

Role of DUS test and Functional characteristics



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- **what is DUS**

2. Role of DUS test

- **definition of a variety**
- **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**

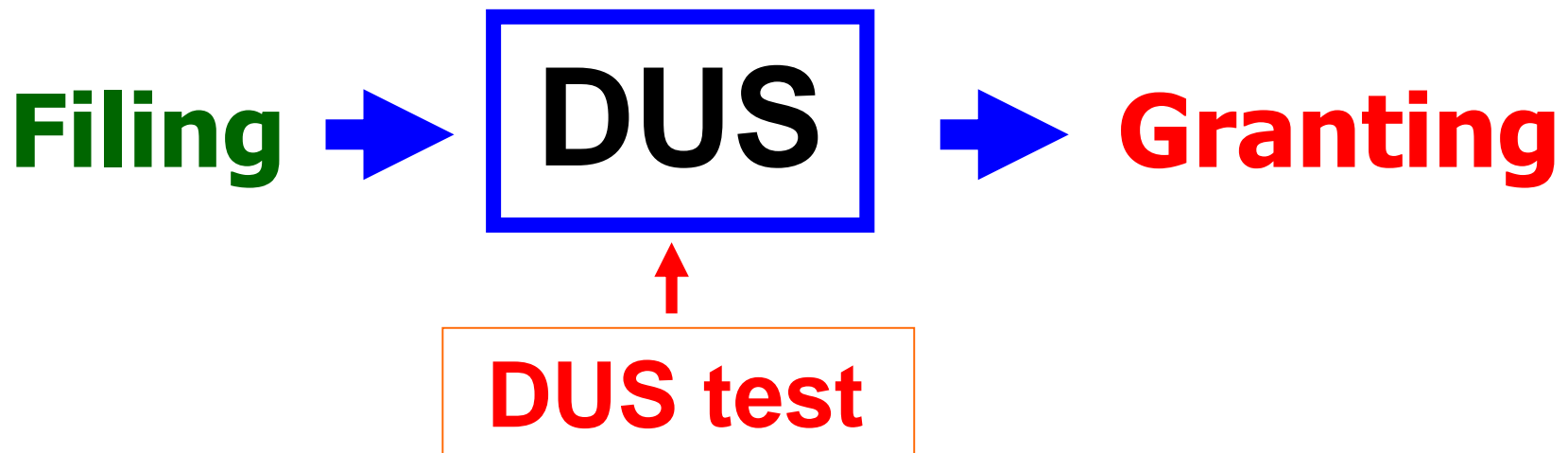
[Other conditions]denomination, fees

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 comply with the DUS requirements

What are UPOV principles ?

What is DUS ?

**How should we do in the DUS
Test ?**

What is DUS?

D: must be distinguishable

D The variety shall be deemed to be distinct if it is clearly distinguishable from any other variety whose existence is a matter of common knowledge at the time of the filing of the application.



What is DUS?

U: must be uniform

U The variety shall be deemed to be uniform if, subject to the variation that may be expected from the **particular features of its propagation**, it is sufficiently uniform in its relevant characteristics.



What is DUS?

S: must be unchanged

S

The variety shall be deemed to be stable if its relevant characteristics remain unchanged after repeated propagation or, in the case of a particular cycle of propagation, at the end of each such cycle.



**Next
generation**



**Next
generation**

What should we do in the DUS test?

Purpose of DUS test

■ UPOV convention: Article 1 (vi): Definition of variety


(vi) "variety" means a plant grouping within a single botanical taxon of the lowest known rank, which grouping, irrespective of whether the conditions for the grant of a breeder's right are fully met, can be

- defined by the expression of the characteristics resulting from a given genotype or combination of genotypes,
- distinguished from any other plant grouping by the expression of at least one of the said characteristics and
- considered as a unit with regard to its suitability for being propagated unchanged;

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.
- 
3. UPOV convention have established that a variety is defined by its characteristics and those characteristics are the basis on which a variety can be examined for DUS.

purpose of DUS test

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

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

Definition of a variety

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

means

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

example; variety description of Rice

Definition of a variety

Example: Characteristics for definition of a variety

	Characteristics
1	Leaf: anthocyanin coloration of auricles
2	Time of heading
3	Stem: length
4	Decorticated grain: length
5	Decorticated grain: color

Definition of a variety

TGs for Rice

9 (*)	40 VS	Leaf: anthocyanin coloration of auricles	Example varieties	Note
QL	(a)	absent	Khang dân 18, Bắc thơm số 7	1
		present	Trân châu lùn	9



1



9

Definition of a variety

TGs for Rice

19 (*)	55 VG	Time of heading (50% of plants with heads)	Example varieties	Note
QN		very early		1
		early	Koshihikari kazusa 2 go	3
		medium	NTL1, Q5	5
		late		7



Definition of a variety

TGs for Rice

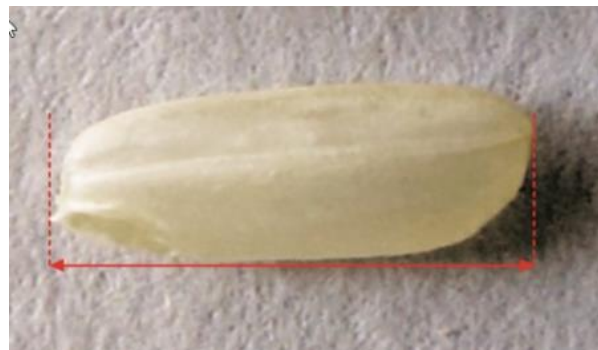
26(*)	70VS	<u>Non-prostrate varieties only: Stem length (excluding panicle)</u>	Example varieties	Note
QN		very short		1
		short	Koshihikari kazusa 2 go	3
		medium	Bắc thơm số 7	5
		long	BM9962	7
		very long		9



Definition of a variety

TGs for Rice

58 (*)	92 MS	Decorticated grain: length	Example varieties	Note
QN		short	Koshihikari kazusa 2 gou	3
		medium	Hoa khôi 4	5
		long		7



Definition of a variety

TGs for Rice

61 (*)	92 VS	Decorticated grain: color	Example varieties	Note
PQ		white	NTL1	1
		light brown	Bắc thơm số 7	2
		variegated brown		3
		dark brown		4
		light red		5
		red	DTL2	6
		variegated purple		7
		purple		8
		dark purple/black		9



1





6



Kaneda;2005



Definition of a variety

Example: Results of observation, measurement: using five characteristics

		Characteristics	data	states of expression	note
QL	VS	Leaf: anthocyanin coloration of auricles			
QN	VG	Time of heading	99 days		
QN	VS	Stem: length	77.8 cm		
QN	MS	Decorticated grain: length	5.7 mm		
PQ	VS	Decorticated grain: color			

Definition of a variety

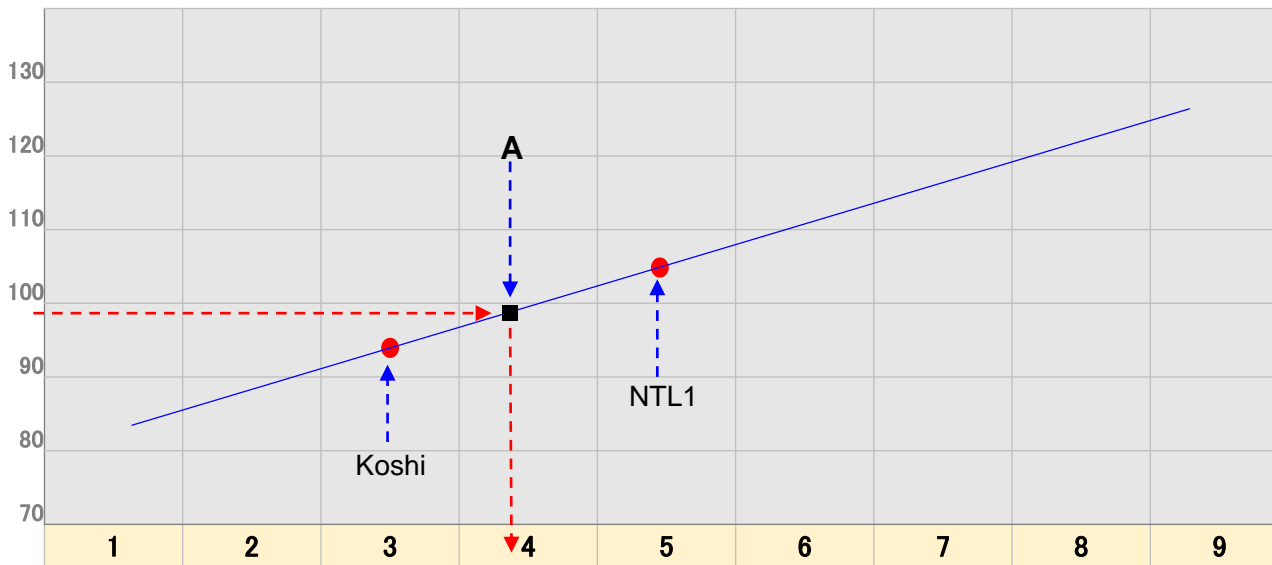
Example: Results of observation, measurement: using five characteristics

		Characteristics	data	states of expression	note
QL	VS	Leaf: anthocyanin coloration of auricles		absent	1
QN	VG	Time of heading	99 days	compare with example varieties	?
QN	VS	Stem: length	77.8 cm	compare with example varieties	?
QN	MS	Decorticated grain: length	5.7 mm	compare with example varieties	?
PQ	VS	Decorticated grain: color		white	1

Definition of a variety

Notes from data: based on example variety's data

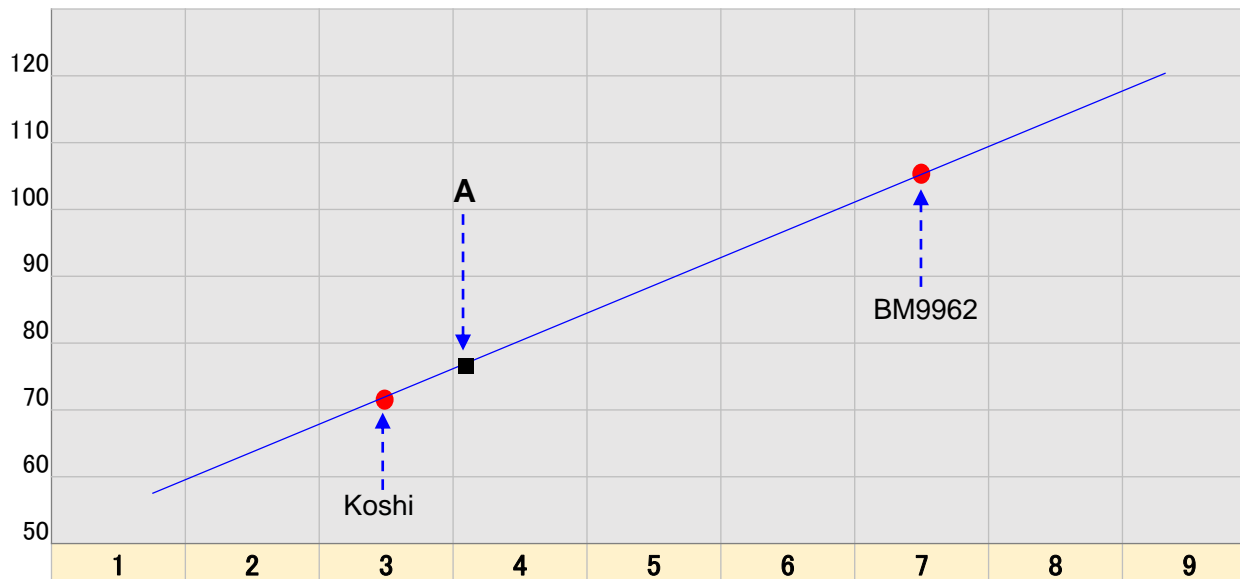
QN: Time of heading



	days	Notes
Koshihikari kazusa 2 go	94	3
NTL 1	106	5
Q 5	106	5
A	99	4

Definition of a variety

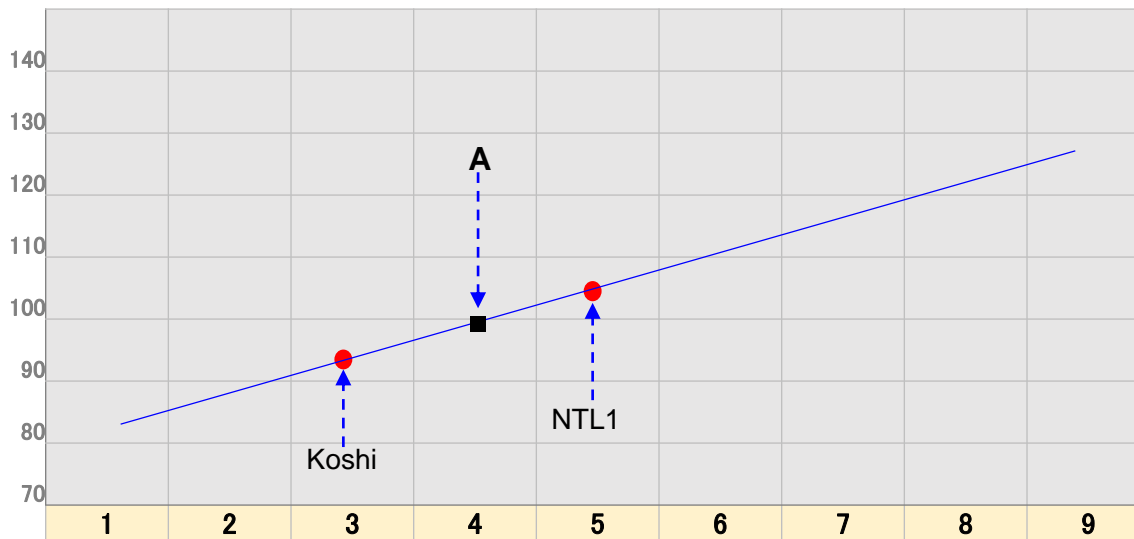
QN: Stem: Length



	cm	Notes
Koshihikari kazusa 2 go	71.0	3
Bắc thơm số 7	78.5	4
BM 9962	106.9	7
A	77.8	4

Definition of a variety



QN: Decorticated grain: Length



	days	Notes
Koshihikari	4.9	3
kazusa 2 go		
Hoa khôì 4	6.3	5
A	5.7	4

Definition of a variety

Example: Results of observation, measurement: using five characteristics

		Characteristics	data	states of expression	note
QL	VS	Leaf: anthocyanin coloration of auricles		absent	1
QN	VG	Time of heading	99 days		4
QN	VS	Stem: length	77.8 cm		4
QN	MS	Decorticated grain: length	5.7 mm		4
PQ	VS	Decorticated grain: color		white	1

Definition of a variety

1. To define the variety by the expression of characteristics

Example: variety description:

RICE			
Variety: A			
Characteristics		State of expression	Notes
1. Leaf: anthocyanin coloration of auricles		absent	1
2. Time of heading		early to medium	4
3. Stem: length		short to medium	4
4. Decorticated grain: length		short to medium	4
5. Decorticated grain: color		white	4

Types of expression of characteristics

QL: Qualitative

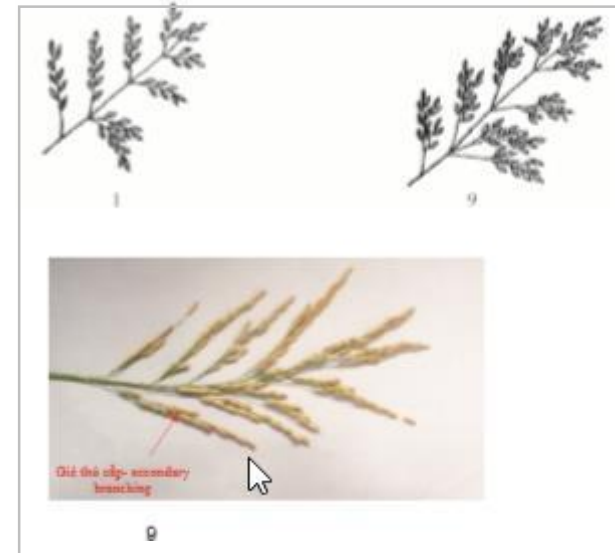
QN: Quantitative

PQ: Pseudo-Qualitative

Types of expression of characteristics

QL: Qualitative

		Characteristics	States of expression
6	QL	Leaf sheath: anthocyanin coloration	absent, present
27	QL	Stem: anthocyanin coloration of nodes	absent, present
32	QL	Panicle: awns	absent, present
40	QL	Panicle: presence of secondary branching	absent, present



Types of expression of characteristics

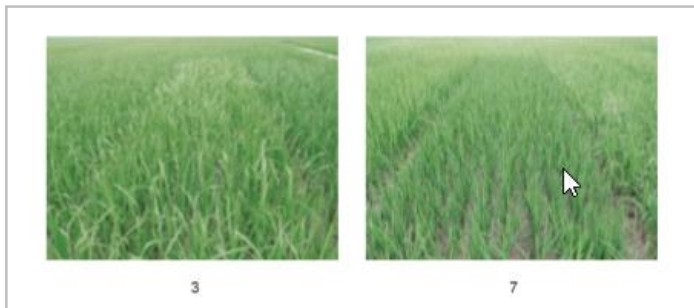
QL: Qualitative

- are expressed in discontinuous states (e.g. sex of plant: female, male).
- As a rule, the characteristics are not influenced by environment.

Types of expression of characteristics

QN: Quantitative

	Characteristics	States of expression
3	QN Leaf: intensity of green color	light, medium, dark
13	QN Leaf blade: Length	short, medium, long
44	QN Time of maturity	early, intermediate, late



Types of expression of characteristics

QN: Quantitative

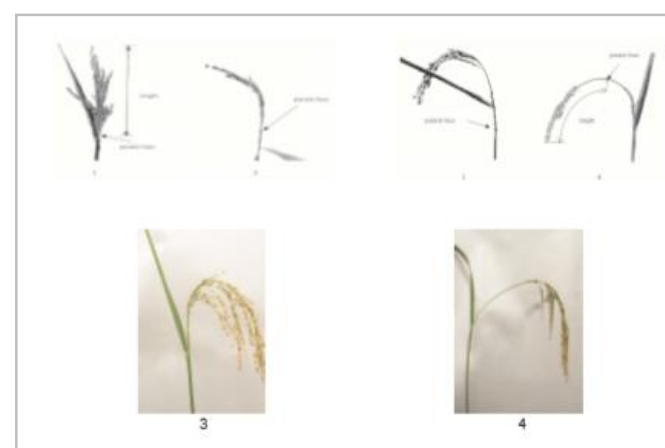
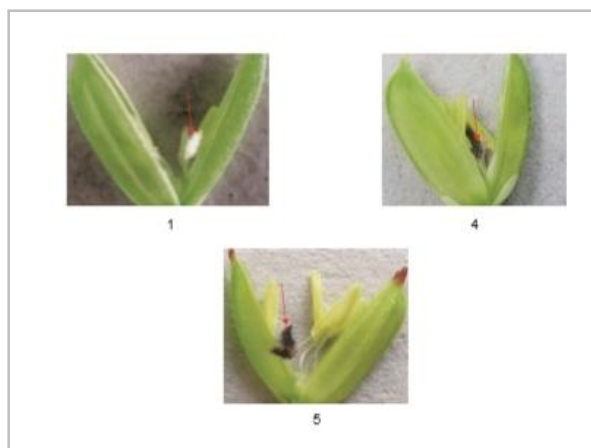
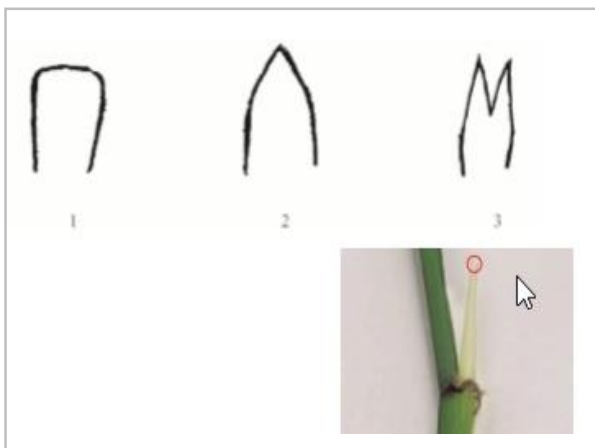
- are those that are measurable on a one-dimensional scale and show continuous variation
- length, height, width, weight,...

	states of expression	Notes	
ex. 1-9 scale short/long low/high narrow/broad weak/strong early/late	very short	1	Notes are given for each "state of expression"
	very short to short	2	
	short	3	
	short to medium	4	
	medium	5	
1-3, 1-5 scale	medium to long	6	
	long	7	
	long to very long	8	
	very long	9	

Types of expression of characteristics

PQ: Pseudo-Qualitative

		Characteristics	States of expression
11	PQ	Leaf: shape of ligule	truncate, acute, cleft
24	PQ	Spikelet: color of stigma	white, light green, yellow, purple
39	PQ	Panicle: attitude in relation to stem	upright, semi-upright, drooping

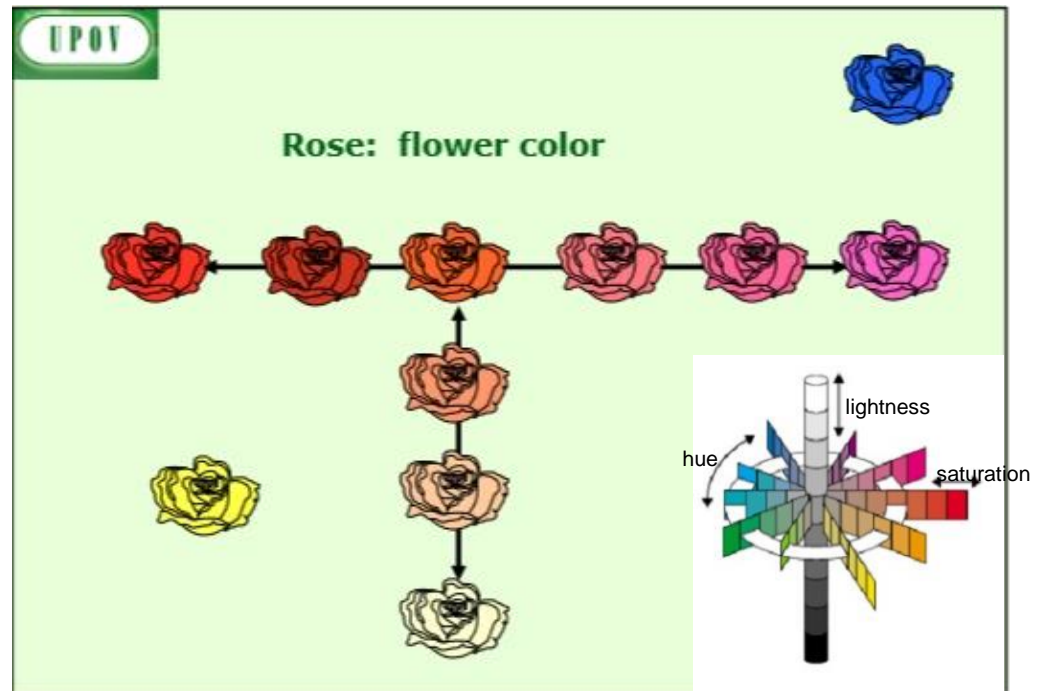


Types of expression of characteristics

PQ: Pseudo-Qualitative

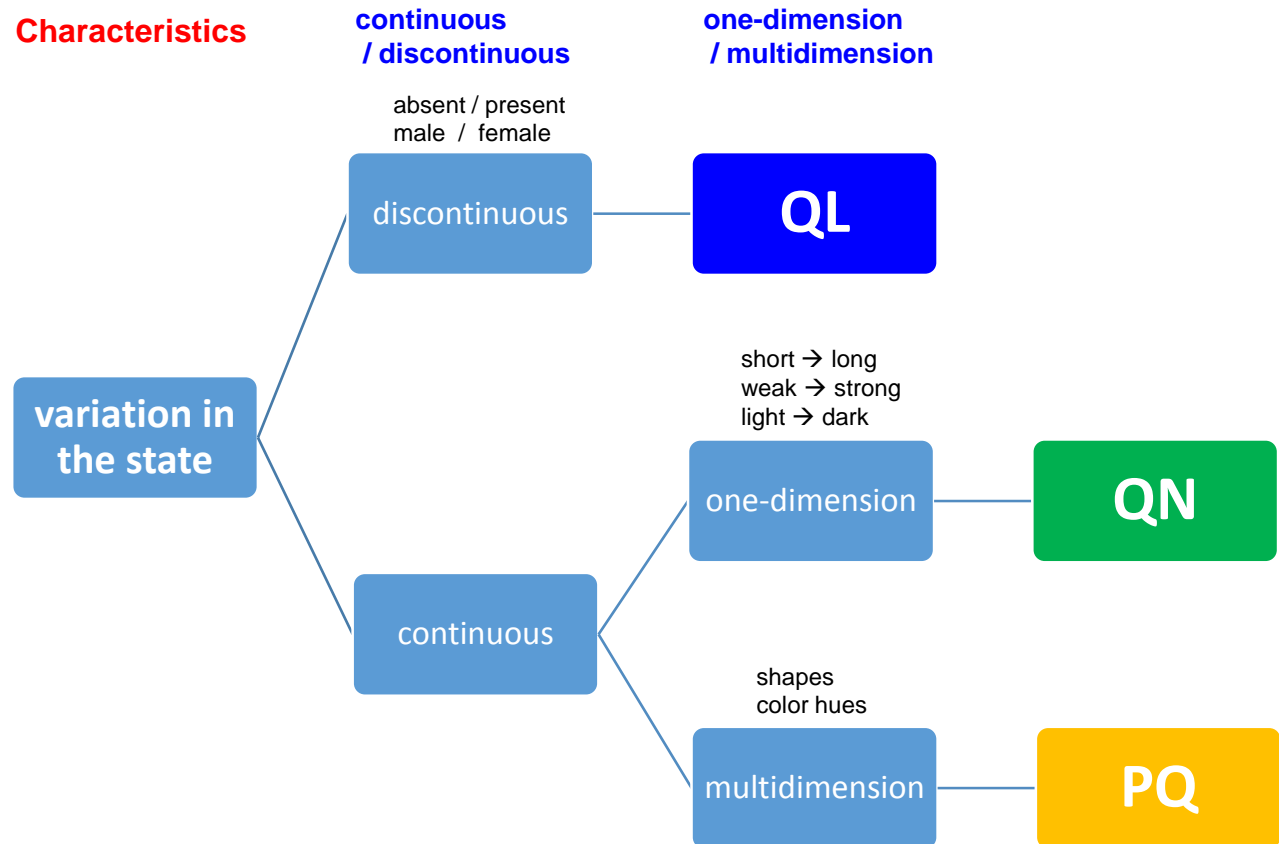
the range of expression is at least partly continuous, but varies in more than one dimension (e.g. shape: ovate (1), elliptic (2), circular (3), obovate (4))

		← broadest part →				
		(below middle)	at middle	(above middle)		
broad (compressed) ↓	narrow (elongated) ↑		3 linear			
			4 oblong	7 oblanceolate	9 spatulate	
		1 triangular	2 ovate	5 elliptic	8 obovate	10 obtriangular
			6 circular			



Types of expression of characteristics

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

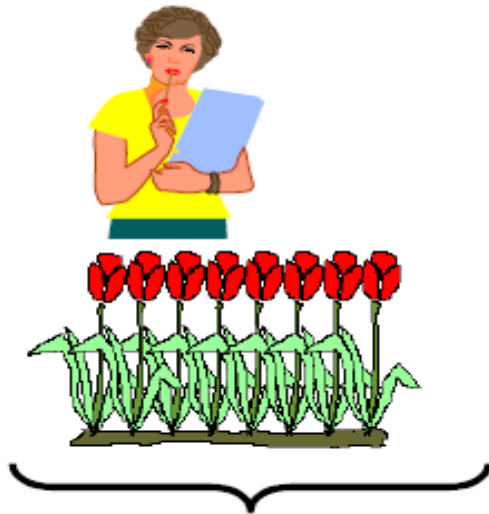
S (Single) : records for a number of single plants or parts of plants

Type of Assessment

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

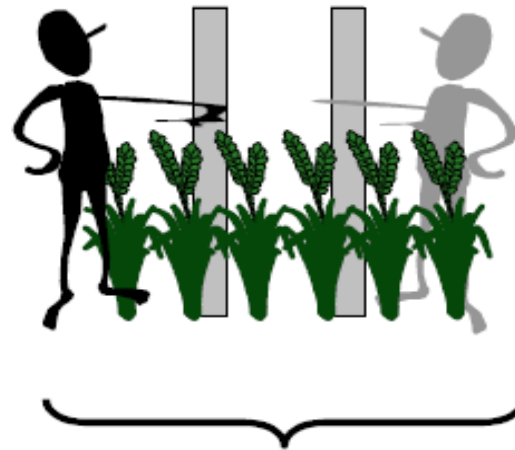
MG : Measurement by a single observation of a group of plants or parts of plants.

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



single variety record

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

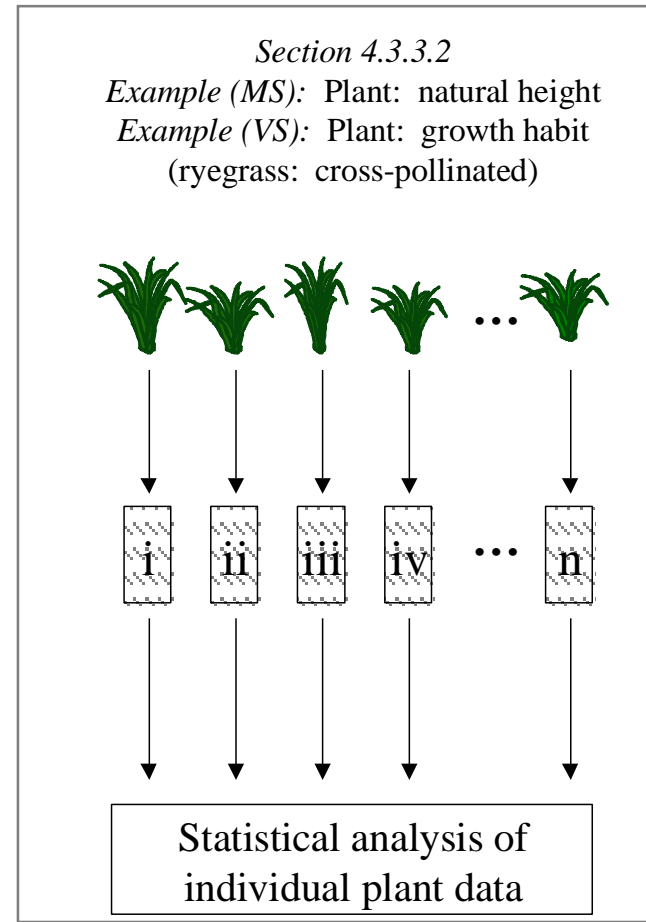
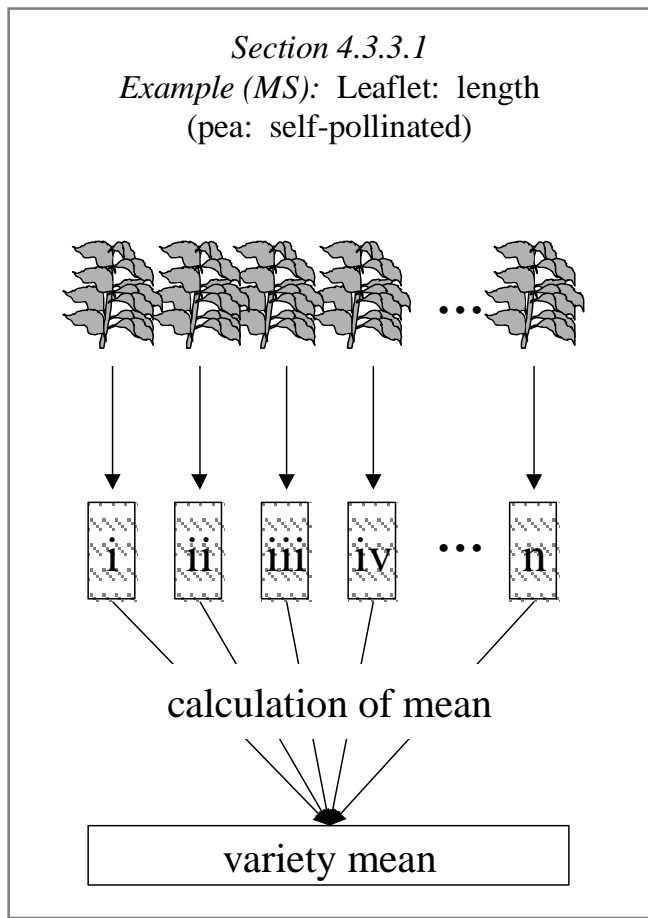


single variety record

Type of Assessment

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

■ Type of assessment in Rice TGs

	QL	PQ	QN	Total
VS	7	16	15	38
VG	3	2	8	13
MS	0	1	10	11
MG	0	1	2	3
	10	20	35	65

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

2. To assess the DUS

Distinctness

Requirement:

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

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

Distinctness

Compare Candidate variety : Existing varieties



VS



necessary to examine distinctness to all varieties of common knowledge

Distinctness

Compare Candidate variety : similar varieties

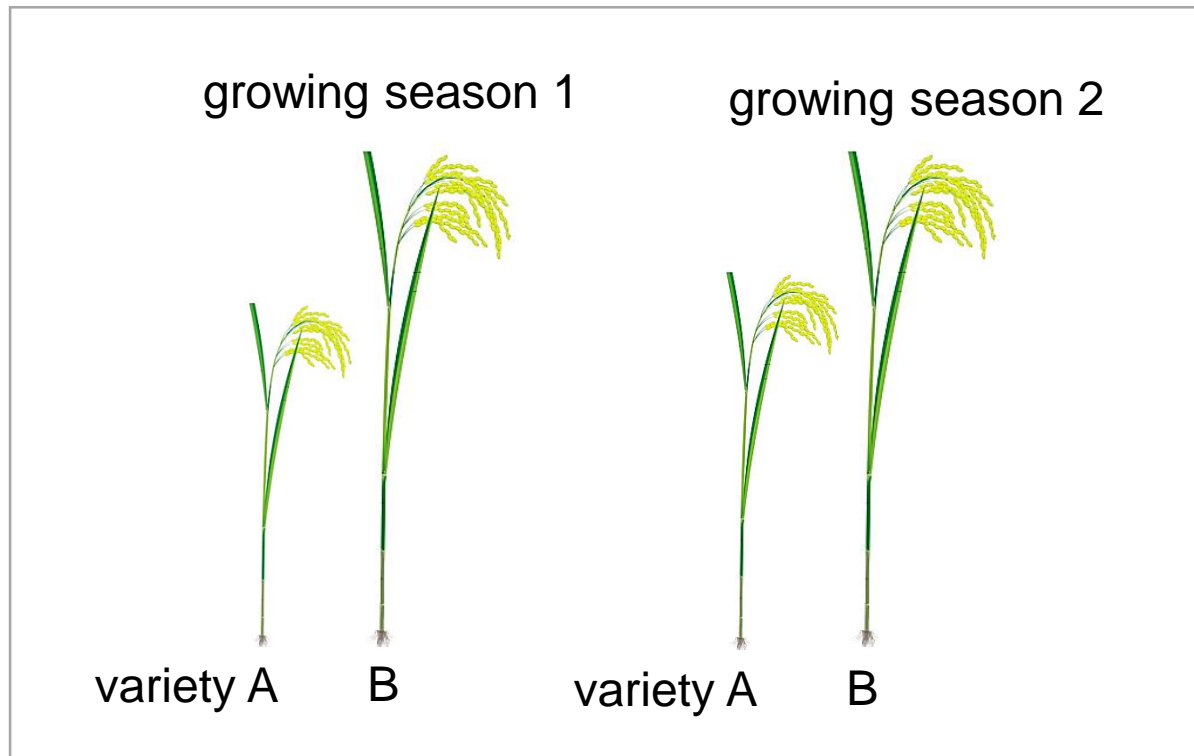


VS



Distinctness

Consistent difference:



Each time, variety B is taller than variety A

Distinctness

Clear differences:

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



QL: Qualitative

QN: Quantitative

PQ: Pseudo-Qualitative

Examining Distinctness_ TGP/9/1

5.2 Approaches for assessing distinctness

5.2.1 Introduction

5.2.1.1 Approaches for assessment of distinctness based on the growing trial can be summarized as follows:

(a) **Side-by-side visual comparison** in the growing trial

(see Section 5.2.2);

(b) **Assessment by Notes / single variety records (“Notes”)**: the assessment of distinctness is based on the recorded state of expression of the characteristics of the variety

(see Section 5.2.3);

(c) Statistical analysis of growing trial data:

Distinctness

Qualitative characteristics:

TG/1/3: 5.3.3.2.1

- In qualitative characteristics, 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**. Varieties should not be considered distinct for a qualitative characteristic if they have the same state of expression.

Different Notes can be considered to be Distinct

Distinctness

TG/209
Dendrobium

13 (+)	Leaf: type of variegation	Example varieties	Note
QL	brindled		1
	spotted		2
	striped		3
	centered		4
	edged		5

TG/209
Dendrobium



1
brindled



2
spotted



3
striped



4
centered



5
edged

Distinctness

Pseudo-Qualitative

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

Distinctness

Quantitative characteristics:

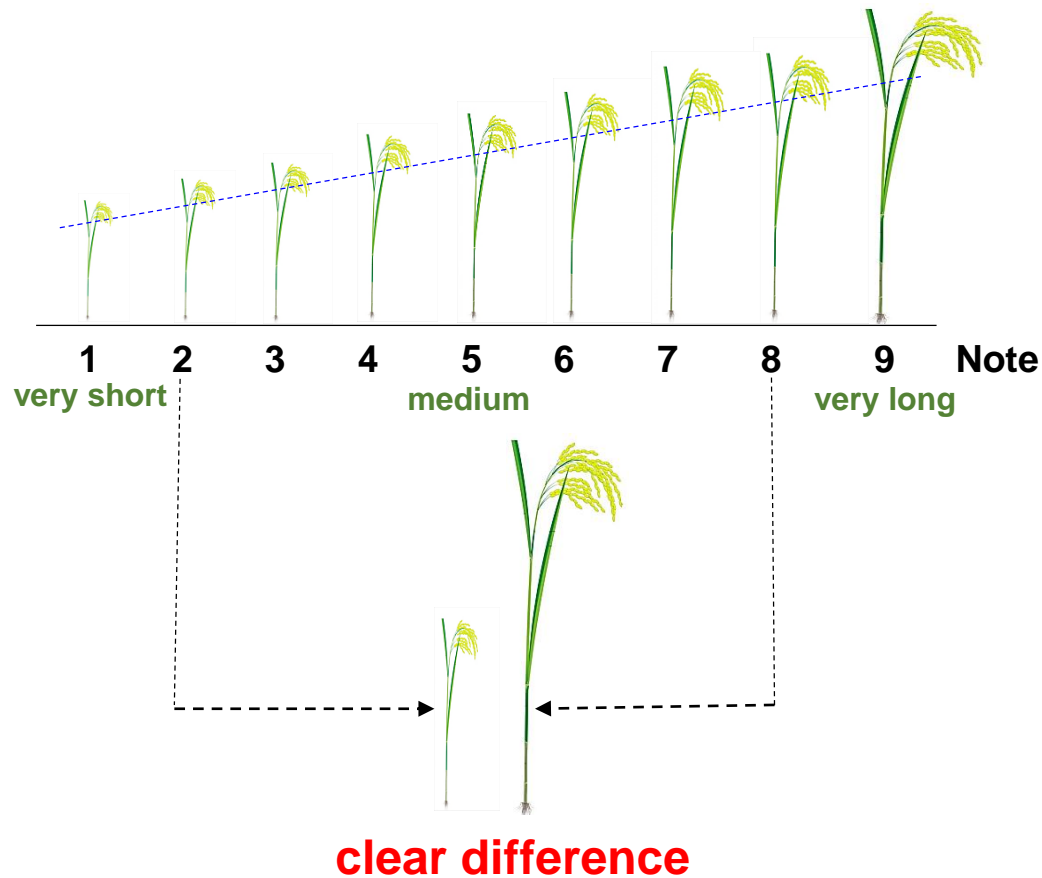
TG/1/3: 5.3.3.2.2

- For quantitative characteristics, **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 Note” rule

Distinctness

Quantitative characteristics: **Distinctness**
clear difference (stem: Length)



Distinctness

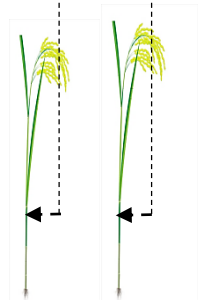
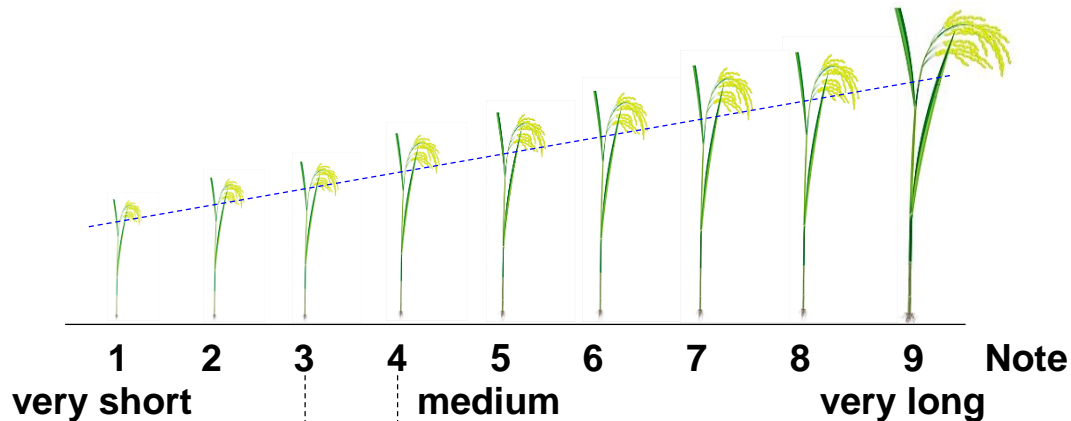
Quantitative

characteristics:

clear difference

Distinctness

(stem: Length)



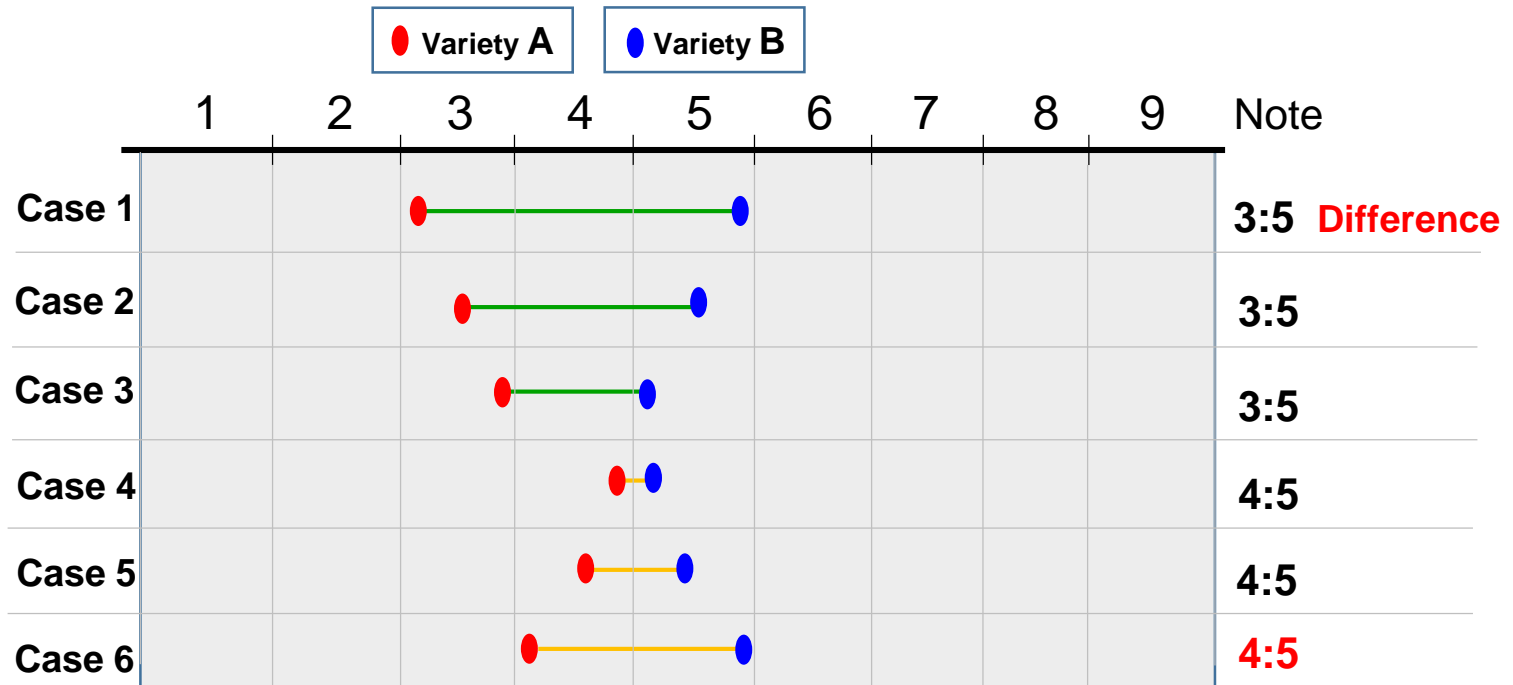
may not be a clear difference

GI: a difference of two Notes often represents a clear difference

Distinctness

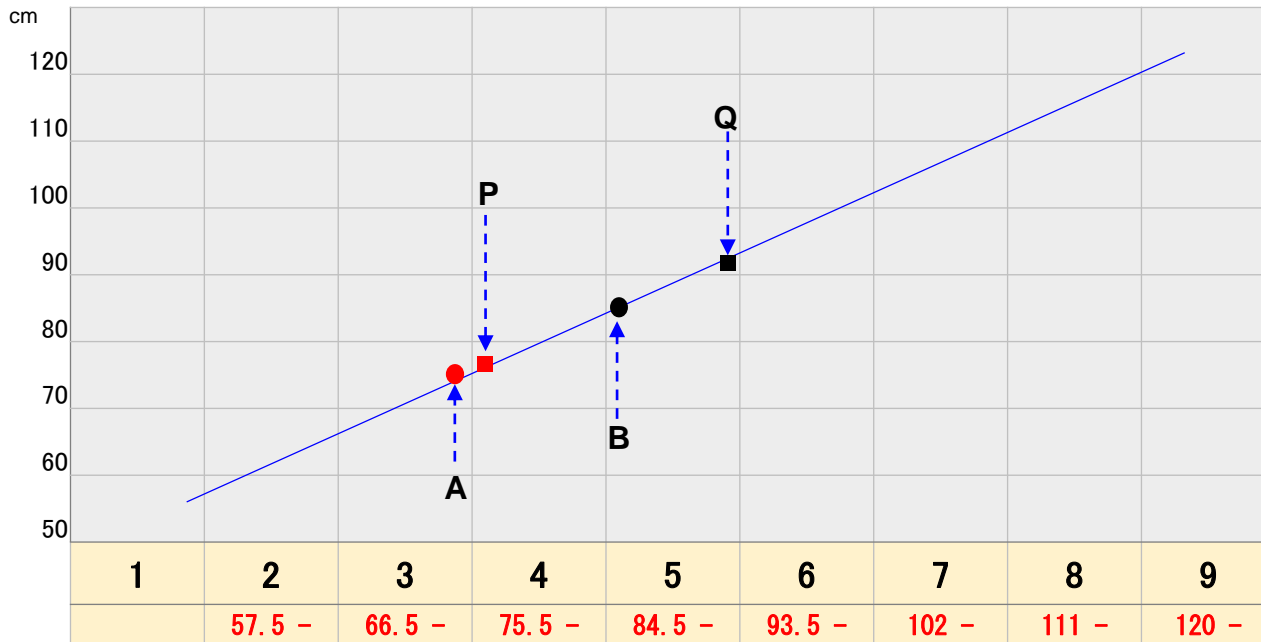
“a difference of two Notes often represents a clear difference”

“Two Note” rule



Distinctness

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

“Two Note” rule means at least One note difference

Uniformity

Requirement:

- 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?

e.g. rice

(a) *Plots*: For the assessment of uniformity of characteristics on the plot as a whole, a population standard of 0.1 % with an acceptance probability of at least 95% should be applied.

In the case of a sample size of 1,500 plants the maximum number of off-types allowed would be 4.

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

OFF-TYPES

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

- **Population standard**

- ✓ 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

Stability

Requirement:

- 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.

Practice: Distinctness

Candidate varieties can be distinguished from existing varieties?

		Leaf: anthocyanin coloration of auricles	Time of heading		Stem: length		Decorticated grain: length		Decorticated grain: color
		QL, VS	QN, VG		QN, VS		QN, MS		PQ, VS
	varieties	absent, present	early, medium, late days		short, medium, long cm		short, medium, long mm		white, light brown, dark brown
candidate	candidate_1	1	3	92	3	67.4	7	7.3	1
	candidate_2	9	3	89	3	73.6	7	7.4	1
existing varieties	A	9	3	91	3	73.1	5	6.4	1
	B	1	5	106	4	77.8	4	5.7	1
	C	1	4	99	5	93.0	7	7.4	1
	D	9	4	97	4	79.6	5	6.2	1
	E	1	3	96	3	71.9	7	7.5	1
	F	9	2	90	4	75.8	6	6.7	1
	G	1	5	107	4	77.6	8	8.3	2
	H	1	5	106	4	78.5	4	5.8	2
	I	9	2	87	3	68.3	6	6.9	2
	J	9	3	91	3	73.6	6	7.0	1
example varieties	Bắc thơm số 7	1	5	106	4	78.5	4	5.8	2
	BM 9962	9	7	118	7	106.9	5	6.4	1
	NTL 1	1	5	106	2	65.8	6	7.0	1
	Koshihikari kazusa 2 go	1	3	94	3	71.0	3	4.9	2
	Hoa khô 4	1	5	105	4	82.6	5	6.3	2
	Q 5	1	5	106	4	77.8	4	5.7	1

Thank you

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