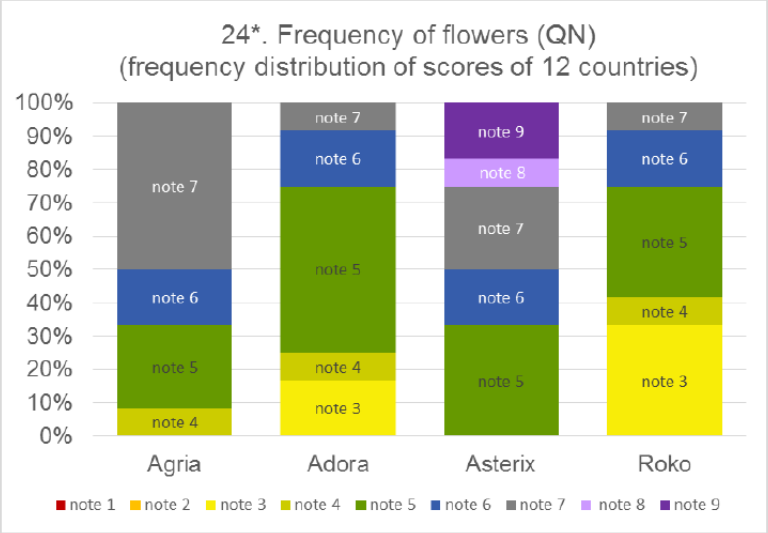
# Variety Descriptions across Europe

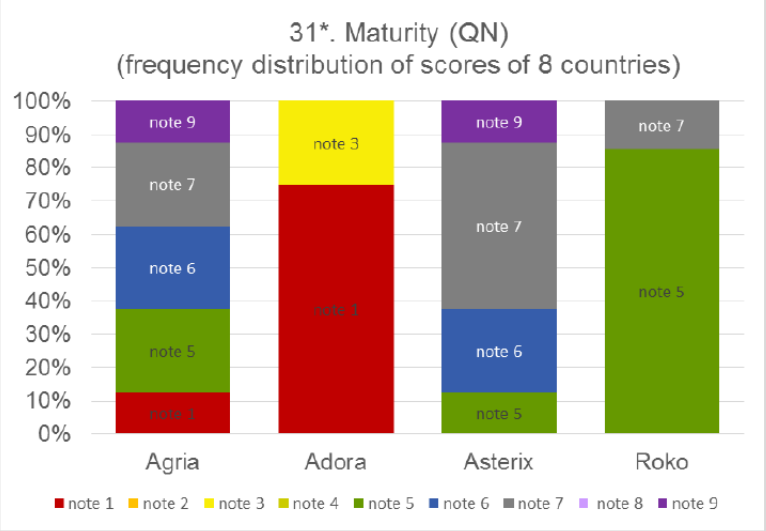
Legend
note 9 = very high
note 1 = absent or very low




17

# Variety Descriptions across Europe

Legend
note 9 = very late
note 1 = very early

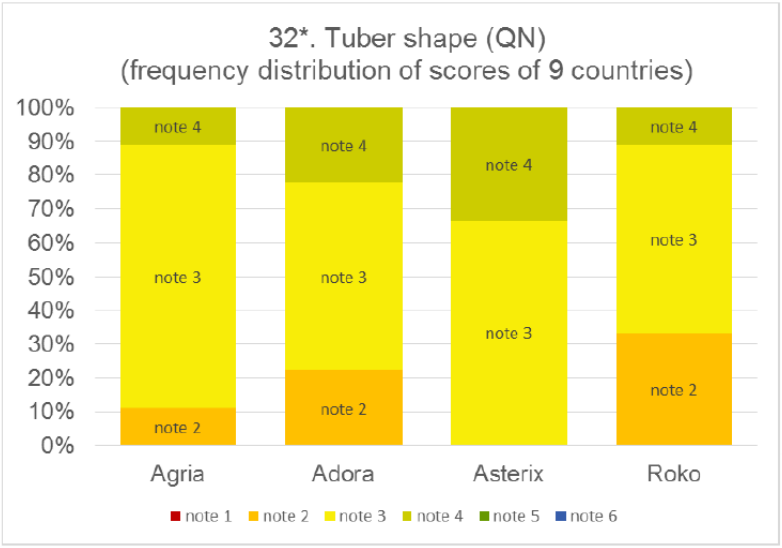



18

# Variety Descriptions across Europe

Legend
note 6 = very long
note 1 = round

1 2 3 4 5 6

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# Effect on Variety Descriptions

**Conclusions:**

- Variety descriptions are very variable across Europe, especially for some characteristics
- In NL variety descriptions were relatively stable between both testing years:
  - the second year did not add much more information to the variety description
  - no effect on distinctness decision

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## From 2 cycles to 1?

- Question: Is it possible to reduce the number of growing cycles in potato to 1 without loss of quality?
  - Effect on variety description
  - Other practical issues

## Current situation

- All new varieties are tested against morph. database(s) as well as DNA database
- DNA is very useful for selecting genetically close varieties (> 85% Jaccard similarity)
- DNA is very useful as supporting evidence with DUS
- DNA helps finding anomalies fast (wrong sample, mixtures)
- Distinctness and uniformity are rarely a problem in potato

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## Database morphological char.

- NL database with variety descriptions
- As of 2018: European Common Database with potato descriptions since 2013 of all CPVO entrusted E.O.'s. Only 17 most stable characteristics.

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## Database DNA

In addition: DNA database. In NL part of DUS since 2009.

- Currently ≈ 2000 varieties, mainly from Europe
  As of 2017 including all available varieties of Common Catalogue
- 9 SSR markers (≈ 115 alleles in total)
- Jaccard similarity < 85% = clear genetic difference (based on research evidence)
- DNA data will be included in European Common Database (morph. char/DNA/lightsprout pictures)

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# Time line DUS potato in NL

| activity | year 1 | | | | | | | | | | | | year 2 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D |
| subm. tubers | | | | | | | | | | | | | | | | | | | | | | | | |
| DNA | | | | | | | | | | | | | | | | | | | | | | | | |
| lightsprouts | | | | | | | | | | | | | | | | | | | | | | | | |
| field | | | | | | | | | | | | | | | | | | | | | | | | |
| data + report | | | | | | | | | | | | | | | | | | | | | | | | |
| subm. tubers | | | | | | | | | | | | | | | | | | | | | | | | |
| (DNA) | | | | | | | | | | | | | | | | | | | | | | | | |
| lightsprouts | | | | | | | | | | | | | | | | | | | | | | | | |
| field | | | | | | | | | | | | | | | | | | | | | | | | |
| data + report | | | | | | | | | | | | | | | | | | | | | | | | |

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# Practical problems with 1 cycle

- Time schedule: DNA results in March. Field trials already prepared (pre-sprouting of tubers). No changes possible with regard to reference varieties. DNA results currently used for 2nd cycle.
- Some varieties do not (or hardly) flower. Currently extra test in 2nd cycle: cultivation on stone

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## Practical problems with 1 cycle?

**Solutions:**

- Shift submission of tubers to Jan 1st (or 15th at the latest)
- Shift DNA test to end of January (results available before planning of trial)
- Put all low frequency flowering varieties in flowering test (based on TQ data) or shift this test to summer/fall

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## Number of growing cycles in potato?

**Conclusion:**

- **Q:** can we reduce the number of growing cycles for DUS in potato to 1 without loss of quality?
- **A:** Yes for the majority of varieties, provided that time schedules can be adjusted.

- In case of doubt, add 2nd cycle.

- N.B. VCU will remain 2 yrs!

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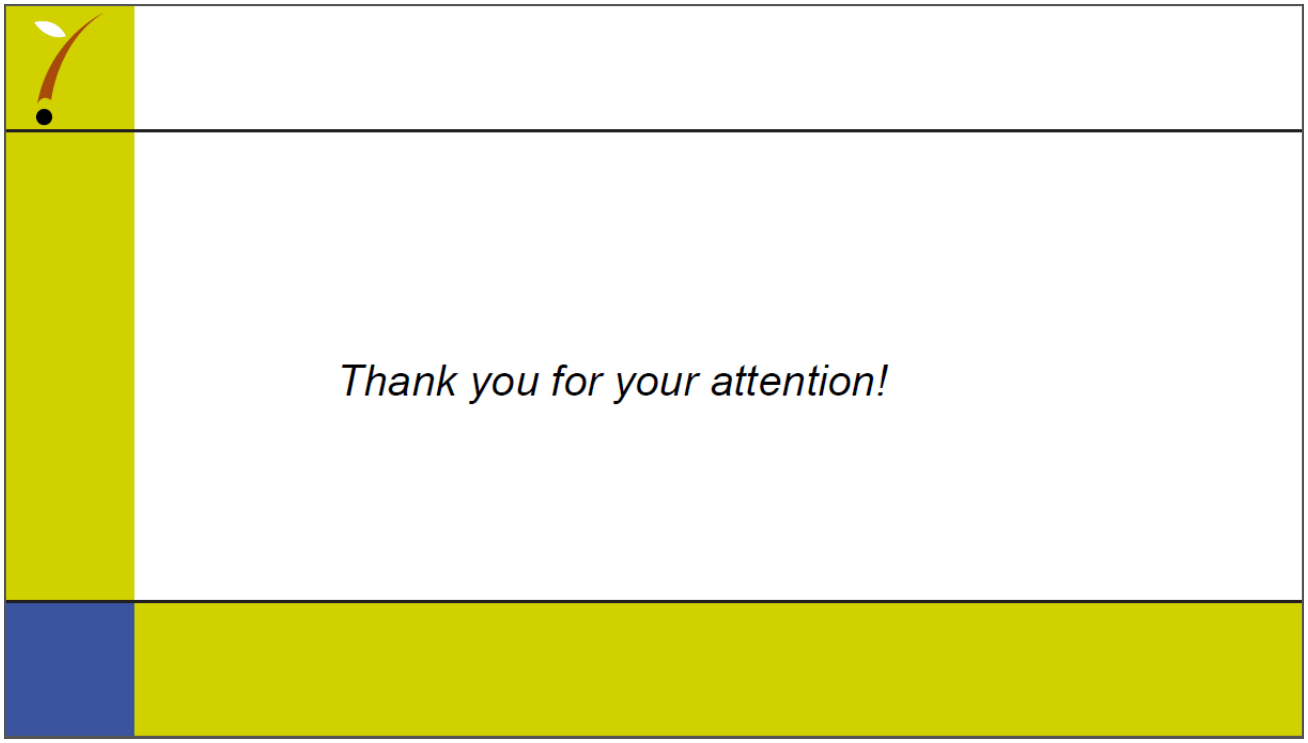
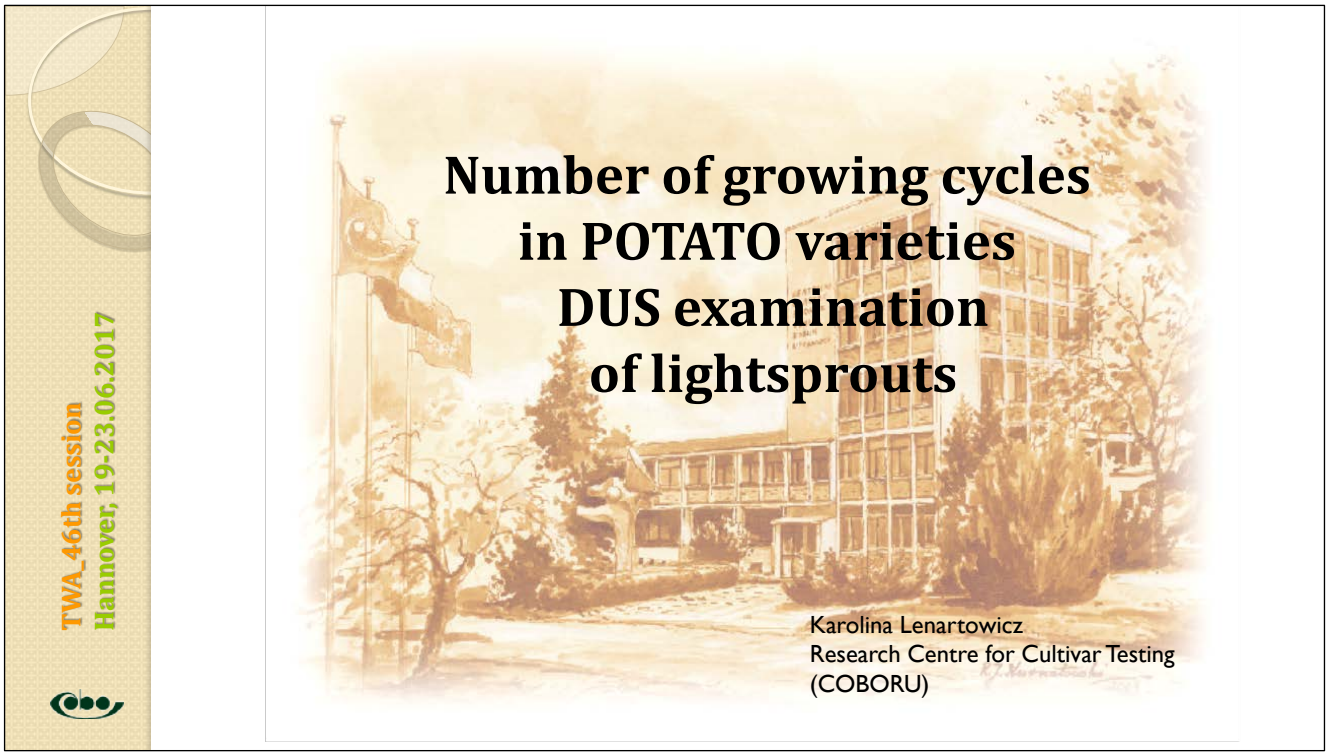


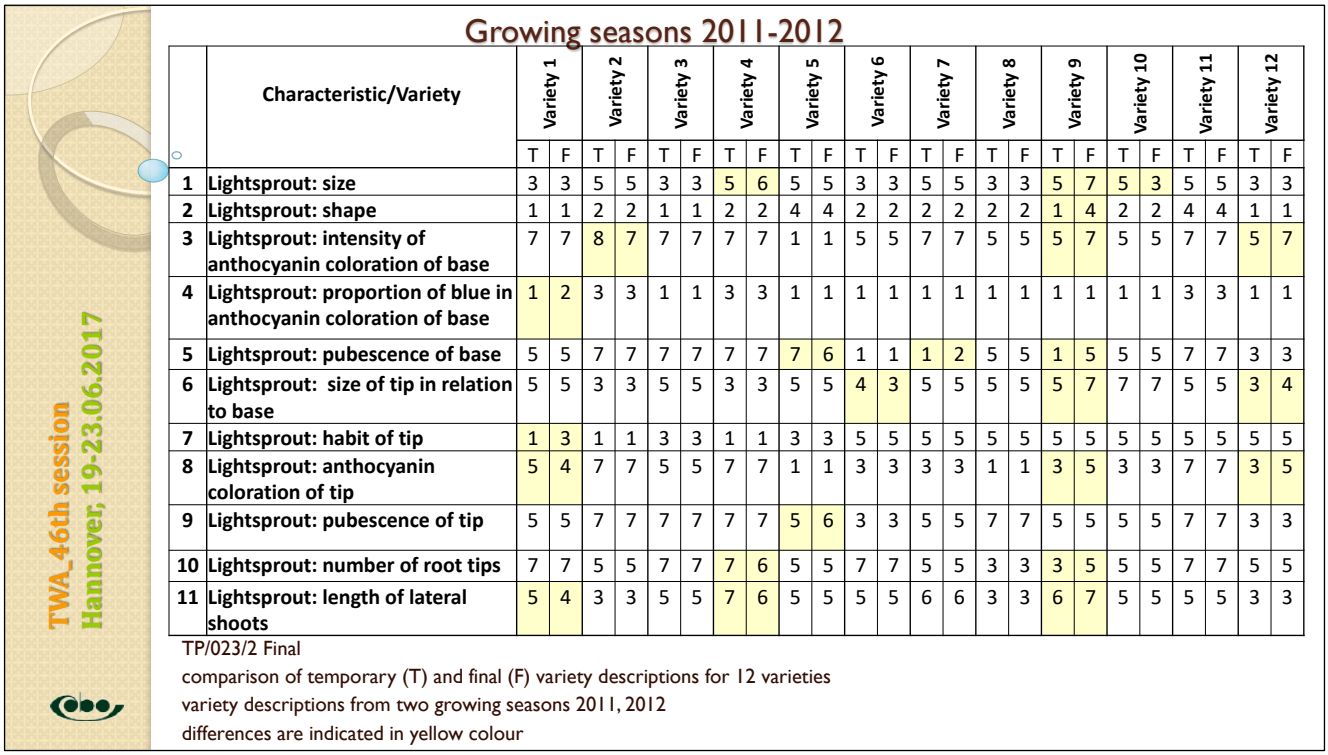

[L'annexe IV suit /
Annex IV follows /
Anlage IV folgt /
Sigue el Anexo IV]

ANNEXE IV / ANNEX IV / ANLAGE IV / ANEXO IV
[in English only / en anglais seulement / nur auf Englisch / solamente en inglés]

NUMBER OF GROWING CYCLES IN POTATO VARIETIES – DUS EXAMINATION OF LIGHTSPROUTS

Presentation by an expert from Poland at the forty-sixth session of the Technical Working Party for Agricultural Crops




Growing seasons 2011-2012

| | Characteristic/Variety | Variety 1 | | Variety 2 | | Variety 3 | | Variety 4 | | Variety 5 | | Variety 6 | | Variety 7 | | Variety 8 | | Variety 9 | | Variety 10 | | Variety 11 | | Variety 12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | T | F | T | F | T | F | T | F | T | F | T | F | T | F | T | F | T | F | T | F | T | F | T | F |
| 1 | Lightsprout: size | 3 | 3 | 5 | 5 | 3 | 3 | 5 | 6 | 5 | 5 | 3 | 3 | 5 | 5 | 3 | 3 | 5 | 7 | 5 | 3 | 5 | 5 | 3 | 3 |
| 2 | Lightsprout: shape | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 4 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 4 | 2 | 2 | 4 | 4 | 1 | 1 |
| 3 | Lightsprout: intensity of anthocyanin coloration of base | 7 | 7 | 8 | 7 | 7 | 7 | 7 | 7 | 1 | 1 | 5 | 5 | 7 | 7 | 5 | 5 | 5 | 7 | 5 | 5 | 7 | 7 | 5 | 7 |
| 4 | Lightsprout: proportion of blue in anthocyanin coloration of base | 1 | 2 | 3 | 3 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 1 | 1 |
| 5 | Lightsprout: pubescence of base | 5 | 5 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 1 | 1 | 1 | 2 | 5 | 5 | 1 | 5 | 5 | 5 | 7 | 7 | 3 | 3 |
| 6 | Lightsprout: size of tip in relation to base | 5 | 5 | 3 | 3 | 5 | 5 | 3 | 3 | 5 | 5 | 4 | 3 | 5 | 5 | 5 | 5 | 5 | 7 | 7 | 7 | 5 | 5 | 3 | 4 |
| 7 | Lightsprout: habit of tip | 1 | 3 | 1 | 1 | 3 | 3 | 1 | 1 | 3 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 8 | Lightsprout: anthocyanin coloration of tip | 5 | 4 | 7 | 7 | 5 | 5 | 7 | 7 | 1 | 1 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 5 | 3 | 3 | 7 | 7 | 3 | 5 |
| 9 | Lightsprout: pubescence of tip | 5 | 5 | 7 | 7 | 7 | 7 | 7 | 7 | 5 | 6 | 3 | 3 | 5 | 5 | 7 | 7 | 5 | 5 | 5 | 5 | 7 | 7 | 3 | 3 |
| 10 | Lightsprout: number of root tips | 7 | 7 | 5 | 5 | 7 | 7 | 7 | 6 | 5 | 5 | 7 | 7 | 5 | 5 | 3 | 3 | 3 | 5 | 5 | 5 | 7 | 7 | 5 | 5 |
| 11 | Lightsprout: length of lateral shoots | 5 | 4 | 3 | 3 | 5 | 5 | 7 | 6 | 5 | 5 | 5 | 5 | 6 | 6 | 3 | 3 | 6 | 7 | 5 | 5 | 5 | 5 | 3 | 3 |

TP/023/2 Final
comparison of temporary (T) and final (F) variety descriptions for 12 varieties
variety descriptions from two growing seasons 2011, 2012
differences are indicated in yellow colour

TWA_46th session
Hannover, 19-23.06.2017

## Growing seasons 2012-2013-2014

| | Characteristic/Variety | Variety 1 | | | Variety 2 | | | Variety 3 | | | Variety 4 | | | Variety 5 | | | Variety 6 | | Variety 7 | | Variety 8 | | Variety 9 | | | Variety 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | T | F | 3 | T | F | 3 | T | F | 3 | T | F | 3 | T | F | 3 | T | F | T | F | T | F | T | F | 3 | T | F |
| 1 | Lightsprout: size | 3 | 5 | 5 | 3 | 3 | 3 | 5 | 7 | 7 | 5 | 7 | 7 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 3 | 3 | 5 | 5 | 3 | 5 |
| 2 | Lightsprout: shape | 1 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 4 | 2 | 2 | 2 | 2 | 2 | 4 | 4 | 2 | 4 | 2 | 2 | 1 | 2 | 2 | 2 | 4 |
| 3 | Lightsprout: intensity of anthocyanin coloration of base | 5 | 7 | 7 | 1 | 1 | 1 | 5 | 5 | 5 | 5 | 5 | 5 | 1 | 7 | 7 | 1 | 1 | 7 | 7 | 6 | 6 | 1 | 1 | 1 | 7 | 9 |
| 4 | Lightsprout: proportion of blue in anthocyanin coloration of base | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 3 | 3 |
| 5 | Lightsprout: pubescence of base | 6 | 7 | 7 | 3 | 3 | 3 | 5 | 5 | 5 | 5 | 7 | 7 | 3 | 5 | 5 | 7 | 7 | 3 | 4 | 1 | 1 | 5 | 3 | 3 | 5 | 7 |
| 6 | Lightsprout: size of tip in relation to base | 5 | 5 | 5 | 3 | 3 | 3 | 3 | 4 | 4 | 5 | 7 | 7 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 |
| 7 | Lightsprout: habit of tip | 3 | 5 | 5 | 3 | 3 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 3 | 5 | 5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 5 |
| 8 | Lightsprout: anthocyanin coloration of tip | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 1 | 1 | 3 | 1 | 1 | 3 | 4 | 4 | 3 | 3 | 3 | 1 | 7 | 7 | 1 | 1 | 1 | 7 | 7 |
| 9 | Lightsprout: pubescence of tip | 5 | 5 | 5 | 3 | 3 | 3 | 5 | 3 | 3 | 5 | 5 | 5 | 7 | 5 | 5 | 7 | 7 | 4 | 5 | 3 | 3 | 3 | 3 | 3 | 7 | 7 |
| 10 | Lightsprout: number of root tips | 6 | 7 | 7 | 7 | 7 | 7 | 5 | 5 | 5 | 5 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 5 | 5 | 7 | 7 | 7 | 5 | 7 |
| 11 | Lightsprout: length of lateral shoots | 5 | 5 | 5 | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 7 | 7 | 7 | 5 | 5 | 3 | 3 | 5 | 5 | 3 | 3 | 5 | 5 | 5 | 5 | 5 |

TP/023/2 Final

comparison of temporary (T) and final (F) variety descriptions for 10 varieties

variety descriptions from two growing seasons 2012, 2013 and for some varieties additional (3) growing season 2014

differences are indicated in yellow colour

differences between 2012 a 2013 result from a change of the conditions in the growing chamber (light, temperature), for comparision added some variety descriptions from 2014

TWA_46th session
Hannover, 19-23.06.2017

## Growing seasons 2013-2014

| | Characteristic/Variety | Variety 1 | | Variety 2 | | Variety 3 | | Variety 4 | | Variety 5 | | Variety 6 | | Variety 7 | | Variety 8 | | Variety 9 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | T | F | T | F | T | F | T | F | T | F | T | F | T | F | T | F | T | F |
| 1 | Lightsprout: size | 6 | 6 | 7 | 7 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 5 | 5 |
| 2 | Lightsprout: shape | 2 | 2 | 5 | 5 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 |
| 3 | Lightsprout: intensity of anthocyanin coloration of base | 3 | 3 | 1 | 1 | 4 | 4 | 7 | 7 | 3 | 3 | 9 | 9 | 7 | 7 | 1 | 1 | 9 | 9 |
| 4 | Lightsprout: proport12ion of blue in anthocyanin coloration of base | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 2 |
| 5 | Lightsprout: pubescence of base | 3 | 3 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 5 | 5 | 5 | 5 | 7 | 7 | 7 | 7 |
| 6 | Lightsprout: size of tip in relation to base | 5 | 5 | 7 | 7 | 5 | 5 | 7 | 7 | 5 | 5 | 3 | 3 | 5 | 5 | 7 | 7 | 3 | 3 |
| 7 | Lightsprout: habit of tip | 5 | 5 | 3 | 3 | 5 | 5 | 5 | 5 | 3 | 3 | 1 | 1 | 3 | 3 | 5 | 5 | 1 | 1 |
| 8 | Lightsprout: anthocyanin coloration of tip | 1 | 1 | 1 | 1 | 4 | 4 | 3 | 3 | 1 | 1 | 7 | 7 | 5 | 5 | 1 | 1 | 5 | 5 |
| 9 | Lightsprout: pubescence of tip | 3 | 3 | 1 | 1 | 5 | 5 | 4 | 4 | 1 | 1 | 6 | 6 | 5 | 5 | 9 | 9 | 5 | 5 |
| 10 | Lightsprout: number of root tips | 4 | 4 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| 11 | Lightsprout: length of lateral shoots | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 5 | 5 | 3 | 3 | 5 | 5 | 6 | 6 | 5 | 5 |

TP/023/2 Final

comparison of temporary (T) and final (F)variety descriptions for 9 varieties

variety descriptions from two growing seasons 2013, 2014

differences are indicated in yellow colour

no differences – 2013-2014

TWA_46th session Hannover, 19-23.06.2017

## Growing seasons 2014-2015

| | Characteristic/Variety | Variety 1 | | Variety 2 | | Variety 3 | | Variety 4 | | Variety 5 | | Variety 6 | | Variety 7 | | Variety 8 | | Variety 9 | | Variety 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | T | F | T | F | T | F | T | F | T | F | T | F | T | F | T | F | T | F | T | F |
| 1 | Lightsprout: size | 5 | 5 | 5 | 5 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 7 | 7 |
| 2 | Lightsprout: shape | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 |
| 3 | Lightsprout: intensity of anthocyanin coloration of base | 5 | 5 | 7 | 7 | 4 | 4 | 9 | 9 | 5 | 5 | 7 | 7 | 7 | 7 | 3 | 3 | 1 | 1 | 1 | 1 |
| 4 | Lightsprout: proportion of blue in anthocyanin coloration of base | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5 | Lightsprout: pubescence of base | 3 | 3 | 3 | 3 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 7 | 7 | 5 | 5 | 1 | 1 | 5 | 5 |
| 6 | Lightsprout: size of tip in relation to base | 5 | 5 | 5 | 5 | 4 | 4 | 3 | 3 | 5 | 5 | 5 | 5 | 3 | 3 | 6 | 6 | 3 | 3 | 3 | 3 |
| 7 | Lightsprout: habit of tip | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 3 | 3 | 3 | 3 | 1 |
| 8 | Lightsprout: anthocyanin coloration of tip | 4 | 4 | 1 | 1 | 1 | 1 | 9 | 9 | 1 | 1 | 1 | 1 | 7 | 7 | 2 | 2 | 1 | 1 | 1 | 1 |
| 9 | Lightsprout: pubescence of tip | 7 | 7 | 3 | 3 | 5 | 5 | 7 | 7 | 5 | 5 | 5 | 5 | 7 | 7 | 5 | 5 | 1 | 1 | 4 | 4 |
| 10 | Lightsprout: number of root tips | 5 | 5 | 7 | 7 | 5 | 5 | 7 | 7 | 7 | 7 | 5 | 5 | 7 | 7 | 7 | 7 | 3 | 3 | 5 | 5 |
| 11 | Lightsprout: length of lateral shoots | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 3 | 3 | 3 | 3 | 5 | 5 |

TP/023/2 Final
comparison of temporary (T) and final (F) variety descriptions for 10 varieties
variety descriptions from two growing seasons 2014, 2015
differences are indicated in yellow colour

TWA_46th session Hannover, 19-23.06.2017

## Growing seasons 2015-2016

| | Characteristic/Variety | Variety 1 | | Variety 2 | | Variety 3 | | Variety 4 | | Variety 5 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | T | F | T | F | T | F | T | F | T | F |
| 1 | Lightsprout: size | 7 | 7 | 5 | 5 | 5 | 5 | 7 | 7 | 7 | 7 |
| 2 | Lightsprout: shape | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 |
| 3 | Lightsprout: intensity of anthocyanin coloration of base | 5 | 5 | 3 | 3 | 5 | 5 | 1 | 1 | 1 | 1 |
| 4 | Lightsprout: proportion of blue in anthocyanin coloration of base | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5 | Lightsprout: pubescence of base | 5 | 5 | 3 | 3 | 5 | 5 | 1 | 1 | 1 | 1 |
| 6 | Lightsprout: size of tip in relation to base | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 7 | Lightsprout: habit of tip | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 5 | 5 | 5 |
| 8 | Lightsprout: anthocyanin coloration of tip | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 |
| 9 | Lightsprout: pubescence of tip | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 3 |
| 10 | Lightsprout: number of root tips | 7 | 7 | 3 | 3 | 7 | 7 | 5 | 5 | 5 | 5 |
| 11 | Lightsprout: length of lateral shoots | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

TP/023/2 Final
comparison of temporary (T) and final (F) variety descriptions for 5 varieties
variety descriptions from two growing seasons 2015, 2016
differences are indicated in yellow colour
no differences – 2015-2016

TWA_46th session
Hannover, 19-23.06.2017

## Conclusions

- modification of growing conditions in the chamber(temperature, light) since 2013 growing season had significant impact on attributed notes
- there are generally slight differences (or no differences) between temporary and final variety descriptions for potato lightsprouts characteristics
- reduction of observation seasons for potato lightsprouts could be possible

TWA_46th session
Hannover, 19-23.06.2017


[L'annexe V suit /
Annex V follows /
Anlage V folgt /
Sigue el Anexo V]

ANNEXE V / ANNEX V / ANLAGE V / ANEXO V
[in English only / en anglais seulement / nur auf Englisch / solamente en inglés]

IMPACT OF NUMBER OF GROWING CYCLES ON VARIETY DESCRIPTIONS AND DISCRIMINATION POWER IN POTATO

Presentation by an expert from Germany at the forty-seventh session of the Technical Working Party for Agricultural Crops

Bundessortenamt

**UPOV TECHNICAL WORKING PARTY FOR AGRICULTURAL CROPS**
Forty-Seventh Session Naivasha, Kenya, May 21 to 25, 2018

# Impact of number of growing cycles on variety descriptions and discrimination power in potato

Beate Rücker, Germany

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Website: www.bundessortenamt.de E-Mail: bsa@bundessortenamt.de



Bundessortenamt

## Background

TC/53, 2017:

- TC invited presentations to the TWPs on the impact of using different numbers of growing cycles on DUS decisions using actual date
- TC agreed in relation to costs for DUS examination that the number of growing cycles should be the minimum necessary for a robust DUS decision and the establishment of a reliable variety description.
- TC agreed that the appropriate number of growing cycles should be established on a crop-by-crop basis.

TWA/47, 2017

- Examples on wheat and barley (DE, UK) and potato (PL, NL)
- Further examples invited for 2018

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## Introduction

- TG/23/6 for Potato: minimum duration of tests should normally be two independent growing cycles.
- Aim of this study: to validate whether two growing cycles are necessary or the duration of test could be reduced.
- Impact of the number of growing cycles was analyzed for quantitative characteristics in potato on the basis of data from actual DUS trials

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## Data for analysis of discrimination power from DUS growing trials:

- Trials comprise about 360 varieties, incl. 50-70 candidates in 1st and 2nd year.
- Discrimination power of individual characteristics was calculated based on 2nd-year-candidates. Comparison to all varieties in the same growing trial.
- Two distinctness tests performed:
  - (a) '1-cycle': second year only.
    Two varieties are considered to be distinct if a clear difference was observed.
  - (b) '2-cycles': second year and first year.
    Two varieties are considered to be distinct if a clear difference in the same direction was observed in both years.
- Same analysis 2013 to 2017. In total, about 130 candidates compared to 350 reference varieties, resulting in ca. 45,000 pairwise comparisons.

4

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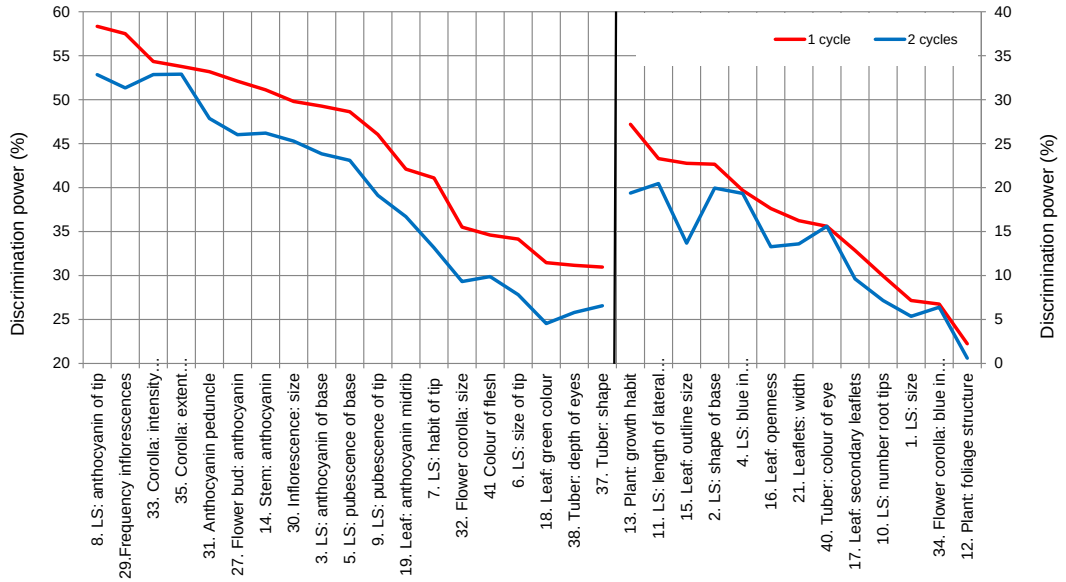
## Impact of the number of growing cycles on discrimination power

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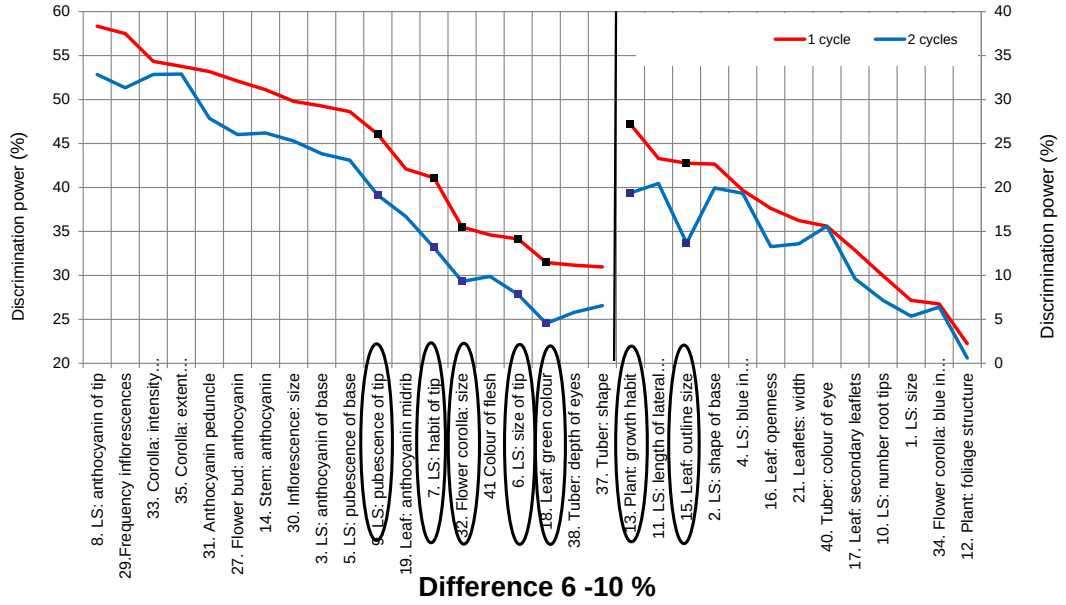
## Impact of the number of growing cycles on discrimination power




**Difference 6 -10 %**

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**Impact on discrimination power:**

- discrimination power in a single cycle between 58 % and 2 %.
- clear difference observed in one cycle was not always confirmed in the second cycle
- consequently, discrimination power was lower after 2 cycles (up to 10 % less)
- '2 out of 3 cycles' option was not analyzed
- reliable decisions based on a single cycle, would require larger minimum differences for some characteristics
- larger minimum differences would lead to lower discrimination power

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**Data for analysis of variety descriptions:**

- Orthogonal DUS observations for 211 varieties in 6 successive growing cycles (2012-2017)
- For each variety establishment of
  6 annual descriptions and
  6 descriptions over 2 cycles
- The variation of descriptions over one and two cycles was analyzed (maximum difference between the 6 descriptions).
- Same characteristics as for distinctness analysis

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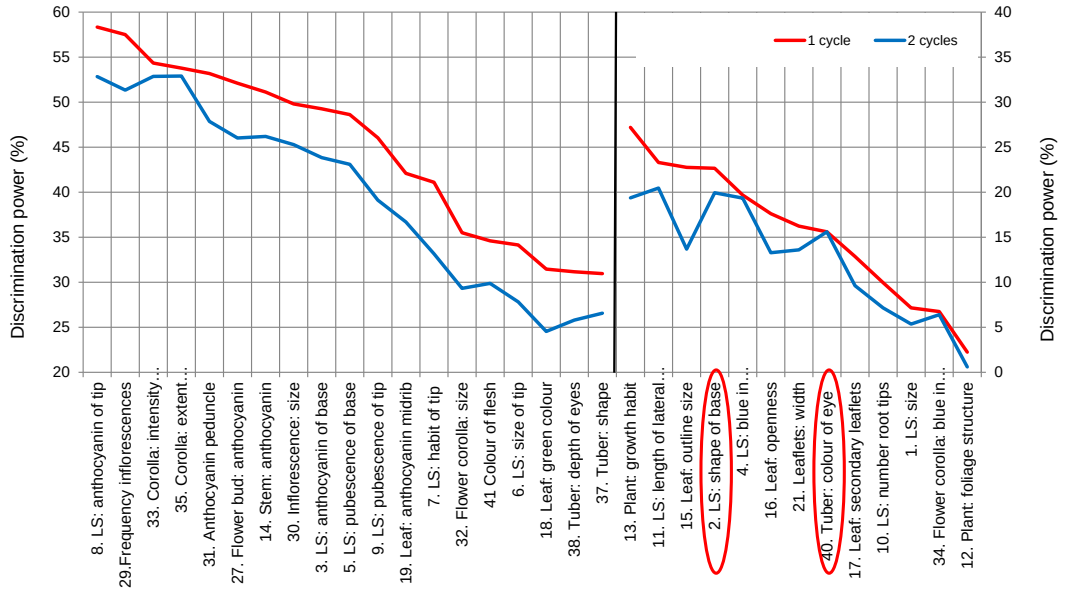
## Impact of the number of growing cycles on discrimination power




9

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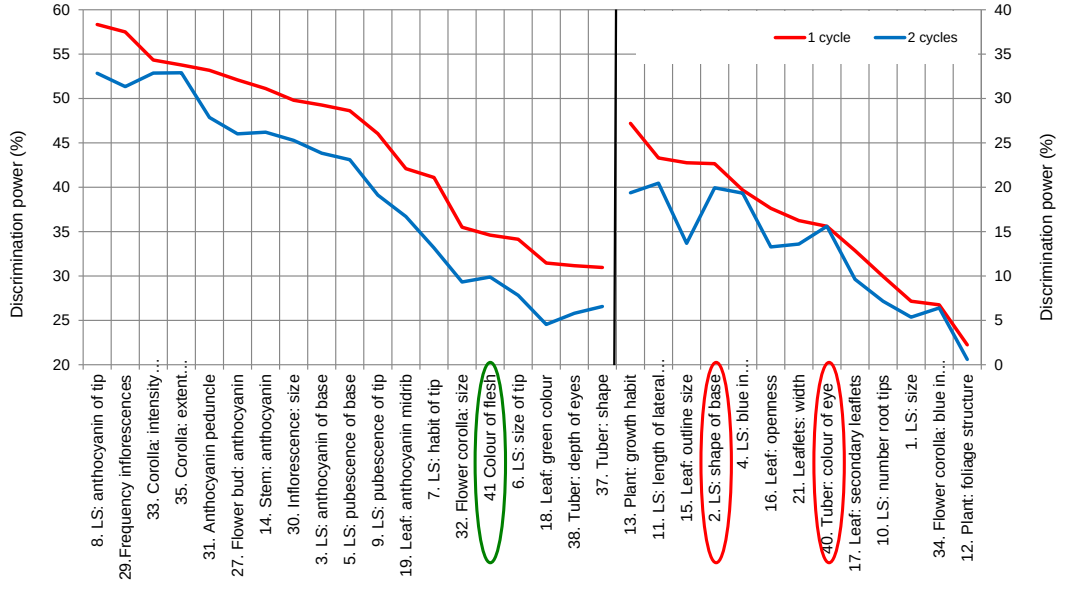
## Impact of the number of growing cycles on discrimination power

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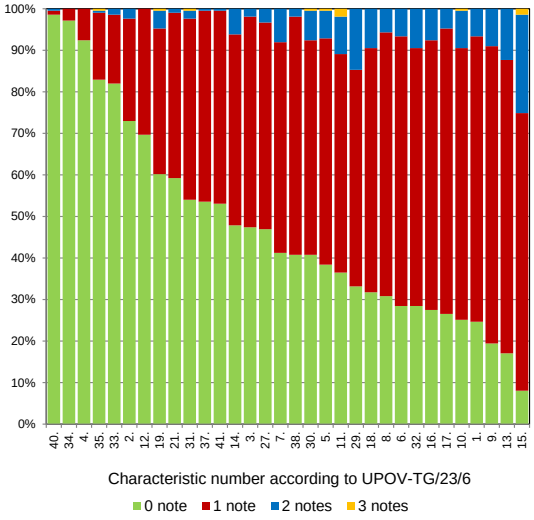
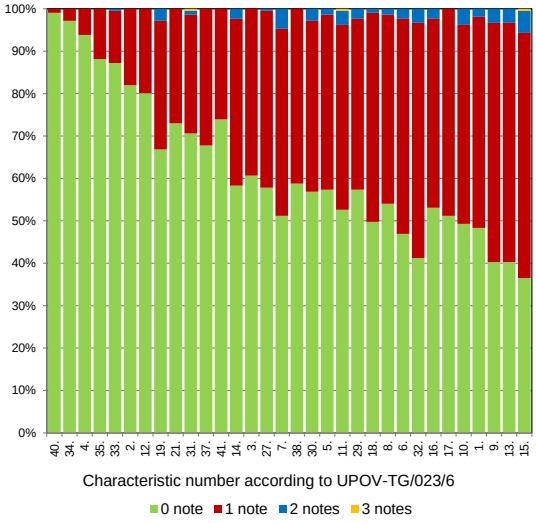
Bundessortenamt

## Difference between variety descriptions
(Maximum difference between 6 descriptions per variety, 211 varieties)

**1-cycle variety descriptions**




**2-cycle variety descriptions**



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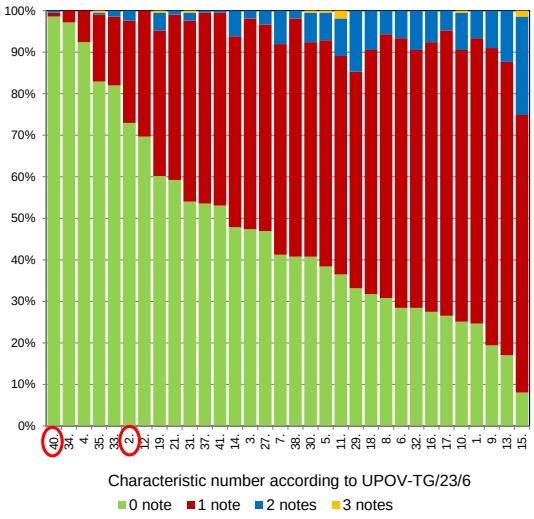
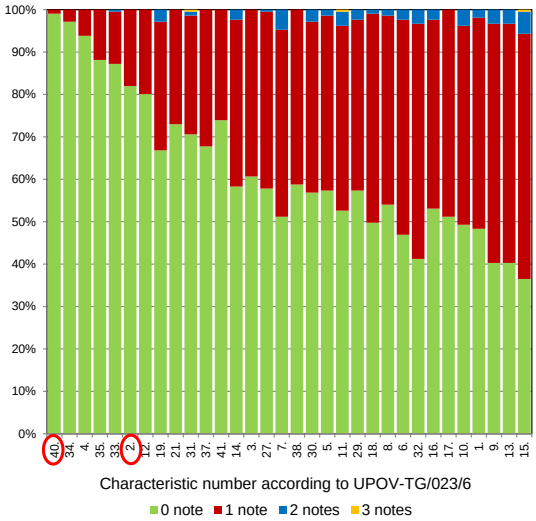
## Difference between variety descriptions
(Maximum difference between 6 descriptions per variety, 211 varieties)

**1-cycle variety descriptions**




**2-cycle variety descriptions**



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**Impact of the number of growing cycles on variety descriptions:**

- Frequency of zero notes difference considerably higher between 2-cycle descriptions. Summary over all characteristics:

| Differences | 1-cycle | 2-cycles |
|---|---|---|
| 0 notes | 47 % | 62 % |
| 1 note | 47% | 36 % |
| >1 note | 6 % | 2 % |

- 1 note difference can be considered as quite stable descriptions. Nevertheless, +/- 1 note can lead to different decisions.
- Two cycles produce more robust descriptions.
- Robust descriptions have particular importance for databases used for management of reference collections (impact on thresholds and efficiency to exclude varieties from growing trials).

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**Conclusion**

- Number of growing cycles has significant impact on distinctness decisions and variety descriptions
  - ➢ Impact on distinctness decisions for varieties compared in the same growing trials
  - ➢ Impact on the management of the reference collection on the basis of descriptions stored in a database.
- Two growing cycles produce more robust variety descriptions and DUS decisions.
- The recommended minimum number of two growing cycles should be followed.
- Variety descriptions based on two cycles provide a better basis for enforcement.

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# THANK YOU!

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[L'annexe VI suit /
Annex VI follows /
Anlage VI folgt /
Sigue el Anexo VI]

ANNEXE VI / ANNEX VI / ANLAGE VI / ANEXO VI
[in English only / en anglais seulement / nur auf Englisch / solamente en inglés]

IMPACT OF THE NUMBER OF GROWING CYCLES ON VARIETY DESCRIPTIONS AND DISCRIMINATION POWER

Presentation by an expert from Germany at the thirty-sixth session of the Technical Working Party on Automation and Computer Programs

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**UPOV TECHNICAL WORKING PARTY ON AUTOMATION AND COMPUTER PROGRAMS**
Thirty-sixth Session, Hanover, Germany, July 2 to 6, 2018

# Impact of the number of growing cycles on variety descriptions and discrimination power

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## Introduction

- TC 2017 considered impact of number of growing cycles
- TC: number of growing cycles should be the minimum necessary for a robust DUS decision and the establishment of a reliable variety description.
- TC: number of growing cycles should be established on crop-by-crop basis.

- TGs wheat, barley and potato: minimum duration of tests should normally be two independent growing cycles.
- Aim of this study: to validate whether two growing cycles are necessary or the duration of test could be reduced.
- Impact of the number of growing cycles was analyzed on the basis of data from actual DUS trials in winter wheat, winter barley and potato performed in DE (see TWA/46/8 Annex I, TWA/47/5)

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## 1. Analysis of discrimination power

**Data for Potato:**

- Trials comprise about 360 varieties, incl. 50-70 candidates in 1st and 2nd year.
- Discrimination power of individual characteristics was calculated based on 2nd-year-candidates. Comparison to all varieties in the same growing trial.
- Two distinctness tests performed:
  - (a) '1-cycle': second year only (year 0)
  - (b) '2-cycles': second year and first year (year 0 / -1)
    Two varieties are considered to be distinct if a clear difference in the same direction was observed in both years.
- Same analysis 2013 to 2017. In total, about 130 candidates compared to 350 reference varieties, resulting in ca. 45,000 pairwise comparisons.



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**Data for Winter Wheat and Winter Barley:**

- Trials comprise about 600 varieties in wheat and 300 varieties in barley.
- Discrimination power of individual characteristics was calculated based on all varieties in the same growing trial(s).
- Distinctness analyzed in three steps:
  - (a) '1 cycle': Comparison of all varieties in the trial (year 0)
  - (b) '2 cycles': For varieties also grown in the year before, distinctness was assessed in both years (year 0 / -1)
    Two varieties are considered to be distinct if a clear difference in the same direction was observed in both years.
  - (c) '2 out of 3 cycles': For varieties also grown the two previous years, distinctness was assessed in all 3 years (year 0 / -1 / -2)
    Two varieties are considered to be distinct if a clear difference in the same direction was observed in at least 2 out of 3 years.

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- Two-year data are available for about 70% of the varieties and three-year data for about 50% of the varieties.
- Same analysis for 2014, 2015 and 2016
- Every year, the distinctness test included
  - (a) 1-cycle-comparisons: 40,000 in wheat and 30,000 in barley
  - (b) 2-cycle-comparisons: 25,000 in wheat and 15,000 in barley
  - (c) 2 out of 3 comparisons: 15,000 in wheat and 6,000 in barley



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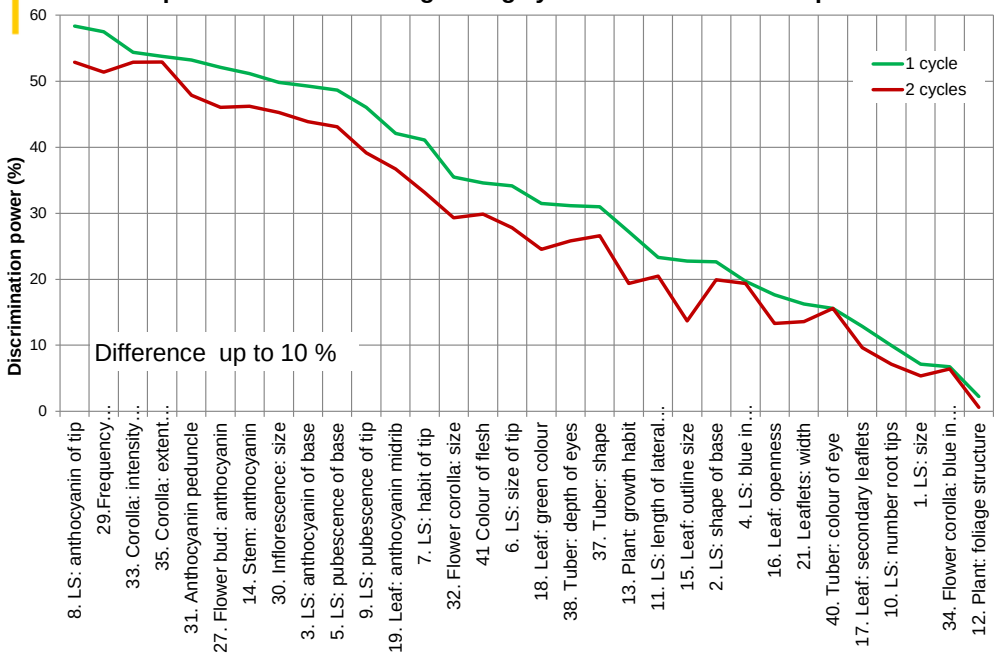
**Potato**

**Impact of the number of growing cycles on discrimination power**



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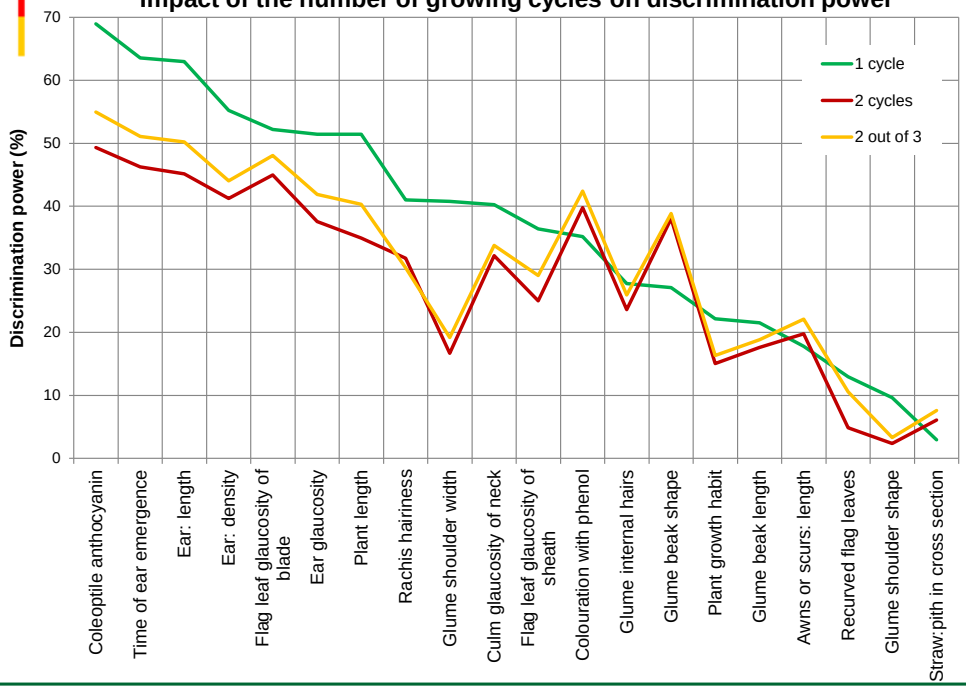
## Wheat

### Impact of the number of growing cycles on discrimination power



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## Wheat

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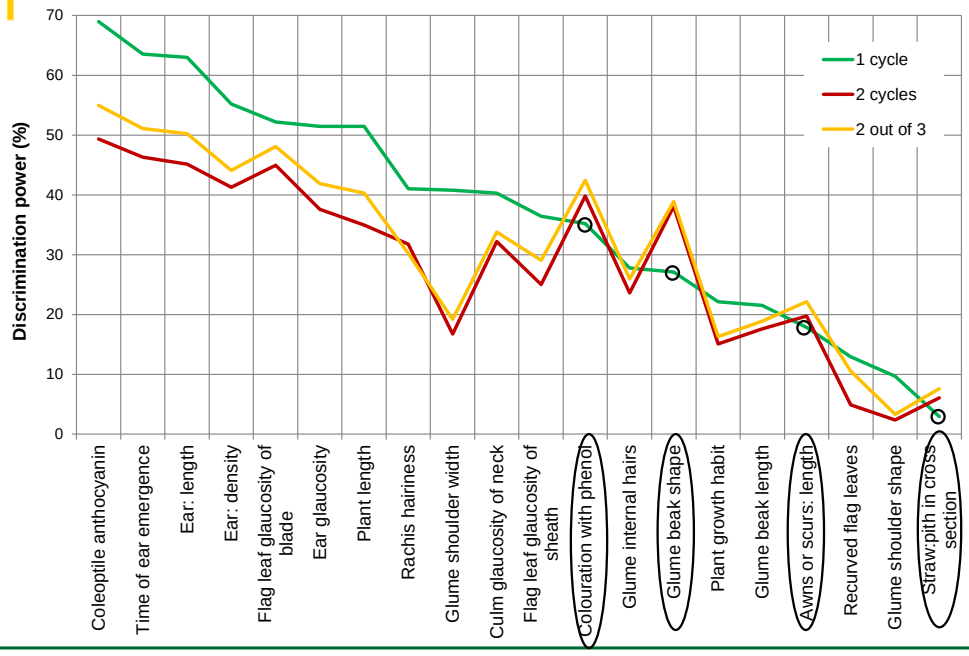

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## Barley

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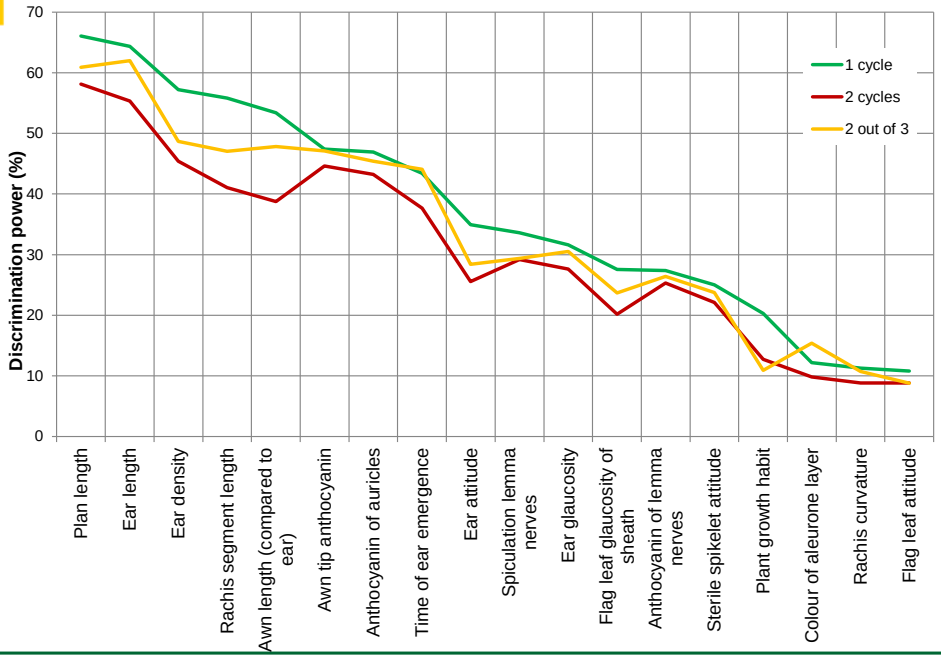




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### Impact on discrimination power:

- clear difference observed in one cycle was not always confirmed in the 2nd cycle
- consequently, discrimination power was lower after 2 cycles
- 3 cycles better than 2 cycles because a difference in 1 cycle can be confirmed in 3rd cycle (3rd cycle not analyzed for potato because normally there are sufficient characteristics with clear differences after 2 cycles)
- reliable decisions based on a single cycle, would require larger minimum differences for most characteristics
- larger minimum differences would lead to lower discrimination power

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## 2. Analysis of variety descriptions

**Data for Potato:**

- Orthogonal DUS observations for 211 varieties in 6 successive growing cycles (2012-2017)
- For each variety establishment of
  6 annual descriptions and
  6 descriptions over 2 cycles
- The variation of descriptions over one and two cycles was analyzed (maximum difference between the 6 descriptions).
- Same characteristics as for distinctness analysis



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## Difference between variety descriptions

(Maximum difference between 6 descriptions per variety, 211 varieties)

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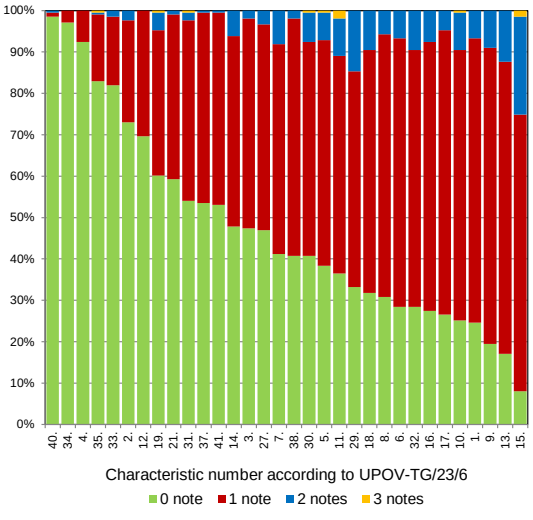


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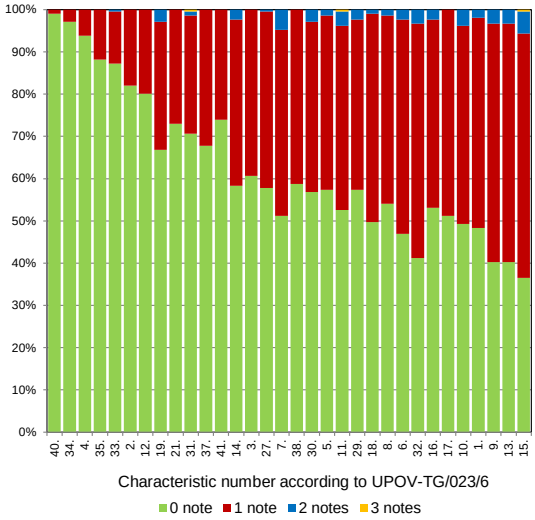

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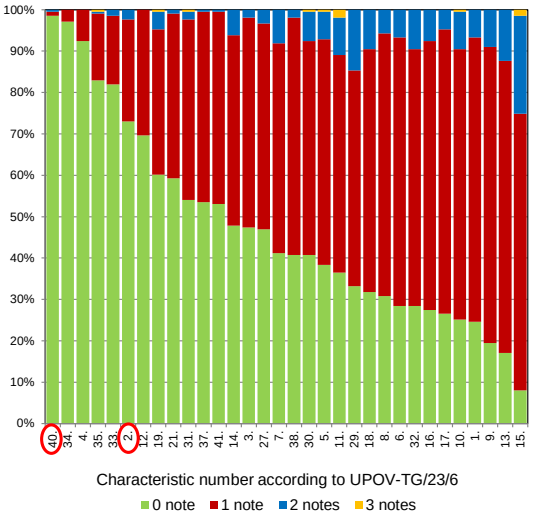
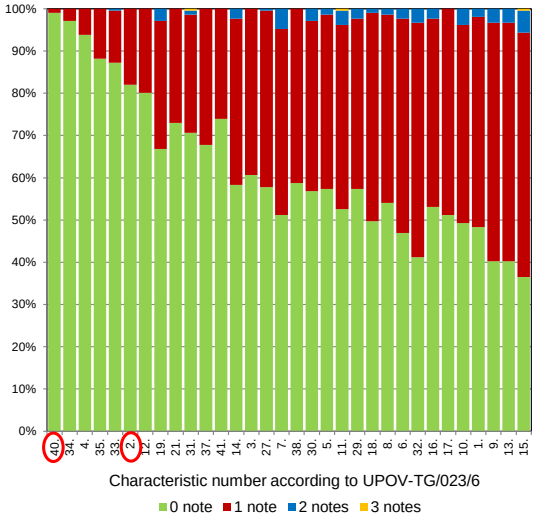



**2-cycle variety descriptions**



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- 1 note difference can be considered as quite stable descriptions. Nevertheless, +/- 1 note can lead to different decisions.
- Two cycles produce more robust descriptions.



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**Data for Wheat and Barley:**

- DUS observations for 77 winter wheat varieties and 47 winter barley varieties in 6 successive growing cycles were used to establish
  - annual descriptions (year 0)
  - descriptions over 2 cycles (year 0 / -1)
  - descriptions over 3 cycles (year 0 / -1 / -2)

- The variation of descriptions over one, two and three cycles was calculated

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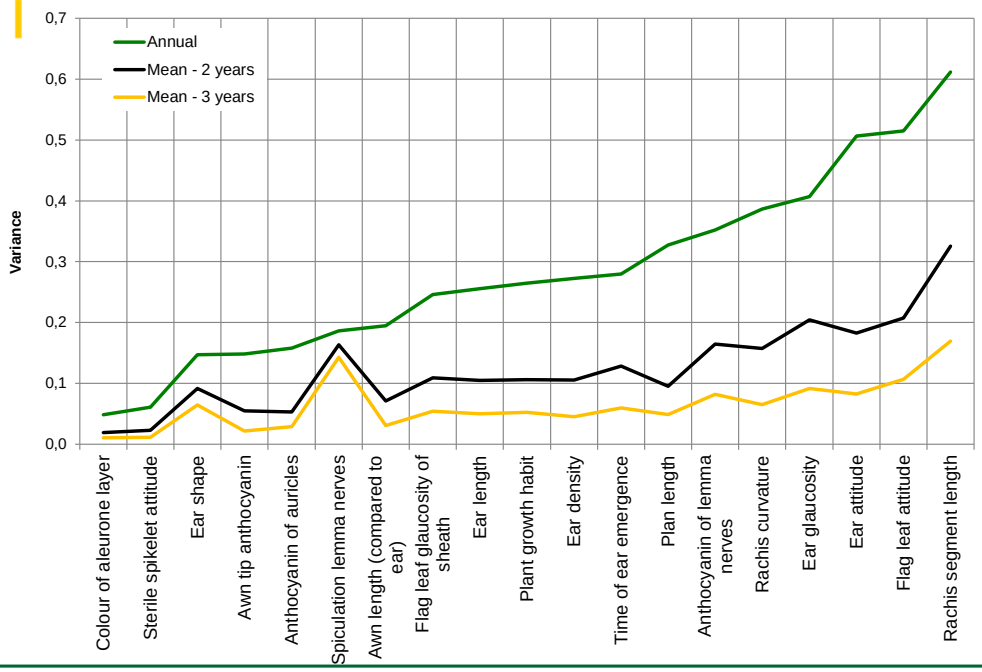
## Barley

### Variance of variety descriptions over testing periods



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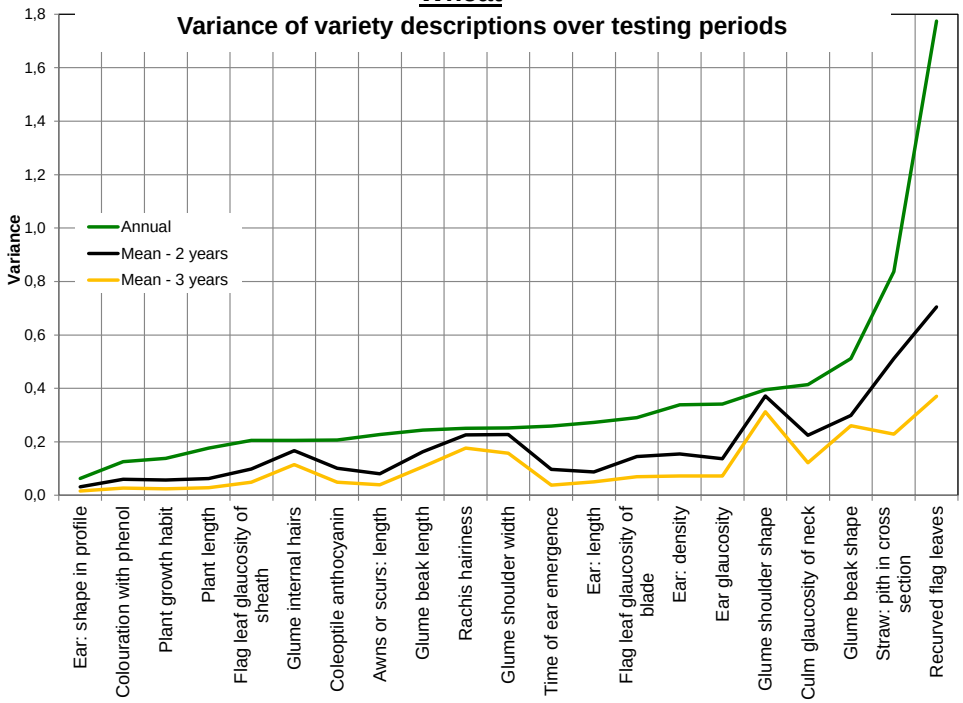
## Wheat

### Variance of variety descriptions over testing periods



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## Conclusions

- Number of growing cycles has significant impact on distinctness decisions and variety descriptions
  - Impact on distinctness decisions for varieties compared in the same growing trials
  - Impact on the management of the reference collection on the basis of descriptions stored in a database.
- Two growing cycles produce more robust variety descriptions and DUS decisions.
- Current recommendation in TG Barley, TG Wheat and TG Potato is appropriate: “Minimum duration of test should normally be two independent growing cycles”.



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- Minimum duration of test should be followed to establish official variety description (basis for identification & enforcement)
- Robust descriptions have particular importance in databases used for management of reference collections (impact on thresholds and efficiency to exclude varieties from growing trials).
- Descriptions in a database (“working description” ) should be based at least on the recommended minimum number of growing cycles. Any additional cycle can improve the quality of the description

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[End of Annex VI and of document /
Fin de l'Annexe VI et du document /
Ende der Anlage VI und des Dokuments /
Fin del Anexo VI y del documento]