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INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

Geneva

WORKING GROUP ON BIOCHEMICAL AND MOLECULAR TECHNIQUES AND DNA PROFILING IN PARTICULAR

Fifteenth Session

Moscow, Russian Federation, May 24 to 27, 2016

CAN MOLECULAR DISTANCE BE USED AS A CHARACTERISTIC?

Document prepared by an expert from the Netherlands

Disclaimer: this document does not represent UPOV policies or guidance

The Annex to this document contains a copy of a presentation “Can molecular distance be used as a characteristic?” made at its fifteenth session of the Working Group on Biochemical and Molecular Techniques and DNA-Profiling in particular (BMT).

Kees van Ettekoven, Head Variety testing Department, Naktuinbouw

[Annex follows]

ANNEX

CAN MOLECULAR DISTANCE BE USED AS A CHARACTERISTIC?

Can molecular distance be used as a characteristic?

June 2016

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Head Variety testing Department
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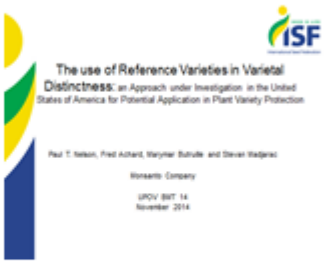
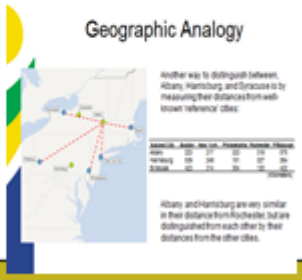
History

In the BMT meeting of 2014, USA colleagues gave a presentation outlining the possibility to use Reference varieties in varietal distinctness.



History

- Using a geographic analogy, the genetic distance of varieties to a set of standards was used to find a way to communicate on genetic information.
- Further work ongoing in USA



Attempt to transform this approach

- Can we use the USA example in a form that answers to the usual UPOV approach using characteristics and states of expressions to establish distinctness and identify and varieties.

Orchids as model crop

- NL biggest market worldwide for flowers and ornamentals
- Important trade-hub
- Total turn over 2014 € 4,5 billion
  - Cut flowers: € 2,6 billion
  - Plants: € 1,6 billion
  - Garden plants: € 0,3 billion



Ministry of Economic Affairs

Orchids as pot plants

Top trade pot plants in NL:

1) **Phalaenopsis** € 500 million
2) Kalanchoe € 60 million
3) Rose € 56 million
4) Anthurium € 51
5) Chrysanthemum € 36 million

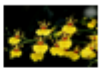
.....

13) **different orchids** € 22 million

Ministry of Economic Affairs

Orchids as pot plants

- *Phalaenopsis* # one since 2001
- Yearly increase 25-30%, in 2010 10%, 400% in 6 years
- Production still increasing, but is slowing down
- From exclusive and old-fashioned to trendy and modern
- Success factors: keeping quality, flower quality & quantity, easy handling
- Product innovation still going on (*Dendrobium, Cymbidium, Miltonia, Oncidium, Paphiopedilum, Burrageara, Cattleya, Vuylstekeria*)



Specifics of orchid testing

- Economicaly important crop.
- Vegetative crop, multiplication by tissue culture.
- Breeding (crossing) is very easy.
- Breeding centers in Asia but also in USA and the Netherlands.
- Complicated flower with many flower characteristics.

Specifics of orchid testing

- Photographs alone are not sufficient.
- Living reference collection needed.
- Comparison between old references and new material difficult.
- Panels of experts needed.
- Risk to grant right on varieties that are already common knowledge in other parts of the world.

Molecular techniques and orchids

To overcome a number of difficulties, a database with DNA information was created.
Main aim of this database:

- to minimize the risk to grant PBR on existing varieties.
- to help in the management of the reference collection.
- to check stability when renewing reference material.
- to avoid sending plant material over the world.

- Plus fast reference for suspected infringment.

From data to characteristics

- Molecular data from the existing database were used to design a model using the genetic distance between applications and a set of standard varieties

Similarity to states of expression

From similarity (Jaccard) distance to state of expression

0-11	=9
12-22	=8
23-33	=7
34-44	=6
45-55	=5
56-66	=4
67-76	=3
78-89	=2
90-100	=1

Ref number	Breeders ref		Type	OPS A Similarity	OPS A score	OPS B Similarity	OPS B score	OPS C Similarity	OPS C score
[illegible]		166134	White medium	50.00	5	39.29	6	44.93	5
STANDARD		145134	White medium	23.53	[illegible]	[illegible].87	9	23.53	7
[illegible]		196434	White large	21.25	7	24.48	6	40.00	6
OPS 571		133034	White large	21.25	7	25.81	7	16.67	8
OPS 601		130644	White large	21.62	8	27.27	7	25.00	7
STANDARD	Phalcineo		White large	24.27	6	29.03	7	34.27	6
STANDARD	PHALFLACAN		White spotted	15.79	8	13.89	8	12.82	8
OPS 428		115031	White spotted	12.51	8	5.41	9	7.69	9
STANDARD	PHALDOTWEL		Yellow	18.92	8	7.89	9	23.22	8
OPS00993	phalcudaq		Yellow	8.33	9	12.50	8	14.71	8
STANDARD	PHALCATEM		Yellow	8.57	9	12.90	8	11.77	8
OPS00994	phalcraform		Yellow	17.14	8	18.75	8	12.99	8
STANDARD	phalobando		white violet	27.27	7	14.71	8	23.53	7
OPS 372	phalbapfos		white violet	19.45	8	14.29	8	13.16	8
STANDARD	PHALIFSIB		Harlekijn	17.95	8	26.47	7	24.33	7
OOR00077	Ganlin Pearl		Harlekijn	17.65	8	8.82	9	14.29	8
OPS1110		277521	Harlekijn	10.81	9	8.82	9	5.26	9
OPS00997	Pikzacht		Purple red	15.79	8	13.89	8	15.79	8
STANDARD	Phalcobap		Purple red	58.18	4	20.00	8	21.87	8

Characteristics in UPOV format

3 applications

CP5 A			
	Char 78.1	Genetic distance to 14154	7 long
	Char 78.2	Genetic distance to Phalcinco	6 medium to long
	Char 78.3	Genetic distance to Phalflacan	5 long to very long
	Char 78.4	Genetic distance to Phaldotwol	5 long to very long
	Char 78.5	Genetic distance to Phalcatom	9 very long
	Char 78.6	Genetic distance to Phalcbando	7 Long
	Char 78.7	Genetic distance to Phalifsib	5 long to very long
	Char 78.8	Genetic distance to Phalcosbap	4 short to medium

CP5 C			
	Char 78.1	Genetic distance to 14154	7
	Char 78.2	Genetic distance to Phalcinco	6
	Char 78.3	Genetic distance to Phalflacan	5
	Char 78.4	Genetic distance to Phaldotwol	5
	Char 78.5	Genetic distance to Phalcatom	5
	Char 78.6	Genetic distance to Phalcbando	7
	Char 78.7	Genetic distance to Phalifsib	7
	Char 78.8	Genetic distance to Phalcosbap	9

CP5 B			
	Char 78.1	Genetic distance to 14154	9
	Char 78.2	Genetic distance to Phalcinco	7
	Char 78.3	Genetic distance to Phalflacan	5
	Char 78.4	Genetic distance to Phaldotwol	9
	Char 78.5	Genetic distance to Phalcatom	5
	Char 78.6	Genetic distance to Phalcbando	5
	Char 78.7	Genetic distance to Phalifsib	7
	Char 78.8	Genetic distance to Phalcosbap	5

Comparison between the 3 applications

- Application of the normal UPOV rules possible?

		CP5 A	CP5 B	CP5 C
Char 78.1	Genetic distance to 14154	7	9	7
Char 78.2	Genetic distance to Phalcinco	6	7	6
Char 78.3	Genetic distance to Phalflacan	5	5	5
Char 78.4	Genetic distance to Phaldotwol	5	9	5
Char 78.5	Genetic distance to Phalcatom	9	5	5
Char 78.6	Genetic distance to Phalcbando	7	5	7
Char 78.7	Genetic distance to Phalifsib	5	7	7
Char 78.8	Genetic distance to Phalcosbap	4	5	9

Suitable as characteristic?

- UPOV TG/1/3
- 2.4.2 The 1991 Act of the UPOV Convention makes this clear by stating in Article 1(vi) that a variety is a plant grouping that can be "defined by the expression of the characteristics resulting from a given genotype or combination of genotypes" and can be "distinguished from any other plant grouping by the expression of at least one of the said characteristics."

Suitable as characteristic?

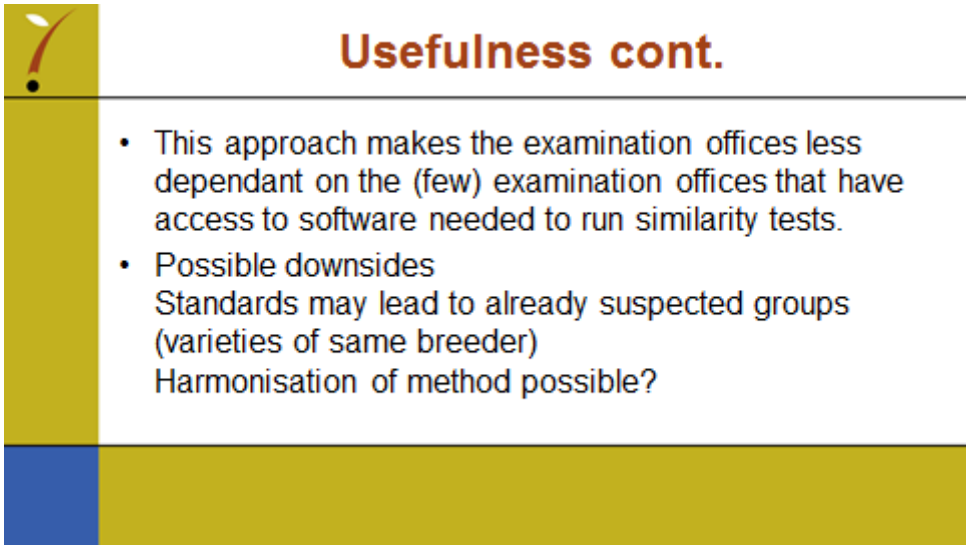
- Can the genetic distance in itself be considered as the expression of a given genotype or more appropriate a combination of a number of genotypes?

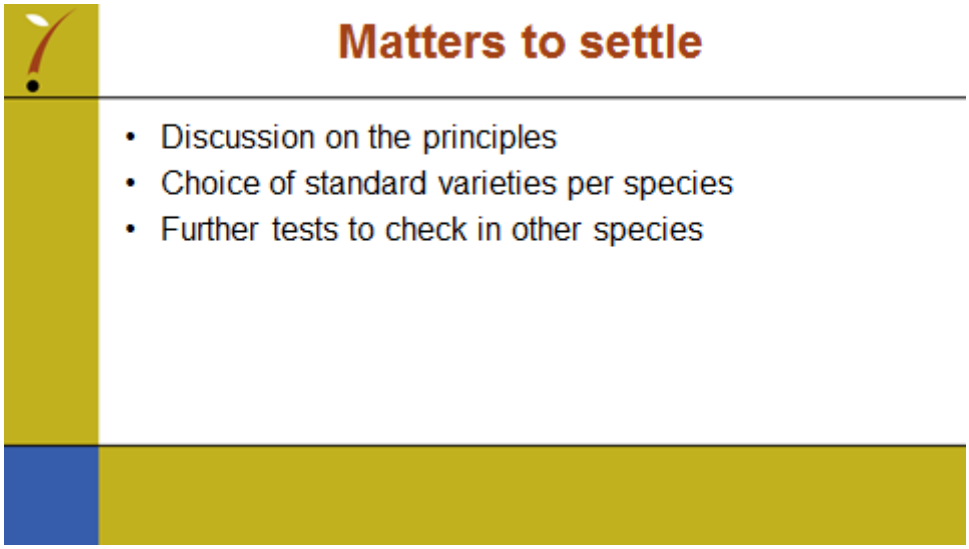
Type of characteristic?

- Genetic distance to a certain standard with the states 1 absent to very short 3 short, 5 medium, 7 long, 9 very long can be considered as QN, MG and should have a (+) with a clear explanation of the method in chapter 8.

Usefulness of such characteristics

- Use of this approach offers the opportunity to exchange DNA information between examination offices through the variety description in a meaningful way, without exchanging the actual DNA information.
- DNA characteristics are more independant from environment, observers etc. than morphological characteristics
- No need to develop databases for this approach.
- Cost effective





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