

Role of DUS test and Functional characteristics



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1. Purpose of DUS test

- what is DUS**

2. Role of DUS test

- definition of a variety**
- How to observe characteristics**
- Examination of DUS**

UPOV principles

■ Conditions for Protection

Article 5; 91 Act of the UPOV

[Criteria to be satisfied] The breeder's right shall be granted where the variety is

- **New**
- **Distinct**
- **Uniform**
- **Stable**

[Other conditions]denomination, fees

What is DUS?

D: must be distinguishable from any other varieties



What is DUS?

U: must be uniform



What is DUS?

S: must be unchanged after repeated propagation



Next
generation



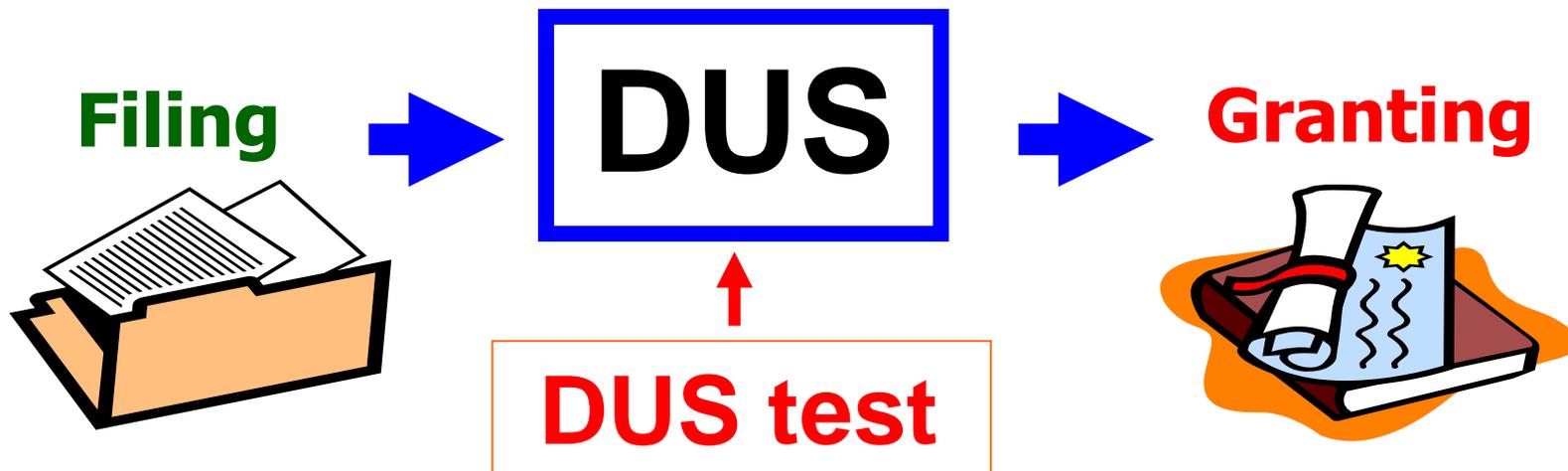
Next
generation

UPOV principles

■ Examination of the Application

Article 12; 91 Act of the UPOV

Any decision to grant a breeder's right shall require an examination for compliance with the conditions under Articles 5 to 9.



Purpose of DUS test: to assess whether the variety complies with the DUS requirements

What should we do in the DUS test?

Purpose of DUS test

■ Characteristics as the Basis for Examination of DUS

TG/1/3: 2.4

1. For any variety to be capable of protection it must first be clearly defined.
2. Only after a variety has been defined can it be finally examined for fulfillment of the DUS criteria required for protection.



purpose of DUS test

1. To define the variety by the expression of characteristics
2. To examine the DUS

D efinition

of the variety

by the expression of characteristics

Definition of a variety

**To define the variety
by the expression of characteristics**



**To clarify the expression of
characteristics , then make a variety
description of the variety**

example; variety description of tomato

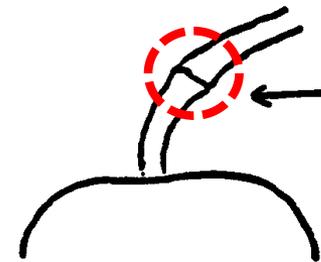
Definition of a variety

TGs for Tomato

19. (*)	VG	Peduncle: abscission layer	Example varieties	Note
QL		absent	Aledo, Bandera, Count, Lerica	1
		present	Montfavet H 63.5, Roma	9



1
absent



9
present

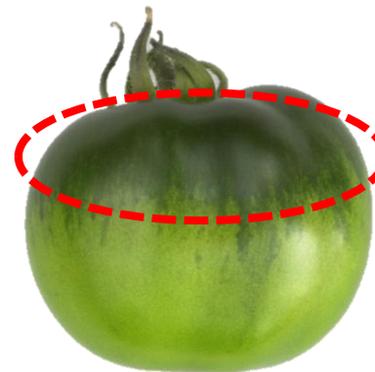
Definition of a variety

TGs for Rice

21. (*)(+)	VG	Fruit: green shoulder (before maturity)	Example varieties	Note
QL	(b)	absent	Felicia, Rio Grande, Trust	1
		present	Daniela, Montfavet H 63.5	9



1
absent

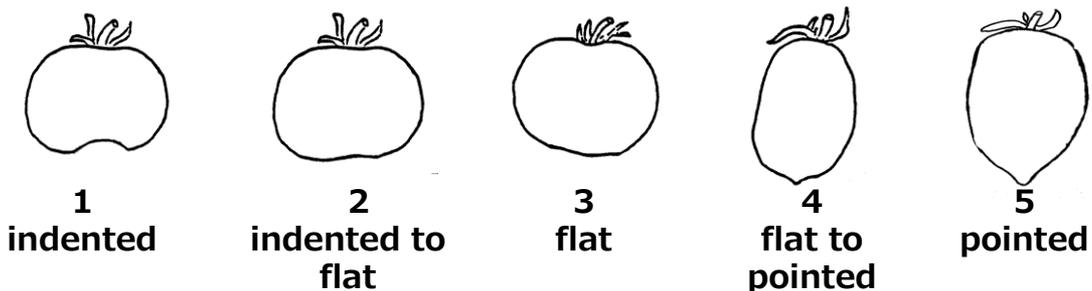
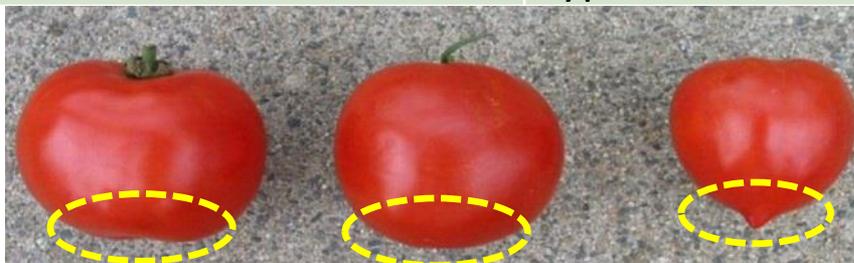


9
present

Definition of a variety

TGs for Rice

33. (+)	VG	Fruit: shape at blossom end	Example varieties	Note
QN	(c)	indented	Marmande VR, Super Mech	1
		indented to flat		2
		flat	Montfayet H 63.4, Montfayet H 63.5	3
		flat to pointed	Cal J, Early Mech, Peto Gro	4
		pointed	Europeel, Heinz 1706, Hypeel 244, Roma VF	5



Definition of a variety

Example: the characteristics assessed are . . .



abscission layer

9: present



green shoulder

9: present



shape at blossom end

3: flat



The variety description which is defined by the expression of characteristics

Observe

Observation of Characteristics

- ✓ **Type of Expression of characteristics**
- ✓ **Method of Observation / Type of Record**

Type of Expression

QL

Qualitative

Characteristics

Type of Expression

QN

Quantitative

Characteristics

Type of Expression

PQ

Pseudo Qualitative

Characteristics

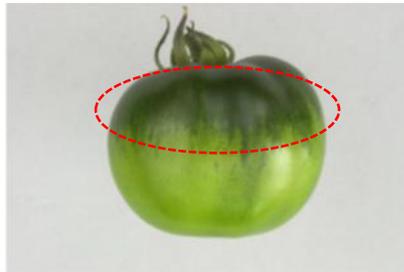
Type of Expression: QL

- ✓ are expressed in discontinuous states
- ✓ As a rule, the characteristics are not influenced by environment.

Fruit: green shoulder (before maturity)



Absent 1

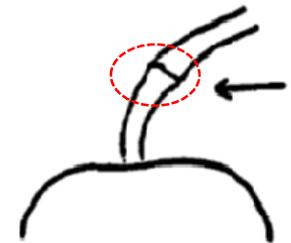


Present 9

Peduncle: abscission layer



absent 1



present 9

Type of Expression: QL

Fruit: anthocyanin coloration (chili)

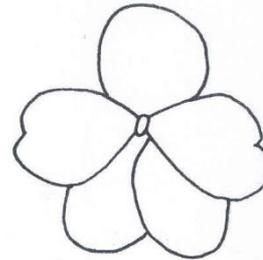


Absent 1

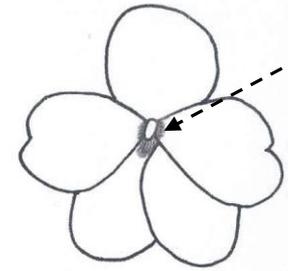


Present 9

flower: presence of eye zone (Impatiens)



Absent 1



Present 9

Tree: sex expression of flowers (persimmon)

16. (*) (a)	Tree: sex expression of flowers	Example variety	Notes
QL	female only	Fuyu, Hiratanenashi, Jiro	1
	female and male	Hanagoshō	2
	female, male and hermaphrodite	Kubogataobishi, Meotogaki	3

ploidy (watermelon)

1 (*) (+)	VG	Ploidy	Example variety	Notes
QL		diploid	SP 4, Sugar Baby, Yamato 3	2
		triploid	Boston, TRIX 313	3
		tetraploid		4

Type of Expression: QL

TG/76 Sweet Pepper, Hot Pepper, Paprika, Chili

23.

VG

**Fruit: anthocyanin
coloration**

**Example
varieties**

Note

QL

(a)

absent

present

Lamuyo

Alabástrom,
Purple beauty, Violette

1

9

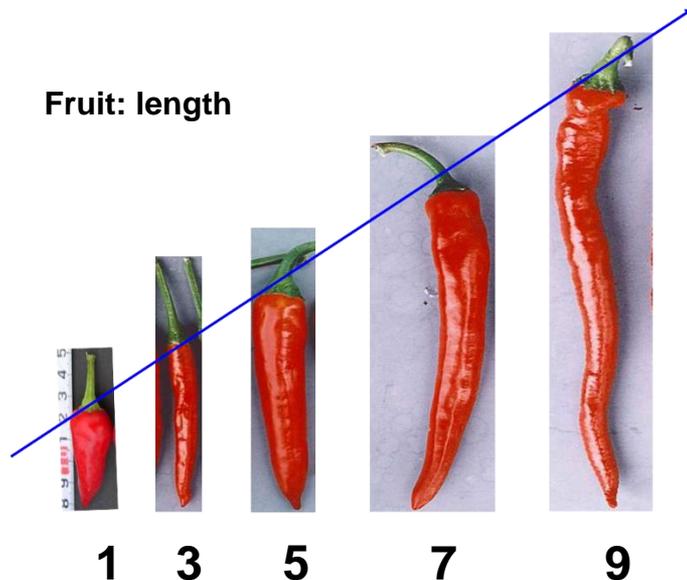
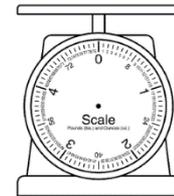
Type of expression

States of expression

Notes

Type of Expression: QN

- ✓ are measurable on a one-dimensional scale and show continuous variation
- ✓ length, height, width, thickness, weight, ..



states of expression

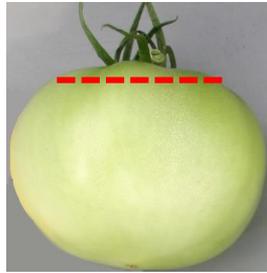
- very short
- very short to short
- short
- short to medium
- medium
- medium to long
- long
- long to very long
- very long

Notes

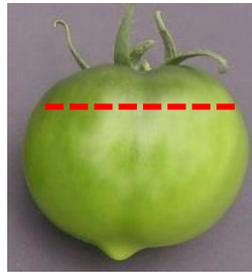
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9

Type of Expression: QN

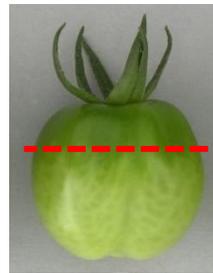
Fruit: extent of green shoulder (before maturity)



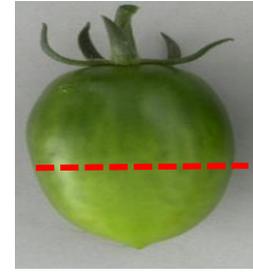
1
very small



3
small



5
medium



7
large

Fruit: ribbing at peduncle end



1
absent or very
weak

3
weak

5
medium

7
strong

9
very strong

Type of Expression: QN

1	40	Leaf blade: pubescence of surface	TG/16/8	
	VS		Rice	
QN	(a)	absent or very weak		1
		weak	Bắc thom số 7	3
		medium	DT122	5
		strong	Khang dân 18	7



3
weak



5
medium



7
strong

14.	(c)	Flower: arrangement of petals	TG/214/1	
	(*)		Catharanthus	
	(+)			
PQ		free	Kururi White	1
		touching	Flappe Coconut	2
		slightly overlapping	Flappe Lilac	3
		strongly overlapping	Peppermint Cooler	4



1
free



2
touching



3
slightly overlapping



4
strongly overlapping

13.	(b)	Leaf blade: angle of apex (excluding tip)	TG/70/4	
	(+)		Apricot	
QN		acute	San Castrese	1
		right-angled	Canino, Ceglédi óriás	2
		moderately obtuse	Bergeron, Polonais, Portici	3
		strongly obtuse	Hargrand, Moniquí	4



1
acute



2
right-angled



3
moderately obtuse



4
strongly obtuse

Type of Expression: QN

TG/44 Tomato

11.	VG	Leaf: size of leaflets	Example varieties	Note
(+)				
QN	(b)	very short	Minitom	1
		short	Tiny Tim	3
		medium	Marmande VR, Royesta	5
		long	Daniela, Hynema	7
		very long	Dombo	9



The size of leaflet should be observed in the middle of the leaf.

Type of Expression: QN

“1-9” scale

notes	states
1	very small (or: absent or very small)
2	very small to small
3	small
4	small to medium
5	medium
6	medium to large
7	large
8	large to very large
9	very large

notes	states
1	very weak (or: absent or very weak)
2	very weak to weak
3	weak
4	weak to medium
5	medium
6	medium to strong
7	strong
8	strong to very strong
9	very strong

Type of Expression: QN

■ Limited range

“1-5” scale

Stem: attitude

note	states
1	erect
3	semi-erect
5	prostrate

“1-4” scale

leaf blade: angle of apex

note	states
1	acute
2	Right-angled
3	moderately obtuse
4	strongly obtuse

“1-3” scale

Flower: fragrance

note	states
1	Absent or very weak
2	weak
3	strong



Type of Expression: PQ

- ✓ range of expression is at least partly continuous, but varies in more than one dimension

Fruit: shape in longitudinal section

		← broadest part →					
		(below middle)		at middle		(above middle)	
broad (compressed) ←	narrow (elongated) →	 10 pyriform	 8 ovate	 5 cylindric	 6 elliptic	 9 obovate	 7 cordate
		 11 obcordate		 4 oblong	 3 circular		
				 2 oblate			
				 1 flattened			

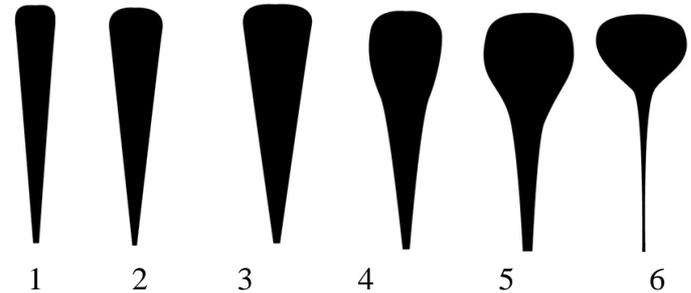
Type of Expression: PQ

TG/44 Tomato

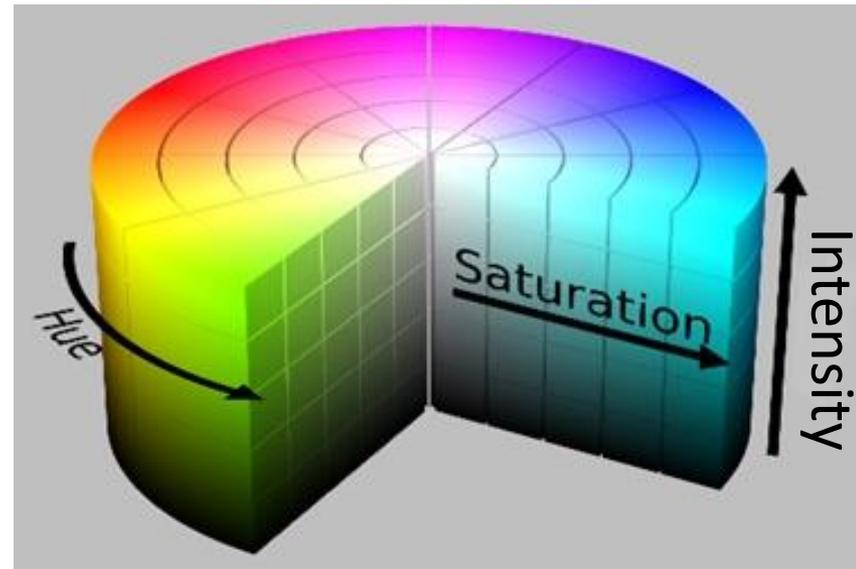
28. (*) (+)	VG MS	Fruit: shape in longitudinal section	Example Varieties	Note
		oblate	Liebesapfel	1
PQ	(b)	circular	Cherry Sweet	2
		cordate	Daniel	3
		square	Delphin, Yolo Wonder	4
		rectangular	Clovis, Nocera rosso	5
		trapezoidal	Delta, Marconi	6

Type of Expression: PQ

1	VG	Root: shape	TG/218/2
(*)			Parsnip
(+)			
PQ		narrow obtriangular	Fist 1
		medium obtriangular	Countess 2
		broad obtriangular	Tenor 3
		medium obovate	Merlin 4
		broad obovate	White King 5
		napiform	Kral, Rotund 6

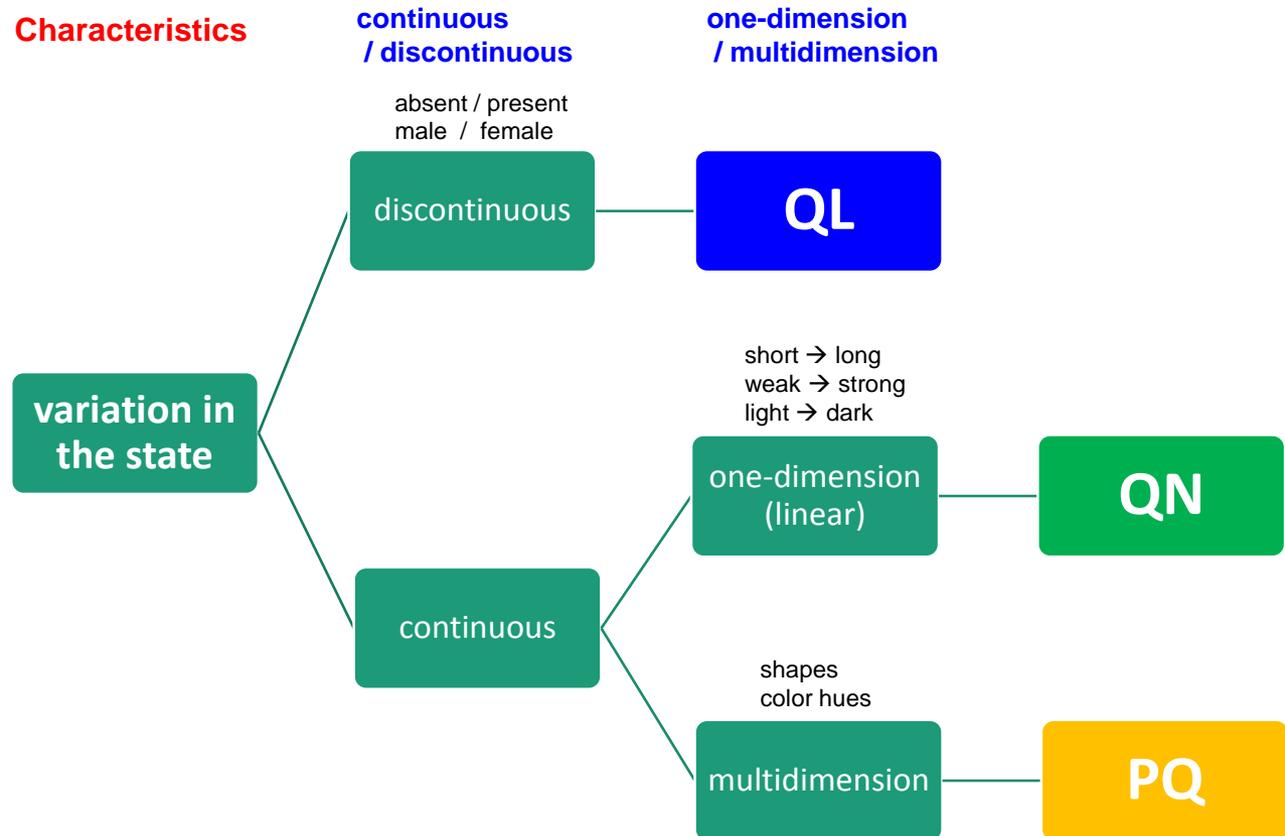


37.	VG	Fruit: color (at maturity)	TG/44
(*)			Tomato
(+)			
PQ	(c)	cream	Jazon, White Mirabell 1
		yellow	Goldene Königin, Yellow Pear 2
		orange	Sungold 3
		pink	Aichi First 4
		red	Daniela, Ferline, Montfavet H 63.5 5
		brown	Ozyrys 6
		green	Green Grape, Green Zebra 7



Types of expression

Decision making chart



Method of observation & Type of record

Method of observation:

M (measurement) : using a ruler/weighing scales, dates, counts, etc.

V (visual) : visual observation includes smell, taste and touch

Type of record:

G (Group) : single record for a variety, or a group of plants or parts of plants

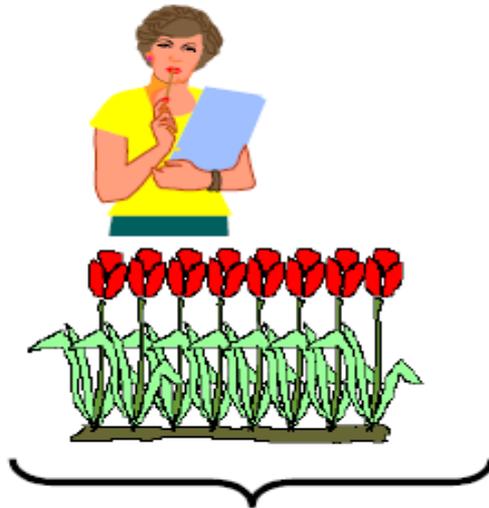
S (Single) : records for a number of single plants or parts of plants

Type of Assessment

VG : Visual assessment by a single observation of a group of plants or parts of plants.

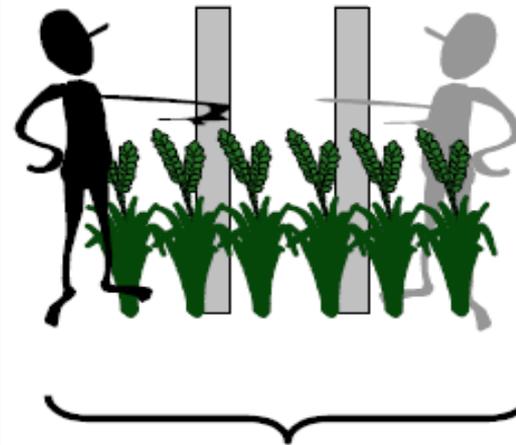
MG : Measurement by a single observation of a group of plants or parts of plants.

Example (VG): Flower: type
(tulip: vegetatively propagated)



single variety record

Example (MG): Plant: height
(wheat: self-pollinated)



single variety record

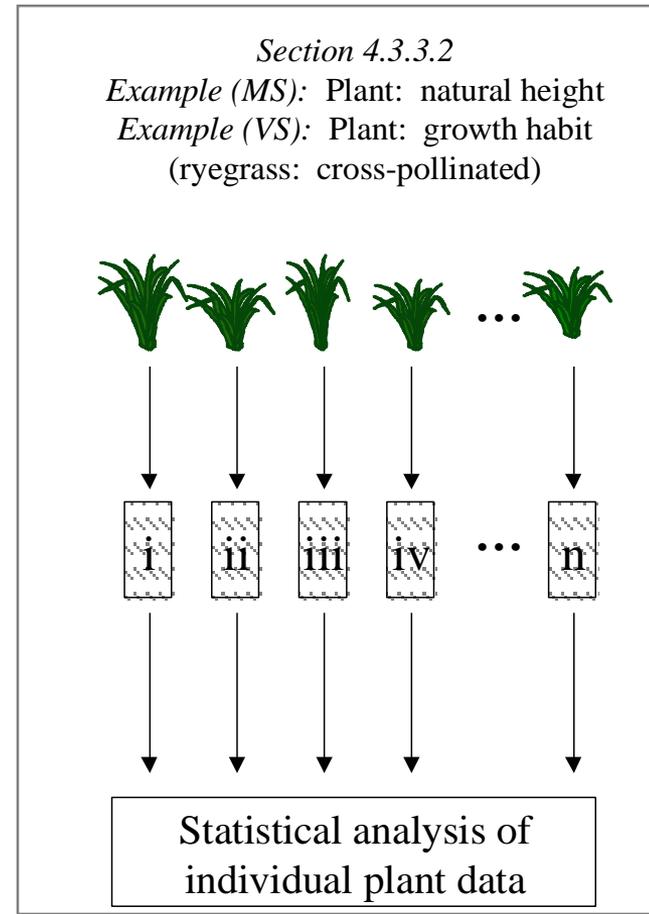
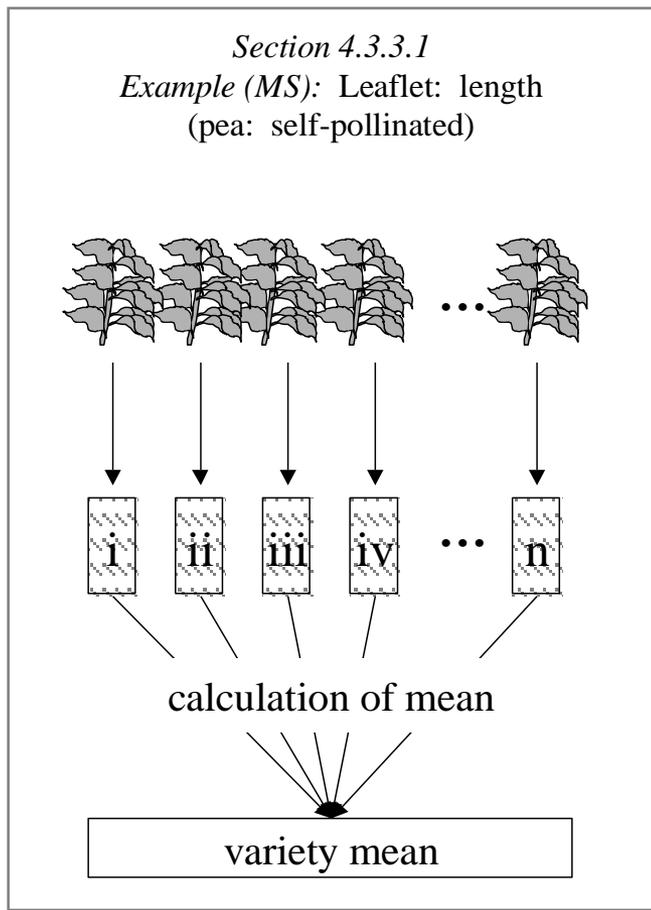
Type of Assessment

12.	VG	Leaf: intensity of green color		
QN	(a)	light	Macero II, Poncette, Rossol	3
		medium	Lucy	5
		dark	Allround, Daniela, Lorena, Red Robin	7
21.	VG	Fruit: green shoulder (before maturity)		
(*) (+)				
QL	(b)	absent	Felicia, Rio Grande, Trust	1
		present	Daniela, Montfavet H 63.5	9
37.	VG	Fruit: color (at maturity)		
(*) (+)				
PQ	(c)	cream	Jazon, White Mirabell	1
		yellow	Goldene Königin, Yellow Pear	2
		orange	Sungold	3
		pink	Aichi First	4
		red	Daniela, Ferline, Montfavet H 63.5	5
		brown	Ozyrys	6
		green	Green Grape, Green Zebra	7

Type of Assessment

MS : Measurement of a number of individual plants or parts of plants.

VS : Visual assessment by observation of a number of individual plants or parts of plants.



Type of Assessment

43.	MS	Time of flowering		
	(+)			
QN		early	Feria, Primabel	3
		medium	Montfavet H 63.5, Prisca	5
		late	Manific, Saint-Pierre	7
44.	MG	Time of maturity		
	(*) (+)			
QN		very early	Dolcevita, Sungold, Sweet Baby	1
		early	Bianca, Rossol, Shiren	3
		medium	Gourmet, UC 82B	5
		late	Arletta, Durinta	7
		very late	Daniela	9

Type of Assessment

■ Type of assessment in Tomato TGs

	QL	PQ	QN	Total
VS	0	0	0	0
VG	11	3	19	33
VG/MS	0	0	12	12
MS	0	0	1	1
MG	0	0	1	1
	11	3	33	47

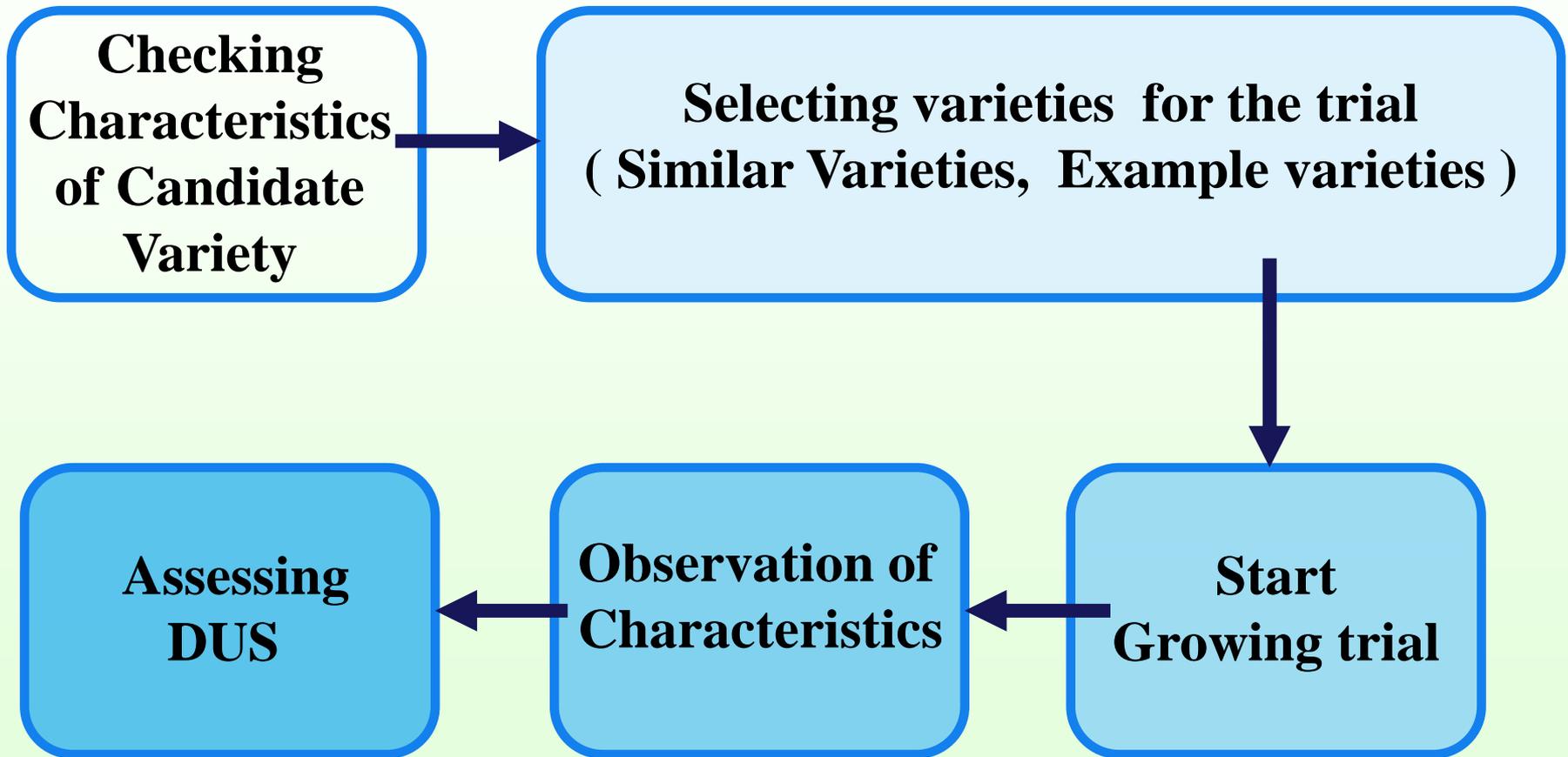
+ 23 QL : Disease char.

- **QL,PQ**; mainly Visual
- **QN**; Visual, Measurement

DUS

Examination

Workflow of the DUS test



DUS test

DUS test



Candidate variety



Similar varieties



Example varieties

Similar varieties: Varieties very close to the candidate varieties in morphological, physiological characteristics

Example varieties: Varieties to clarify the states of expression of a characteristic, then to assist with preparation of the description

D

Distinctness examination

Distinctness

Requirement:

Article 7; 91 Act of the UPOV

- a variety must be **clearly distinguishable** from any other variety whose existence is a matter of common knowledge.

clearly distinguishable => **1. Consistent**
2. Clear

Clearly Distinguishable from any other varieties ?

"it is necessary to examine distinctness in relation to all varieties of common knowledge."



VS



Compare **Candidate variety** **VS** **Existing varieties**

Selection of Similar Varieties

Where a candidate variety is sufficiently different from particular group of varieties,



VS



No need to compare the candidate variety with different group of varieties

Selection of Similar Varieties



VS



No need to compare candidate variety with different group of varieties

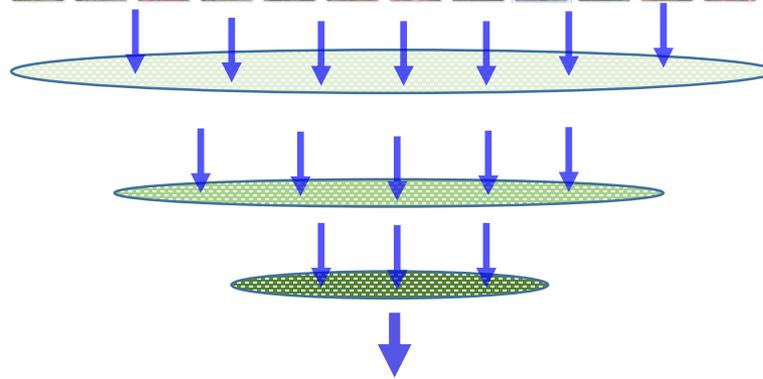
How to select different group of varieties?

Selection of Similar Varieties

Selecting the similar varieties



Candidate varieties



Grouping characteristics



Similar varieties

Selection of Similar Varieties

Not be necessary for comparing with all varieties, where a candidate variety is different from a particular group of varieties



VS

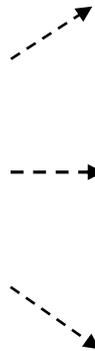


Compare *Candidate variety* **VS** *Similar varieties*

Selection of Similar Varieties



Candidate varieties



≠



≠



≠



Similar varieties

the candidate variety is considered to be distinguished to all existing varieties

Grouping characteristics

■ Grouping characteristics: Tomato

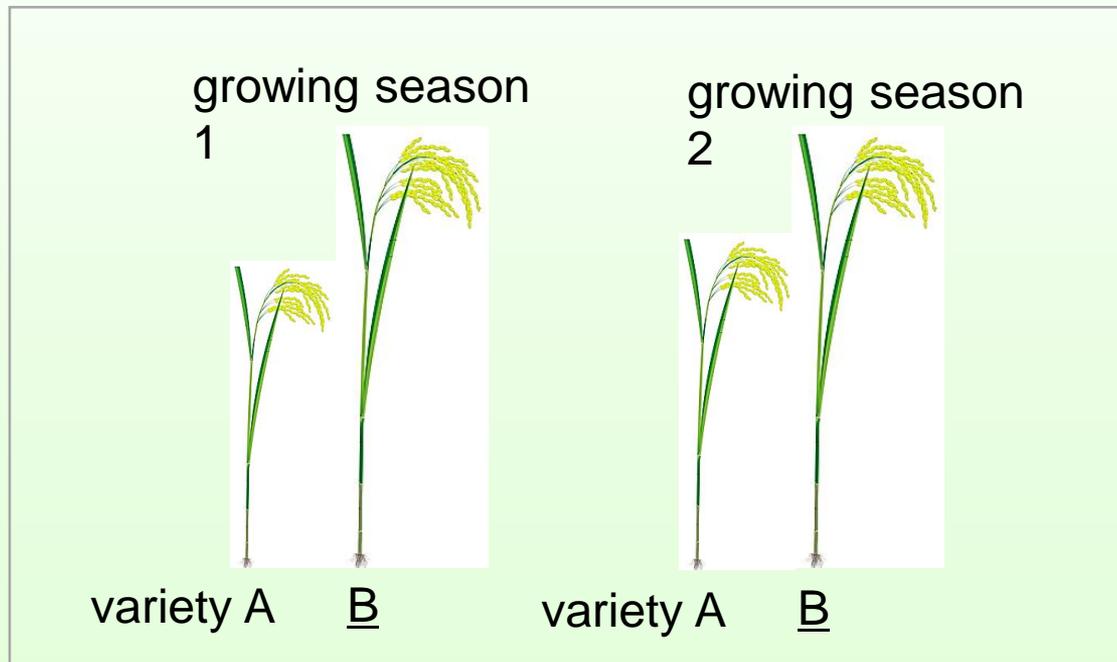
- (a) Plant: growth type (characteristic 2: QL)
- (b) Leaf: type of blade (characteristic 10: QL)
- (c) Peduncle: abscission layer (characteristic 19:QL)
- (d) Fruit: green shoulder (before maturity)
(characteristic 21:QL)
- (e) Fruit: size (characteristic 26:QN)
- (f) Fruit: shape in longitudinal section (characteristic 28:PQ)
- (g) Fruit: number of locules (characteristic 36:QN)
- (h) Fruit: color (at maturity) (characteristic 3:PQ)

Distinctness

Consistent difference

1. Consistent difference:

To ensure sufficient consistent is to examine the characteristics in at two independent growing cycles.



Each time, variety B is taller than variety A

Distinctness

Clear difference

2. Clear differences:

Determining whether a difference between two varieties is clear depends on the **type of expression of the characteristics**.



QL: Qualitative

QN: Quantitative

PQ: Pseudo-Qualitative

Distinctness

Clear difference

QL characteristics:

TG/1/3: 5.3.3.2.1

Requires:

- the difference between two varieties may be considered clear if one or more characteristics have expressions that **fall into two different states in the Test Guidelines**

Different "states" can be considered to be Distinct

Distinctness

Clear difference

QN characteristics:

TG/1/3: 5.3.3.2.2

- For QN, a **difference of two Notes often represents a clear difference**, but that is not an absolute standard for assessment of distinctness. Depending on factors, such as the testing place, the year, environmental variation or range of expression in the variety collection, a clear difference may be more or less than two Notes. Guidance is provided in document TGP/9, ‘Examining Distinctness’.”

✓ **“Two Notes” rule**

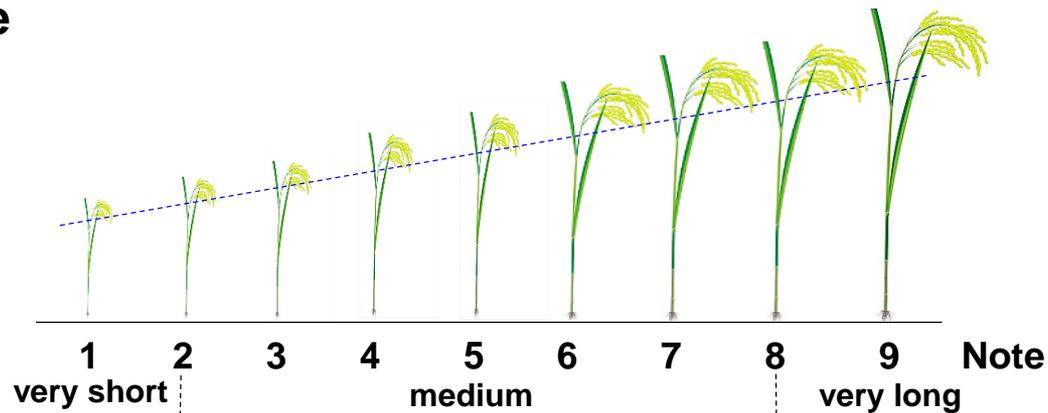
Distinctness

Clear difference

QN characteristics:

clear difference

(stem: Length)



Note 2:8; clear difference

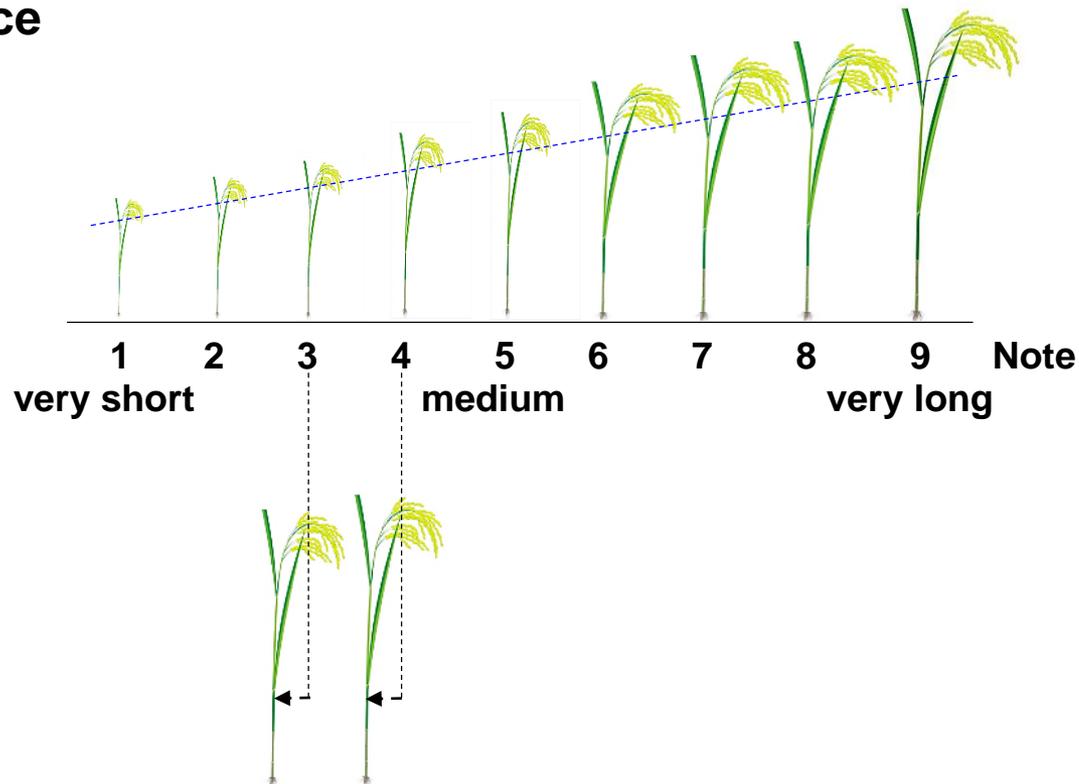
Distinctness

Clear difference

QN characteristics:

clear difference

(stem: Length)

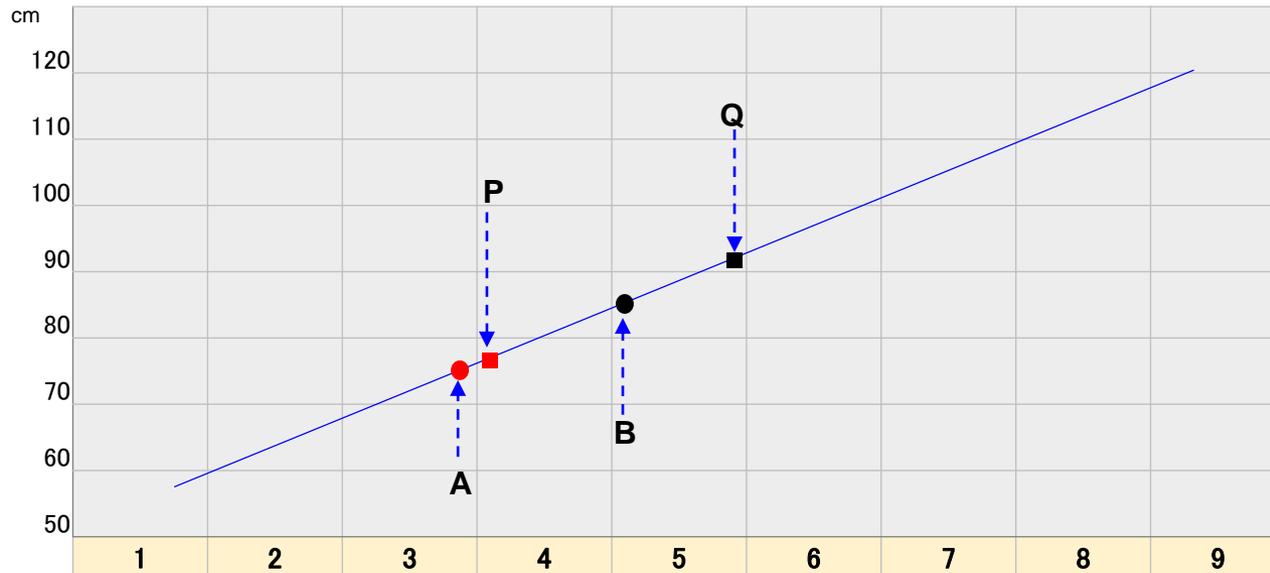


Note 3:4; may not be a clear difference

Distinctness

Clear difference

QN: Stem: Length



	length: cm	Notes
A	75.0	3
B	85.0	5
A - B	10.0	2
P	77.0	4
Q	92.0	5
P - Q	15.0	1

Note

two note 3:5 |A-B|    10 cm

one note 4:5 |P-Q|    15 cm

$$4:5 |P-Q| > 3:5 |A-B|$$

“Two Notes” rule means at least One note difference

Distinctness

Clear difference

PQ characteristics:

TG/1/3: 5.3.3.2.3

- **A different state in the Test Guidelines may not be sufficient to establish distinctness** (see also section 5.5.2.3). However, in certain circumstances, varieties described by the same state of expression may be clearly distinguishable.
- ✓ It is difficult to define a general rule on the difference in Notes to establish Distinctness.
- ✓ **should be assessed on a Case by case basis**

Examining Distinctness



Distinctness

Clear difference

	Characteristics	Assessment
QL	<ul style="list-style-type: none">- discontinuous states- absent / present	one or more characteristics have expressions that fall into two different states
QN	<ul style="list-style-type: none">- continuous states- length, width	A difference of two notes represents a clear difference
PQ	<ul style="list-style-type: none">- more than one dimension- shape, color	A different state in the TGs may not be sufficient



Uniformity examination

Uniformity

Requirement:

Article 8; 91 Act of the UPOV

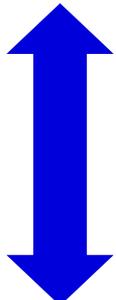
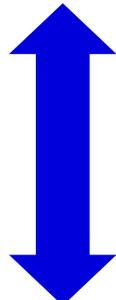
- A variety must be sufficiently uniform in its relevant characteristics, subject to the variation that may be expected from the **particular features of its propagation**

Where all the plants of a variety are very similar, and in particular for vegetatively propagate and self-pollinated varieties, **Uniformity is assessed by the number of off-types**

How many off-types should we accept?

Uniformity

■ Acceptable number of off-types

features of propagation	Genetic variation	Acceptable Number of off-types
•Vegetatively propagated	Low	Low
•Self-pollinated		
•Hybrid (single-cross)		
•Cross-pollinated		
•Hybrid (Multiple-cross)		

Where all the plants of a variety are very similar, and in particular for vegetatively propagated and self-pollinated varieties, Uniformity is assessed by the number of off-types

Uniformity

How many off-types should we accept?

According to the size of the sample examined, statistical tables give the maximum number of off-types tolerated in that given samples

e.g.: *population standard = 1% and*
 acceptance probability = 95%

<i>Sample size</i>	<i>Number of off-types allowed</i>
<i>1-5</i>	<i>0</i>
<i>6-35</i>	<i>1</i>
<i>36-82</i>	<i>2</i>
<i>83-137</i>	<i>3</i>
<i>138-198</i>	<i>4</i>
<i>199-262</i>	<i>5</i>

Uniformity

How many off-types should we accept?

- **Population standard**

 - (Acceptable Number of off-types)

 - ✓ Percentage of off types to be accepted if all individuals of the variety could be examined

- **Acceptance probability**

 - ✓ Probability of correctly accepting that a variety is uniform

PS, AP in each UPOV TGs

population standard	Acceptance probability	sample size	Number of off types	species
0.1	95	1500	4	Rice
0.1	95	2000	5	Durum wheat
1	95	5	0	Almond, Blueberry, Persimmon, Avocado, coffee, fig, Dragon fruit, Mango
1	95	6	1	Nerium, BirdCherry, Buddleja, Papaya
1	95	7	1	Eucalyptus, Rubber
1	95	8	1	Alstromeria, Hydrangea, Clematis, Rose of Sharon, Canna, Hebe
1	95	9	1	Phalaenopsis, Oncidium
1	95	10	1	Bougainvillea, Camellia, Pineapple, Dendrobium, TeaTree, Brachyscome, Poinsetia
1	95	12	1	Dahlia
1	95	15	1	ZonalPelargonium, Banana, Lobelia, Osteospermum, Sutera
1	95	20	1	Yam, Peppermint, Pumpkin, Tomato, Lily, Melon, Gladiolus, Chrysanthemum
1	95	24	1	sugarcane
1	95	25	1	tulip
1	95	40	2	bitter gourd, asparagus, Brussels sprout, cucumber, Petunia, Antirrhinum, Onion
1	95	50	2	Amaranth, Sweet potato, Sesame
1	95	60	2	cornsalad, chinese Cabbage, broccoli, Calabres sprouting, chimes Chive, Shiitake
1	95	90	3	Oyster Mushroom
1	95	100	3	Chick Pea, Lentil
2	95	20	2	Elatior Begonia, Kalanchoe, Chili, Watermelon,
2	95	200	7	Beetroot, Carrot, Leek, Radish, Black Radish
3	95	40	3	Maize
5	95	40	4	Artichoke, Cardoon
Hybrids:2 inbred:2	Hybrids:95 inbred:95	Hybrids:100 inbred:200,30	Hybrids:5 inbred:7,2	Parsnip
Hybrids:2 inbred:3	Hybrids:95 inbred:95	Hybrids:100 inbred:100	Hybrids:5 inbred:6	Spinach,
inbred:1 (s)cross:3	inbred:95 (s)cross:95	inbred:60 (s)cross:60	inbred:2 (s) cross:4	Cauliflower

Uniformity



Uniformity

Off-type

- A plant is to be considered an off-type if it can be ***clearly distinguished from the variety*** in the expression of any characteristic of the whole or part of the plant that is used in the testing of distinctness, taking into consideration the particular features of its propagation.

clearly distinguished from the variety = same criteria as for Distinctness

S

Stability examination

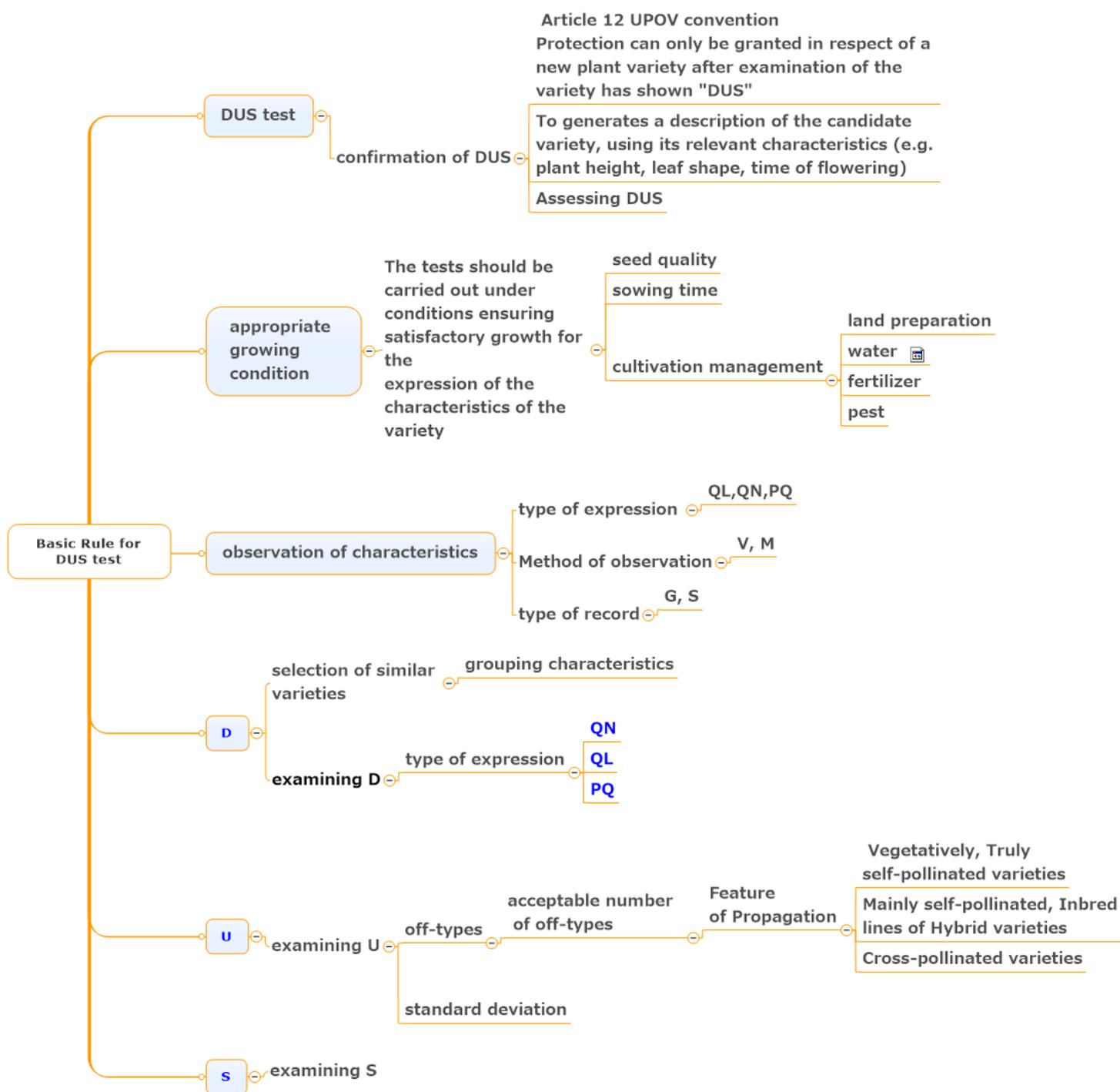
Stability

Requirement:

Article 9; 91 Act of the UPOV

- Relevant characteristics must remain unchanged after repeated propagation
 - In practice, it is not usual to perform tests of stability that produce results as certain as those of the testing of distinctness and uniformity.
 - However, for many types of variety, when a variety has been shown to be uniform, it can also be considered to be stable
 - Where appropriate, or in cases of doubt, stability may be tested, either by growing a further generation, or by testing a new seed or plant stock to ensure that it exhibits the same characteristics as those shown by the previous material supplied.

Making a Test Report



Thank you for your attention

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