

TP Sugar Beet 2024 (S_Beet24)
 TP adopted: 01.01.2024
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TystofteFoundation

Hybrider af Sukkerroe / Sugar Beet
 Hybrids

Beta vulgaris L. ssp. vulgaris var. saccharifera
 Alef.

Beta vulgaris L. ssp. vulgaris var. altissima Doell
 (BETAA_VUL_GVS)

TECHNICAL PROTOCOL

FOR THE CONDUCT OF TESTS

FOR DISTINCTNESS, UNIFORMITY AND STABILITY

Alternative Names:

<i>Botanical name</i>	<i>English</i>	<i>Danish</i>	<i>Swedish</i>
Beta vulgaris L. ssp. vulgaris var. saccharifera Alef.	Sugar Beet	Sukkerroe	Sockerbeta

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1 Subject of this Technical Protocol

This protocol applies to hybrid varieties of *Beta vulgaris* L. ssp. *vulgaris* var. *saccharifera* Alef. (syn. *Beta vulgaris* L. ssp. *vulgaris* var. *altissima* Döll).

2 Material Required

The material is to be supplied in the form of naked untreated seed.

The minimum quantity of plant material, to be supplied by the applicant, should be: 350 g of seed

The applicant is responsible for ensuring compliance with any customs, transportation and plant health requirements.

The plant material supplied should be visibly healthy, vigorous, and not affected by any seedborne diseases or pests.

3 Method of Examination

3.1 Number of Growing Cycles

The minimum duration of tests is two independent growing cycles.

3.2 Testing Location

Tests are normally conducted at TystofteFoundation.

3.3 Conditions for Conducting the Examination

The tests are carried out under conditions ensuring satisfactory growth for the expression of the relevant characteristics of the variety and for the conduct of the examination.

The optimum stage of development for the assessment of each characteristic is indicated by a number in the Table of Characteristics (Chapter 8). The stages of development denoted by each number are described in table 3-1 below.

Table 3-1: Uwe Meier, 1997: Growth Stages of Mono- and Dicotyledonous Plants. Federal Biological Research Center for Agriculture and Forestry (Editor)

00	Dry seed
10 - 11	Leaf development (youth stage), Seedling
35 - 39	Rosette growth: leaves cover 50% - 90% of ground
40 - 45	Development of harvestable vegetative plant parts – Beet root
49	Beet root has reached harvestable size

3.4 Method of Observation

The method of observing the characteristic is indicated by the following key in the Table of Characteristics:

- MG: single measurement of a group of plants or parts of plants
- MS: measurement of a number of individual plants or parts of plants
- VG: visual assessment by a single observation of a group of plants or parts of plants
- VS: visual assessment by observation of individual plants or parts of plants
- TQ: the characteristic is adopted from the TQ as informed by the applicant

4 Test Design

Two DUS trials are elaborated in each growing period – one field trial with spaced plants for visual assessments and measurements of harvested roots – and one greenhouse trial for observing germinity of the seeds and anthocyanin coloration of hypocotyl.

4.1 Field trial

The field trial is elaborated in an Alpha design in 3 replicates. The ordinary field trial is enlarged with a fourth replicate where all second-year candidates are visually compared in side-by-side plots with the (typically 2) most similar varieties established from the first year of DUS-testing.

Each plot is 4 meters long and 2 meters wide and consists of 4 rows. The trial is drilled ensuring that, after thinning, there is approximately 18 cm between the plants. The two middle rows are harvested for measuring of the roots in the laboratory.

In each plot there are at least 80 plants and in the field test at least 240 plants.

For all candidate varieties off-type plants are registered and removed from each plot in the field before harvest.

4.2 Greenhouse test

The greenhouse test has the same randomization as the field trial, but only 2 replicates with at least 50 plants per replicate.

5 Assessment of Distinctness, Uniformity and Stability

5.1 Distinctness

For distinctness, COY D is applied on all quantitative characteristics except for the greenhouse characteristic anthocyanin coloration of the hypocotyl where minimum distance is applied. For qualitative and pseudo-qualitative characteristics, minimum distance is applied.

For COY D a variety is considered distinct if a single characteristic shows significant differences at 1 % level, or two independent characteristics show significant differences at 5 % level.

If varieties are grown side-by-side and a clear difference in one or more characteristics is observed in a direct comparison, the two varieties are considered distinct.

5.1.1 Number of Plants / Parts of Plants to be Examined

Unless otherwise indicated, for the purposes of distinctness, all observations on single plants should be made on 45 plants for candidate varieties, 30 plants for reference varieties or parts taken from each of 45 plants for candidate varieties and 30 plants for reference varieties, divided on and taken from 3 replicates, and any other observations made on all plants in the test, disregarding any off-type plants.

All observations in the greenhouse trial are determined by measurement or counting and is made on at least 100 plants or parts of plants divided on and taken from 2 replicates.

5.2 Uniformity

For measured characteristics (MS) COY U is applied for testing the relative uniformity of the varieties.

For Hypocotyl: Percentage of seedlings with anthocyanin coloration of hypocotyl, a variety is considered uniform if the expression differ less than 3 notes between growing cycles.

For Germinity in the greenhouse trial and for visually assessed characteristics in the field trial (VG):

A candidate will be considered to be sufficiently uniform if the number of off-types in each growing cycle does not exceed the threshold indicated in table 5-1 below based on a population standard of 2% with an acceptance probability of 95%.

Table 5-1 Threshold for off-types (pop.std. 2%, acc.prob. 95%)

NUMBER OF PLANTS	OFF-TYPES ALLOWED
100 – 131	5
132 – 165	6
166 – 200	7
201 – 236	8
237 – 273	9
274 – 310	10
311 – 348	11
349 – 386	12

5.3 Stability

A variety is considered stable if it is sufficiently uniform.

6 Grouping of Varieties

The following have been agreed as useful grouping characteristics:

Germinity – Char. 1

Ploidi – Char. 2

7 Introduction to the Table of Characteristics

7.1 States of Expression and Corresponding Notes

States of expression are given for each characteristic to define the characteristic and to harmonize descriptions. Each state of expression is allocated a corresponding numerical note for ease of recording of data and for the production and exchange of the description.

All relevant states of expression are presented in the characteristic.

7.2 Example Varieties

Where appropriate, example varieties are provided to clarify the states of expression of each characteristic.

7.3 Legend

		English		Dansk		Svenska		Example Varieties Eksempelsorter Exempelsorter	Notes/ Notes
1	2	3	4	5	6	7			
		Name of characteristics in English		Egenskabernes navn på dansk		Egenskapernas namn på svenska			
		States of expression		Egenskabernes udtryk		Egenskapernas uttryck			

1 Characteristic number

2 G: Grouping characteristic

3 Type of expression

QL: Qualitative characteristic

QN: Quantitative characteristic

PQ: Pseudo-qualitative characteristic

4 Method of observation – see paragraph 3.4

5 Where is the characteristic observed

A: Field trial

B: Greenhouse test

TQ: Technical Questionnaire

6 (+) Explanations for individual characteristics (Chapter 8.1)

7 Growth stage key – see paragraph 3.3

8 Table of Characteristics

DK no.		English	Dansk	Svenska	Example Varieties Eksempelsorter Exempelsorter	Notes/ Notes
1	G	QL	VS	B (+)	10-11	
		Germinity	Germinitet	Germinitet		
		Monogerm	Monogerm	Monogerm	Selma KWS	1
		Multigerm	Multigerm	Multigerm		2
2	G	QL	TQ	10-11		
		Ploidy	Ploiditet	Ploiditet		
		Diploid	Diploid	Diploid	Selma KWS	2
		Triploid	Triploid	Triploid		3
		Tetraploid	Tetraploid	Tetraploid		4
		Polyploid/other	Polyploid/andet	Polyploid/andra		5
3		QN	VS	B (+)	10-11	
		Hypocotyl: Percentage of seedlings with anthocyanin coloration of hypocotyl	Kimstængel: % stængler med anthocyaninfarvning	Hypokotylfärg: % stjälkar med antocyaninfärgning		
		0-9%	0-9%	0-9%	Hopla	1
		10-19%	10-19%	10-19%		2
		20-29%	20-29%	20-29%	Nelson	3
		30-39%	30-39%	30-39%		4
		40-59%	40-59%	40-59%	Selma KWS	5
		60-69%	60-69%	60-69%		6
		70-79%	70-79%	70-79%	Falster	7
		80-89%	80-89%	80-89%		8
		90-100%	90-100%	90-100%	Lavenda KWS	9
4		QN	VG	A (+)	35-39	
		Leaf: attitude	Blad: stilling	Blad: position		
		Erect	Opret	Upprätt		1
		Erect to semi-erect	Opret til halvt opret	Upprätt till halvupprätt		2
		Semi-erect	Halvt opret	Halvupprätt	Smilla KWS	3
		Semi-erect to intermediate	Halvt opret til mellemstilling	Halvupprätt till mellanliggande		4
		Intermediate	Mellemstilling	Mellanliggande	Lavenda KWS	5
		Intermediate to semi-prostrate	Mellemstilling til halvt liggende	Mellanliggande till halvliggande		6
		Semi-prostrate	Halvt liggende	Halvliggande	Vertigo	7
		Semi-prostrate to prostrate	Halvt liggende til vandret	Halvliggande till horisontell		8
		Prostrate	Vandret	Horisontell		9

DK no.	English		Dansk	Svenska	Example Varieties Eksempelsorter Exempelsorter	Notes/ Notes
5	QN	VG	A	35-39		
	Leaf blade: green colour	Bladplade: grønfarvning	Bladplatta: grönfärgning			
	Very light	Meget lys	Mycket ljus			1
	Very light to light	Meget lys til lys	Mycket ljus till ljus			2
	Light	Lys	Ljus	Nexus		3
	Light to medium	Lys til middel	Ljus till medel			4
	Medium	Middel	Medel	Smilla KWS		5
	Medium to dark	Middel til mørk	Medel till mörk			6
	Dark	Mørk	Mörk	Smart Renja KWS		7
	Dark to very dark	Mørk til meget mørk	Mörk till mycket mörk			8
	Very dark	Meget mørk	Mycket mörk			9
6	QN	VG	A	40-45		
	Leaf blade: undulation of margin	Bladrand: krusethed	Bladkant: krusighet			
	Absent or very weak	Ingen eller meget svag	Ingen eller meget svag			1
	Very weak to weak	Meget svag til svag	Mycket svag till svag			2
	Weak	Svag	Svag	Smart Renja KWS		3
	Weak to medium	Svag til middel	Svag till medel			4
	Medium	Middel	Medel	Comanche		5
	Medium to strong	Middel til stærk	Medel till kraftig			6
	Strong	Stærk	Kraftig	Smilla KWS		7
	Strong to very strong	Stærk til meget stærk	Kraftig till mycket kraftig			8
	Very strong	Meget stærk	Mycket kraftig			9
7	QN	VG	A	40-45		
	Leaf blade: blistering	Bladplade: vablethed	Bladplatta: bubblighet			
	Absent or very weak	Ingen eller meget svag	Ingen eller meget svag			1
	Very weak to weak	Meget svag til svag	Mycket svag till svag			2
	Weak	Svag	Svag	Fairway		3
	Weak to medium	Svag til middel	Svag till medel			4
	Medium	Middel	Medel	Twix		5
	Medium to strong	Middel til stærk	Medel till kraftig			6
	Strong	Stærk	Kraftig	Vertigo		7
	Strong to very strong	Stærk til meget stærk	Kraftig till mycket kraftig			8
	Very strong	Meget stærk	Mycket kraftig			9

DK no.	English		Dansk	Svenska	Example Varieties Eksempelsorter Exempelsorter	Notes/ Noter
8	QN	VG	A	(+)	40-45	
	Leaf blade: glossiness	Bladplade: glans	Bladplatta: glansighet			
	Absent or very weak	Ingen eller meget svag	Ingen eller mycket svag			1
	Very weak to weak	Meget svag til svag	Mycket svag till svag			2
	Weak	Svag	Svag	Fairway		3
	Weak to medium	Svag til middel	Svag till medel			4
	Medium	Middel	Medel	Twix		5
	Medium to strong	Middel til stærk	Medel till kraftig			6
	Strong	Stærk	Kraftig	Smart Renja KWS		7
	Strong to very strong	Stærk til meget stærk	Kraftig till mycket kraftig			8
	Very strong	Meget stærk	Mycket kraftig			9
9	QN	VG	A	(+)	40-45	
	Leaf: length including petiole	Blad: længde inkl. stilk	Blad: längd inkl. stjälk			
	Very short	Meget kort	Mycket kort			1
	Very short to short	Meget kort til kort	Mycket kort till kort			2
	Short	Kort	Kort	Fortnox		3
	Short to medium	Kort til middel	Kort till medel			4
	Medium	Middel	Medel	Limousine		5
	Medium to long	Middel til lang	Medel till lång			6
	Long	Lang	Lång	Aloyzious		7
	Long to very long	Lang til meget lang	Lång till mycket lång			8
	Very long	Meget lang	Mycket lång			9
10	QN	VG	A	(+)	40-45	
	Leaf blade: length	Bladplade: længde	Bladplatta: längd			
	Very short	Meget kort	Mycket kort			1
	Very short to short	Meget kort til kort	Mycket kort till kort			2
	Short	Kort	Kort	Fairway		3
	Short to medium	Kort til middel	Kort till medel			4
	Medium	Middel	Medel	Sigurd		5
	Medium to long	Middel til lang	Medel till lång			6
	Long	Lang	Lång	Aloyzious		7
	Long to very long	Lang til meget lang	Lång till mycket lång			8
	Very long	Meget lang	Mycket lång			9

DK no.	English		Dansk		Svenska	Example Varieties Eksempelsorter Exempelsorter	Noter/ Notes
11	QN	VG	A	(+)	40-45		
	Leaf blade: width		Bladplade: bredde		Bladplatta: bredd		
	Very narrow		Meget smal		Mycket smal		1
	Very narrow to narrow		Meget smal til smal		Mycket smal till smal		2
	Narrow		Smal		Smal	Evalotta KWS	3
	Narrow to medium		Smal til middel		Smal till medel		4
	Medium		Middel		Medel	Degas	5
	Medium to broad		Middel til bred		Medel till bred		6
	Broad		Bred		Bred	Sigurd	7
	Broad to very broad		Bred til meget bred		Bred till mycket bred		8
	Very broad		Meget bred		Mycket bred		9
12	QN	VG	A	(+)	40-45		
	Leaf blade: width compared to length		Bladplade: bredde i forhold til længde		Bladplatta: bredd i förhållande till längd		
	Very narrow		Meget smal		Mycket smal		1
	Very narrow to narrow		Meget smal til smal		Mycket smal till smal		2
	Narrow		Smal		Smal	Hopla	3
	Narrow to medium		Smal til middel		Smal till medel		4
	Medium		Middel		Medel	Palace	5
	Medium to broad		Middel til bred		Medel till bred		6
	Broad		Bred		Bred	Lavenda KWS	7
	Broad to very broad		Bred til meget bred		Bred till mycket bred		8
	Very broad		Meget bred		Mycket bred		9
13	PQ	VG	A	(+)	40-45		
	Leaf blade: shape of tip		Bladplade: spidsform		Bladplatta: spetsform		
	Pointed		Spids		Spetsig		1
	Slightly rounded		Let afrundet		Lätt avrundad	Evalotta KWS	2
	Blunt		Stump		Trubbig		3
14	PQ	VG	A		49		
	Root: color below ground		Rod: farve under jord		Rot: färg under jord		
	White		Hvid		Vit	Selma KWS	1
	White to yellow		Hvid til gul		Vit till gul		2
	Yellow		Gul		Gul		3
	Yellow to orange		Gul til orange		Gul till orange		4
	Orange		Orange		Orange		5
	Orange to red		Orange til røde		Orange till röd		6
	Red		Rød		Röd		7

DK no.	English		Dansk		Svenska	Example Varieties Eksempelsorter Exempelsorter	Noter/ Notes
15	PQ	VG	A	(+)	49		
	Root: shape		Rod: form		Rot: form		
	Spheroidal		Kugleformet		Sfärisk		1
	Spheroidal to ovoid		Kugleformet til oval		Sfärisk till äggformad		2
	Ovoid		Oval		Äggformad		3
	Ovoid to conical		Oval til konisk		Äggformad till konisk		4
	Conical		Konisk		Konisk	Evalotta KWS	5
	Conical to cylindrical		Konisk til cylindrisk		Konisk till cylindrisk		6
	Cylindrical		Cylindrisk		Cylindrisk		7
16	QN	MS	A	(+)	49		
	Root: length		Rod: længde		Rot: längd		
	Very short		Meget kort		Mycket kort		1
	Very short to short		Meget kort til kort		Mycket kort till kort		2
	Short		Kort		Kort	Smart Janninka KWS	3
	Short to medium		Kort til middel		Kort till medel		4
	Medium		Middel		Medel	Lunella KWS	5
	Medium to long		Middel til lang		Medel till lång		6
	Long		Lang		Lång	Knut	7
	Long to very long		Lang til meget lang		Lång till mycket lång		8
	Very long		Meget lang		Mycket lång		9
17	QN	MS	A	(+)	49		
	Root: width		Rod: bredde		Rot: bredd		
	Very narrow		Meget smal		Mycket smal		1
	Very narrow to narrow		Meget smal til smal		Mycket smal till smal		2
	Narrow		Smal		Smal	Bauer	3
	Narrow to medium		Smal til middel		Smal till medel		4
	Medium		Middel		Medel	Smart Janninka KWS	5
	Medium to broad		Middel til bred		Medel till bred		6
	Broad		Bred		Bred	Stevns	7
	Broad to very broad		Bred til meget bred		Bred till mycket bred		8
	Very broad		Meget bred		Mycket bred		9

DK no.	English		Dansk		Svenska	Example Varieties Eksempelsorter Exempelsorter	Notes/ Notes
18	QN	MS	A	(+)	49		
	Root: length compared to width		Rod: længde i forhold til bredde		Rot: längd i förhållande till bredd		
	Very low		Meget lav		Mycket låg		1
	Very low to low		Meget lav til lav		Mycket låg till låg		2
	Low		Lav		Låg		Stevns 3
	Low to medium		Lav til middel		Låg till medel		4
	Medium		Middel		Medel		Evalotta KWS 5
	Medium to high		Middel til høj		Medel till hög		6
	High		Høj		Hög		Cub 7
	High to very high		Høj til meget høj		Hög till mycket hög		8
	Very high		Meget høj		Mycket hög		9
19	QN	MS	A	(+)	49		
	Root: height above ground		Rod: højde over jord		Rot: höjd över jord		
	Very low		Meget lav		Mycket låg		1
	Very low to low		Meget lav til lav		Mycket låg till låg		2
	Low		Lav		Låg		Smart Renja KWS 3
	Low to medium		Lav til middel		Låg till medel		4
	Medium		Middel		Medel		Evalotta KWS 5
	Medium to high		Middel til høj		Medel till hög		6
	High		Høj		Hög		Fairway 7
	High to very high		Høj til meget høj		Hög till mycket hög		8
	Very high		Meget høj		Mycket hög		9
20	QN	MS	A	(+)	49		
	Root: ratio above ground		Rod: andel over jord		Rot: andel över jord		
	Very little		Meget lille		Mycket liten		1
	Very little to little		Meget lille til lille		Mycket liten till liten		2
	Little		Lille		Liten		Smart Renja KWS 3
	Little to medium		Lille til middle		Liten till medel		4
	Medium		Middel		Medel		Vertigo 5
	Medium to large		Middel til stor		Medel till stort		6
	Large		Stor		Stort		Fenja KWS 7
	Large to very large		Stor til meget stor		Stort till mycket stort		8
	Very large		Meget stor		Mycket stort		9

8.1 Explanations

8.1.1 Ad 1: Germinity

2 x 50 seeds from the submitted sample (growth stage 10-20) are assessed. The germinity is then assessed on a scale from 1 to 2 by counting the number of sprouts per seed cluster.

1 – monogerm, one sprout per seed cluster

2 – multigerm, more than one sprout per seed cluster

If 95 % or more are assessed as 1 – the variety is monogerm

If 95 % or more are assessed as 2 – the variety is multigerm

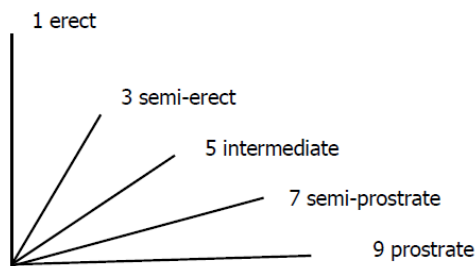
8.1.2 Ad 3: Hypocotyl: percentage of seedlings with anthocyanin coloration of hypocotyl

2 x 50 seeds from the submitted sample (growth stage 10-20) are assessed.

Assessment by counting the number of seedlings with anthocyanin coloration of hypocotyl. The following colors are counted as anthocyanin coloration: red, orange, pink.

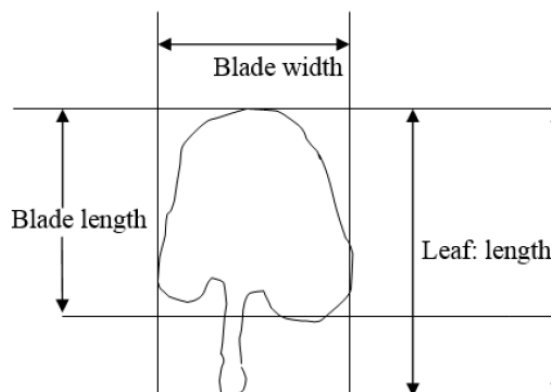
8.1.3 Ad 4: Leaf: attitude

Leaf: attitude is assessed on a scale from 1 to 9 on the second outermost leaf wreath on the beet. If the leaves are standing upright, a grade of 1 (erect) is given. If the leaves form an approximately 45-degree angle with the ground, a grade of 5 (intermediate) is given. If the leaves predominantly lie along the ground, a grade of 9 (prostrate) is given. The entire scale can be utilized.



8.1.4 Ad 9: Leaf length including petiole / 10: Leaf blade: length / 11: Leaf blade: width

Assessed in the field trial (growth stage 40-45).



8.1.5 Ad 12: Leaf blade: width compared to length

Assessed in the field trial (growth stage 40-45).



3 – Narrow



5 – Medium



7 - Broad

8.1.6 Ad 13: Leaf blade: shape of tip

Assessed in the field trial (growth stage 40-45)

- 1 - pointed
- 2 - rounded
- 3 - stump



1



2



3

8.1.7 Ad 14: Root: color below ground



1 - White



3 - Yellow



5 - Orange



7 - Red

8.1.8 Ad 15: Root: shape

Assessed on a scale from 1 to 7 in the field trial.



1 - Spherical



3 - Oval



5 - Conical



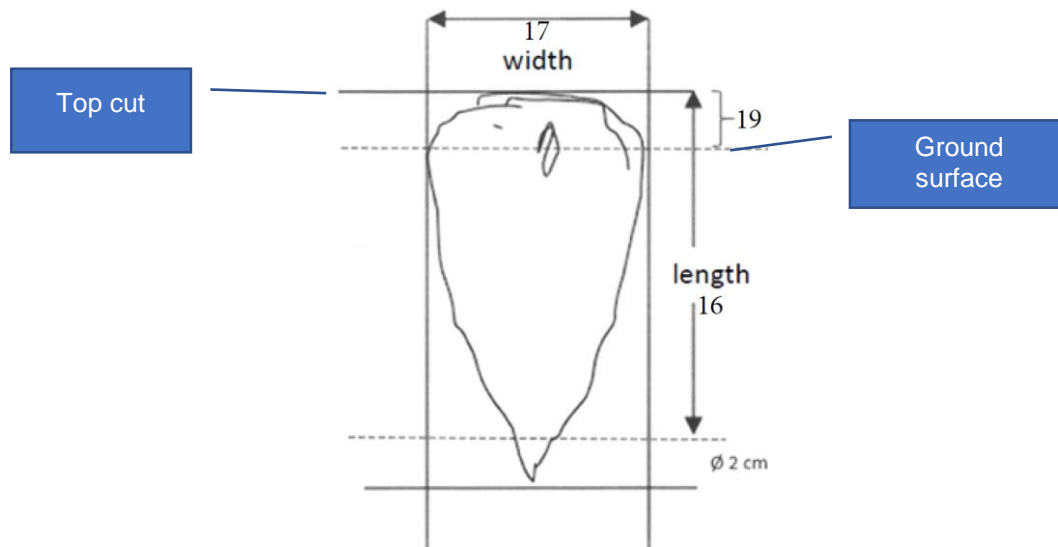
7 - Cylindrical

8.1.9 Ad 16, 17, 19: Root: length, width and height above ground

16 Root: length: To measure between the root tip at 2 cm diameter and the top cut (which is made at the base of the green petioles).

17 Root: width: To measure at the broadest extension of the root, parallel to the top cut.

19 Root: height above ground: Is measured from where the root changes color above ground (ground surface - typically the mechanical mark, left from the machine lifting the roots in the field can be used as guide) to the top cut.

8.1.10 Ad 18: Root: length compared to width

Must be calculated as the ratio Root: length divided with Root: width.

8.1.11 Ad 20: Root: ratio above ground

Must be calculated as ratio Root: height above ground divided with Root: length.

