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IMPACT OF USING DIFFERENT NUMBERS OF GROWING CYCLES ON DUS DECISIONS USING ACTUAL DATA

Document prepared by the Office of the Union

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EXECUTIVE SUMMARY

1. The purpose of this document is to provide examples on the impact of using different numbers of growing cycles on DUS decisions using actual data.

2. The TWA is invited to consider the information to be presented at its forty-sixth session on the impact of using different numbers of growing cycles on DUS decisions using actual data, as presented in Annexes I to III to this document.

BACKGROUND

3. The background to this document is provided in document TWP/1/21 "Number of growing cycles in DUS examination".

INFORMATION TO BE PRESENTED AT THE FORTY-SIXTH SESSION OF THE TWA

4. The Annexes to this document contain the following information to be presented at the forty-sixth session of the TWA:

ANNEX I: "Impact of number of growing cycles on variety descriptions and discrimination power in wheat and barley", document prepared by an expert from Germany

ANNEX II: "Number of growing cycles in potato varieties - DUS examination of lightsprouts", presentation prepared by an expert from Poland

ANNEX III: "Number of growing cycles: the impact on cereal variety descriptions", presentation prepared by an expert from the United Kingdom

5. The TWA is invited to consider the information to be presented at its forty-sixth session on the impact of using different numbers of growing cycles on DUS decisions using actual data, as presented in Annexes I to III to this document.

[Annexes follow]

ANNEX I

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

Document prepared by an expert from German

The impact of the number of growing cycles was analyzed for quantitative characteristics in wheat and barley on the basis of data from DUS trials.

Material and methods

Discrimination power of individual characteristics was 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 German DUS growing trials comprise about 600 varieties in winter wheat and 300 varieties in winter barley. Three year data are available for about 50% of the varieties and two year data for about 70% of the varieties. Every year, the distinctness test includes about 40,000 pairwise 1-cycle-comparisons in wheat and 30,000 in barley (under consideration of some grouping characteristics). About 25,000 2-cycle-comparisons and 15,000 2 out of 3 comparisons were considered in wheat, 15,000 and 6,000 in barley, respectively.

The same analysis was performed for 2014, 2015 and 2016. The discrimination power was calculated in percent pairwise comparisons in which a clear difference was observed. The mean discrimination power over the three years was calculated

A different data set was used to calculate the impact of the number of growing cycles on 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). In addition, descriptions over 2 cycles (year 0 / -1) and 3 cycles (year 0 / -1 / -2) were established. The variation of descriptions over one, two and three cycles was calculated.

Results

Discrimination power

The mean discrimination power over the three years is presented in figure 1 and 2. The decision on distinctness was significantly influenced by the number of growing cycles. A clear difference observed in the first cycle was not always confirmed in the second cycle. Consequently, the discrimination power was lower after 2 cycles in most of the characteristics. A clear difference observed in only one of the years may be confirmed in a third year, resulting in a higher discrimination power in 2 out of 3 cycles.

A few characteristics in wheat did not follow this principle, see figure 2: grain coloration with phenol, lower glume beak shape, awns or scurs length and straw pith in cross section. A low 1-cycle-discrimination power was observed for these characteristics. This result may be attributed to the fact that the expression of these characteristics is not evenly distributed in the collection. The low mean discrimination power in 1-cycle comparisons could be caused by a different distribution in the varieties in the first year (about 30% of all varieties). Environmental effects can also have an impact on the discrimination power in some years.

Variety descriptions

The variation of descriptions over one, two and three cycles is illustrated in figures 3 and 4. Annual variety descriptions show a higher variation than descriptions over two and three years for all characteristics in both

species. The stability of descriptions is much higher after two cycles and can be further improved by a third cycle.

Conclusion

The study has shown that the number of growing cycles has a significant impact on distinctness decisions and variety descriptions. It confirms the current recommendation in the Test Guidelines for barley and wheat which reads as follows: “The minimum duration of test should normally be two independent growing cycles”.

The recommended minimum duration of test should be followed to establish the official variety description. Reliability and stability of the description is a precondition for enforcement.

Descriptions also play an important role for the management of references collections, in particular when databases with descriptions for varieties of common knowledge are used for the selection of similar varieties for the growing trial. The possible error of descriptions has to be taken into account for any comparison. The exclusion of varieties from the growing trial is a crucial step in the distinctness test. Normally, the error for descriptions of candidate varieties is quite high at the beginning of test. The most important is to limit the error of descriptions of reference varieties by feeding the database with sufficiently stable descriptions. All 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.

Figure 1: Winter barley - Impact of the number of growing cycles on discrimination power

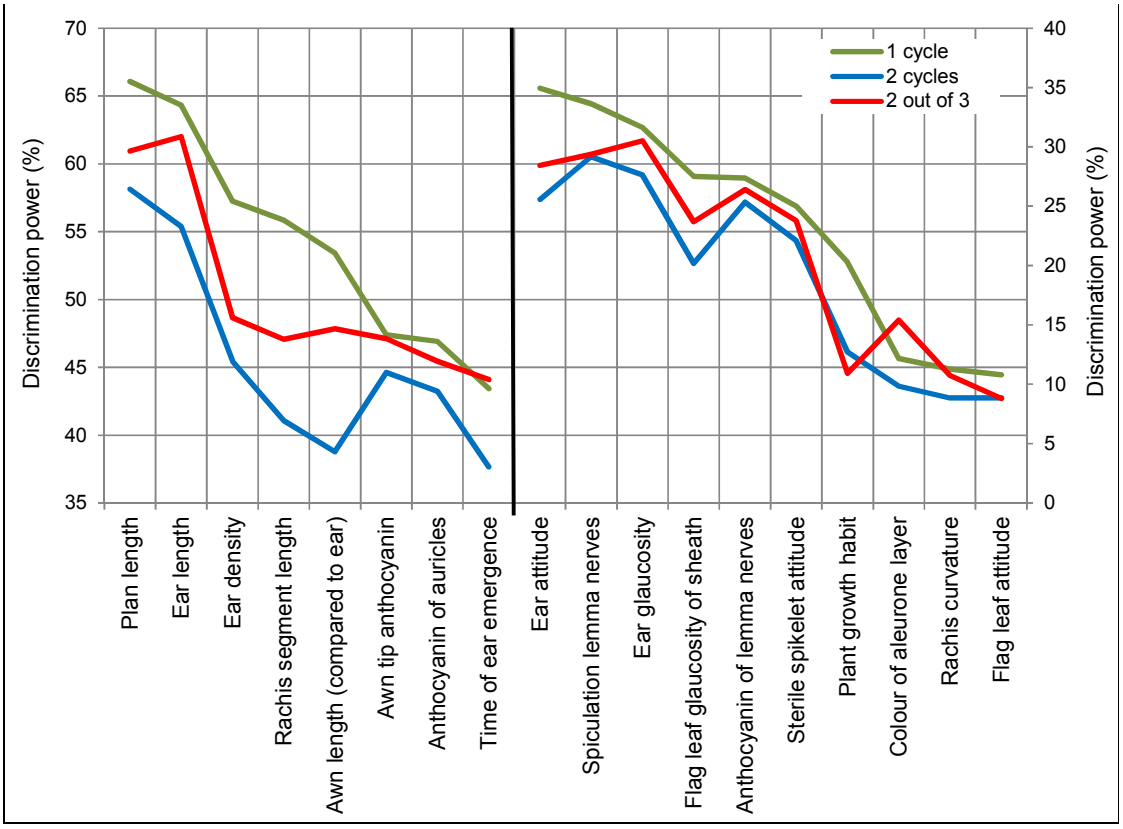


Figure 2: Winter wheat - Impact of the number of growing cycles on discrimination power

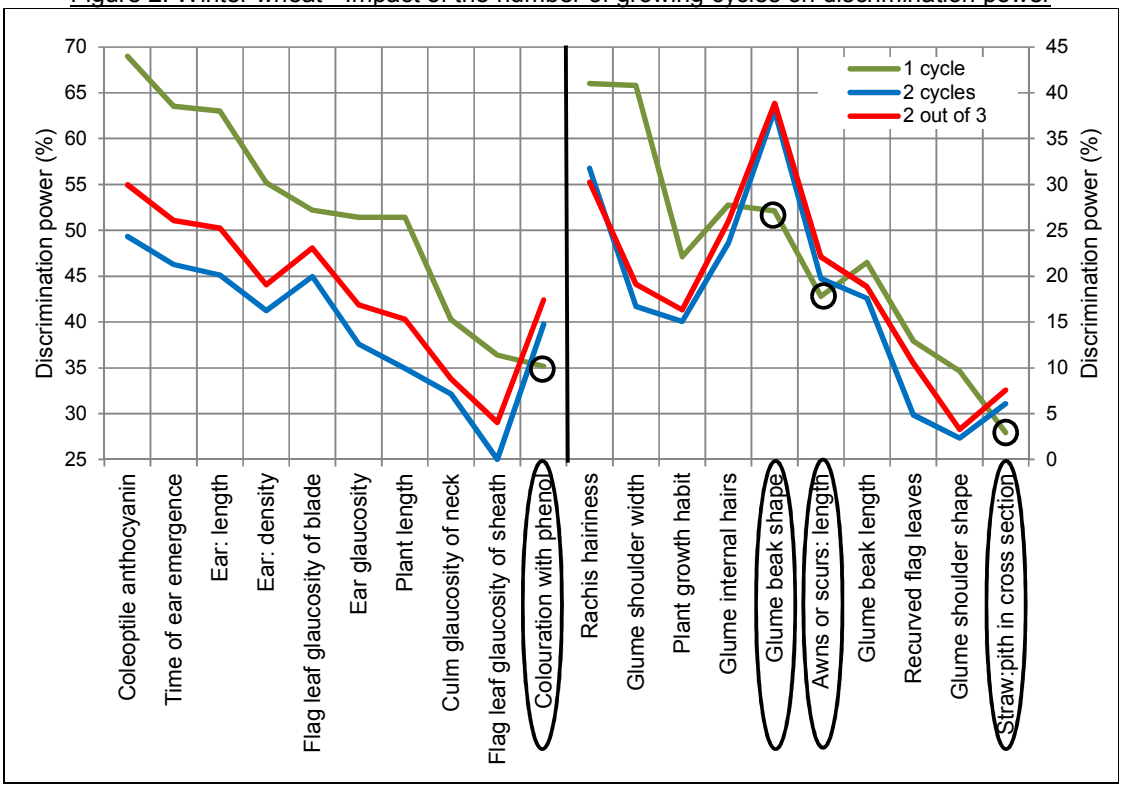


Figure 3: Winter barley – variance of variety descriptions over testing periods

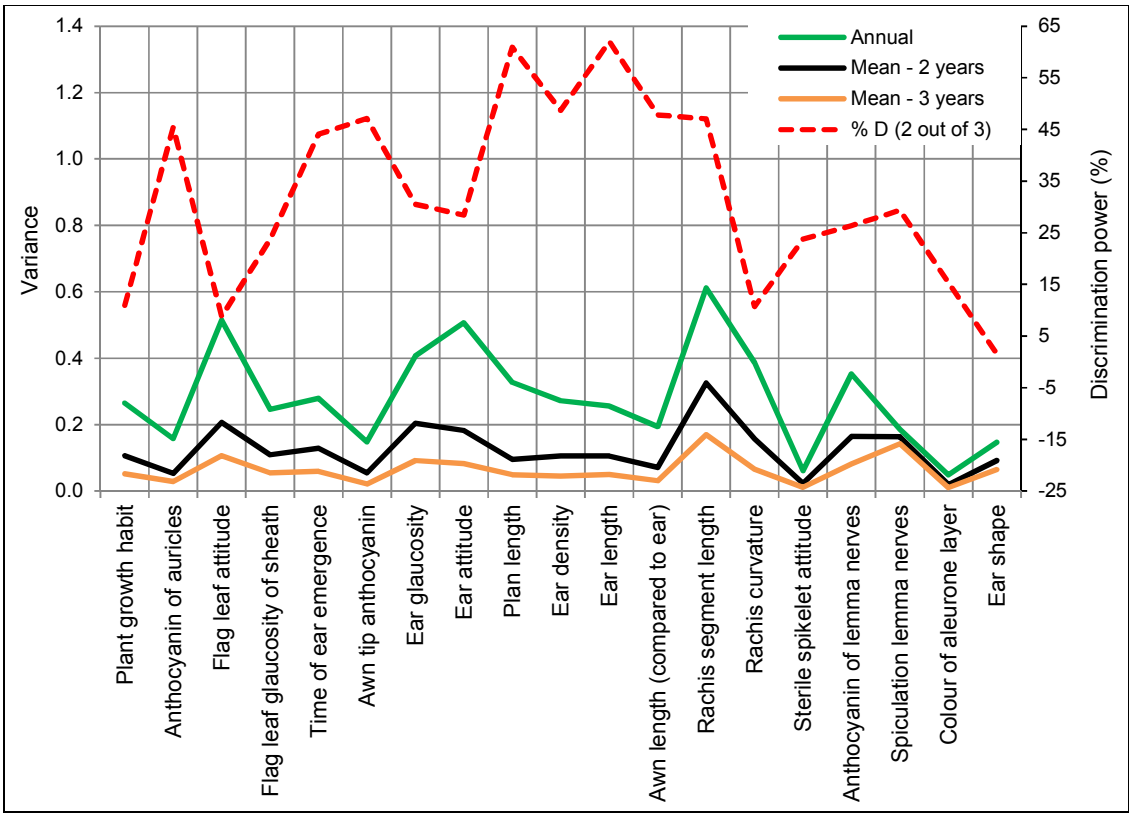
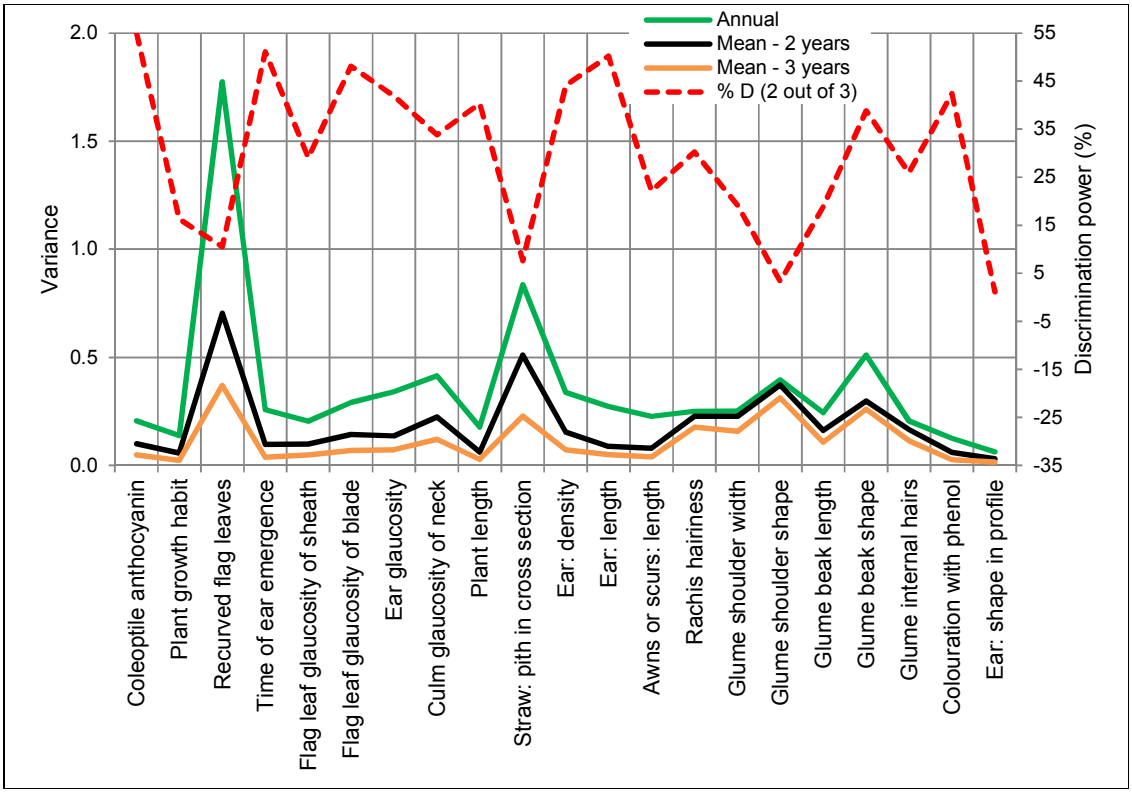


Figure 4: Winter wheat – variance of variety descriptions over testing periods

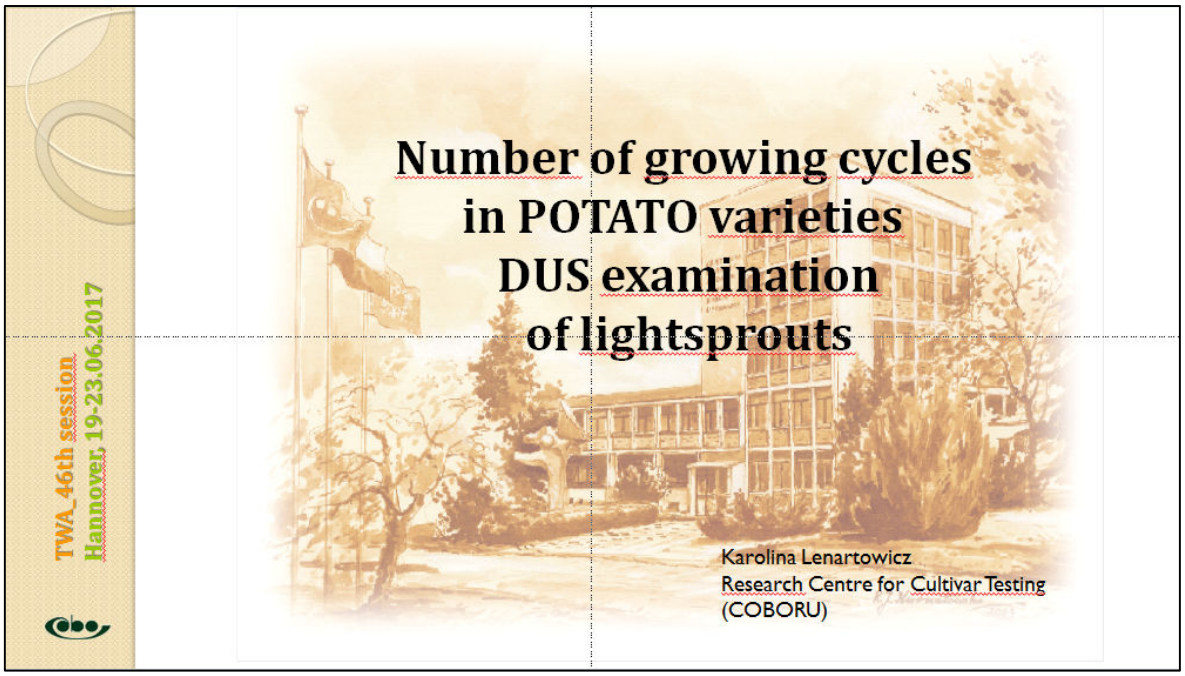


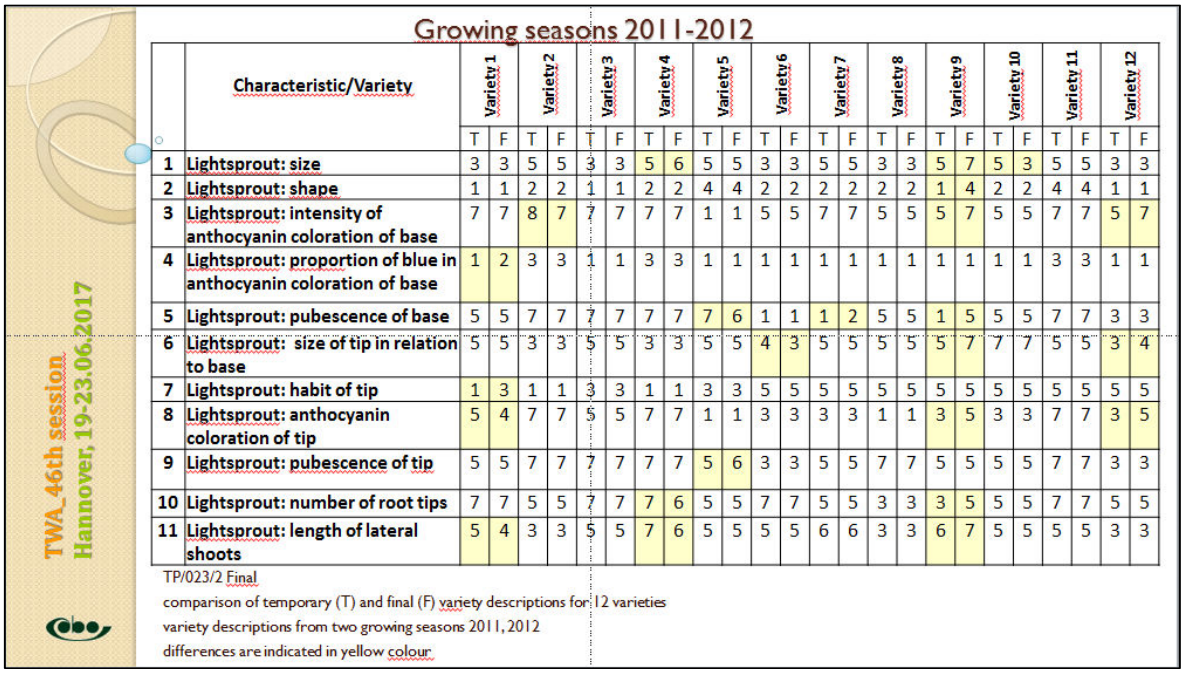
[Annex II follows]

ANNEX II

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

Presentation prepared by an expert from Poland





	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

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

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

Thank you for your attention

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TWA_46th session Hannover, 19-23.06.2017

[Annex III follows]

ANNEX III

NUMBER OF GROWING CYCLES: THE IMPACT ON CEREAL VARIETY DESCRIPTIONS

Presentation prepared by an expert from the United Kingdom

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	

NIAB TAG

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

[End of Annex III and of document]