INTRODUCTION TO UPOV AND THE SITUATION WITH REGARD TO MOLECULAR TECHNIQUES

Document prepared by the Office of the Union

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The Annex to this document contains a copy of a presentation “Introduction to UPOV and the situation with regard to molecular techniques” made at the OECD/UPOV/ISTA Joint Workshop on Molecular Techniques.

[Annex follows]
ANNEX

OECD/UPOV/ISTA JOINT WORKSHOP ON MOLECULAR TECHNIQUES

Introduction to UPOV and the situation with regard to molecular techniques

Seoul, Republic of Korea, November 12, 2014

1. INTRODUCTION TO UPOV

UPOV: INDEPENDENT INTERGOVERNMENTAL ORGANIZATION

The International Convention for the Protection of New Varieties of Plants established in 1961
The International Union for the Protection of New Varieties of Plants

Union internationale pour la protection des obtentions végétales

Mission Statement

To provide and promote an effective system of plant variety protection, with the aim of encouraging the development of new varieties of plants, for the benefit of society.

UPOV status

Members of UPOV (72)
- Initiating States (10) and Organization (1)
- States (24) and Organization (1) in contact with the UPOV Office

The information shown on this map is derived from the database of the UPOV containing the legal status of any country or territory.
2. Overview of DUS Examination

a: Conditions for granting a breeder’s right
b: Guidance for DUS Examination
c: Characteristics

THE CONDITIONS FOR GRANTING A BREEDER’S RIGHT

Criteria to be satisfied

- NOVELTY
- DISTINCTNESS
- UNIFORMITY
- STABILITY

“DUS”
THE CONDITIONS FOR GRANTING A BREEDER’S RIGHT

Other conditions

- VARIETY DENOMINATION
- FORMALITIES
- PAYMENT OF FEES

NO OTHER CONDITIONS!

2. Overview of DUS Examination

a: Conditions for granting a breeder’s right
b: Guidance for DUS Examination
c: Characteristics

Guidance for DUS Examination

facilitates:

BEST PRACTICE (based on experience)

- good decisions
- good definition of the object of protection
  (strong protection)
- efficiency in method of examination (learn from the best)

HARMONIZATION

- efficiency
  - mutual acceptance of DUS reports
    (minimize cost of examination for individual authorities)
  - mutual recognition of variety descriptions
    (all parties speak the same "language")
  - simple and cheap system for applicants
    (minimize cost for breeders)

Importance of Harmonized Approach within UPOV

⇒ To facilitate cooperation in DUS testing
e.g. purchase of DUS reports

⇒ To establish internationally recognized variety descriptions (effective protection)

UPOV provides guidance by:

- The “General Introduction” (TG/1/3)
  - General technical principles
  - Organization of DUS Testing
  - Associated "TGP" Documents (e.g. statistical methods)

  = version 3

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2. Overview of DUS Examination

a: Conditions for granting a breeder’s right
b: Guidance for DUS Examination
c: Characteristics

Selection of Characteristics

The basic requirements that a characteristic should fulfill before it is used for DUS testing or producing a variety description are that its expression (TG/1/3: Section 4.2.1):

(a) results from a given genotype or combination of genotypes;
(b) is sufficiently consistent and repeatable in a particular environment;
(c) exhibits sufficient variation between varieties to be able to establish distinctness;
(d) is capable of precise definition and recognition;
(e) allows uniformity requirements to be fulfilled;
(f) allows stability requirements to be fulfilled, meaning that it produces consistent and repeatable results after repeated propagation or, where appropriate, at the end of each cycle of propagation.

Selection of Characteristics

- may have direct commercial relevance
  - Flower color (ornamental)
  - Fruit color
- but commercial relevance NOT required
  - Leaf shape

Selection of Characteristics

- Yield ???
- Straw strength ???
Etc.
3. The Role of BMT within UPOV

UPOV Structure

Test Guidelines

TGP documents
Role of the BMT

Consider the possible application of biochemical and molecular techniques in DUS testing

The BMT is a group open to DUS experts, biochemical and molecular specialists and plant breeders, whose role is to:

(i) Review general developments in biochemical and molecular techniques;
(ii) Maintain an awareness of relevant applications of biochemical and molecular techniques in plant breeding;
(iii) Consider the possible application of biochemical and molecular techniques in DUS testing and report its considerations to the TC;
(iv) If appropriate, establish guidelines for biochemical and molecular methodologies and their harmonization;
(v) Consider initiatives from TWP, for the establishment of crop specific subgroups;
(vi) Develop guidelines regarding the management and harmonization of databases of biochemical and molecular information, in conjunction with the TWC;
(vii) Receive reports from Crop Subgroups and the BMT Review Group;
(viii) Provide a forum for discussion on the use of biochemical and molecular techniques in the consideration of essential derivation and variety identification.

Guidance and harmonization for a range of applications

The BMT is a group open to DUS experts, biochemical and molecular specialists and plant breeders, whose role is to:

(h) If appropriate, establish guidelines for biochemical and molecular methodologies and their harmonization;
(v) Develop guidelines regarding the management and harmonization of databases of biochemical and molecular information, in conjunction with the TWC;

Raise awareness of general developments:

The BMT is a group open to DUS experts, biochemical and molecular specialists and plant breeders, whose role is to:

(i) Review general developments in biochemical and molecular techniques;
(ii) Maintain an awareness of relevant applications of biochemical and molecular techniques in plant breeding;

(vii) Provide a forum for discussion on the use of biochemical and molecular techniques in the consideration of essential derivation and variety identification.

BMT/14 agenda items 4 “Show presentations on new developments in biochemical and molecular techniques by DUS experts” and item 8 “Methods for analysis of molecular data”
4. Situation in UPOV concerning the Possible Use of Molecular Techniques in the DUS Examination

- Use of biochemical and molecular markers in the examination of Distinctness, Uniformity and Stability (DUS)
- Frequently Asked Questions in molecular techniques (FAQ)

**UPOV/INF/17/1 (INFORMATION document)**

“Guidelines for DNA Profiling: Molecular Marker Selection and Database Construction (‘BMT Guidelines’)”

The purpose of this document (BMT Guidelines) is to provide guidance for developing harmonized methodologies with the aim of generating high quality molecular data for a range of applications. The BMT Guidelines are also intended to address the construction of databases containing molecular profiles of plant varieties. [...]”

**UPOV/INF/18/1 (INFORMATION document)**

“Possible Use of Molecular Markers in the Examination of Distinctness, Uniformity and Stability”

The purpose of this document is to provide guidance on the possible use of biochemical and molecular markers in the examination of Distinctness, Uniformity and Stability (DUS). [...]”

Both documents have been adopted and published on UPOV website.

**UPOV/INF/18 POSSIBLE APPLICATION MODELS**

**MODELS WITH A POSITIVE ASSESSMENT**

- Characteristic-specific molecular markers
- Combining phenotypic and molecular distances in the management of variety collections
- Calibrated molecular distances in the management of variety collections

**MODELS WITHOUT A POSITIVE ASSESSMENT**

- Use of molecular marker characteristics

**TGP/15/1 (Technical Guidelines Protocol)**

“Guidance on the Use of Biochemical and Molecular Markers in the Examination of Distinctness, Uniformity and Stability (DUS)”

The purpose of this document is to provide guidance on the use of biochemical and molecular markers in the examination of Distinctness, Uniformity and Stability (DUS). On the basis of the models in document UPOV/INF/18 that have received a positive assessment and for which accepted examples have been provided.

Adopted by the Council of UPOV in October, 2013.
APPLICATION MODELS in TGP/15 (brown part)

MODELS WITH A POSITIVE ASSESSMENT
- Characteristic-specific molecular markers
- Combining phenotypic and molecular distances in the management of variety collections
- Calibrated molecular distances in the management of variety collections

MODELS WITHOUT A POSITIVE ASSESSMENT
- Use of molecular marker characteristics

APPLICATION MODEL:
Characteristic-specific molecular markers

Molecular markers can be used as a method of examining DUS characteristics that satisfy the criteria for characteristics set out in the General Introduction (TGP/1), Chapter 4, section 4.2, on the following basis:

(a) the test for the marker is conducted on the same number of individual plants, with the same criteria for DUS as for the examination of the characteristic by a bioassay;
(b) there is verification of the reliability of the link between the marker and the characteristic;

APPLICATION MODEL:
Characteristic-specific molecular markers (Cont.)

(c) different markers for the same characteristic are different methods for examining the same characteristic;
(d) markers linked to different genes conferring expression of the same characteristic are different methods for examining the same characteristic; and
(e) markers linked to different regulatory elements for the same gene conferring expression of the same characteristic are different methods for examining the same characteristic

(see TGP/15, Section 2.1)

APPLICATION MODEL:
Combining phenotypic and molecular distances in the management of variety collections

A key feature of the process of eliminating varieties of common knowledge prior to the DUS growing trial is that the threshold is set with a suitable margin of safety. This threshold is termed the “Distinctness plus” threshold, which means that the distances between a candidate variety and “Distinct plus” varieties are robust enough to take a decision without direct comparison in the growing trial.

APPLICATION MODEL:
Combining phenotypic and molecular distances in the management of variety collections (Cont.)

(a) there is reliable information that the molecular distances are sufficiently related to phenotypic differences, such that
(b) the method selects varieties in the variety collection which are similar to the candidate varieties; and
(c) the method does not create an increased risk of not selecting a variety in the variety collection which needs to be compared to the candidate varieties in the field.

(see TGP/15 Section 2.2)
TGP/15 Annex II: Example of Parent Lines in Maize

The objective of this example is to develop an efficient tool, based on a combination of phenotypic and molecular distances, to identify within the variety collection, those varieties which need to be compared with candidate varieties in order to improve the selection of "distinct plus" varieties and so to limit the workload without decreasing the quality of the test. The challenge is to develop a secure system that:
(a) only selects varieties which are similar to the candidate varieties;
and
(b) limits the risk of not selecting a variety in the variety collection which needs to be compared in the field, especially when there is a large or expensive variety collection.

Visual assessment by maize crop experts:

Scale of similarity:
1. the two varieties are similar or very close
2. the two varieties are distinct but close
3. the comparison was useful, but the varieties are clearly distinct
4. the comparison should have been avoided because the varieties are very different
5. the comparison should have been avoided because the varieties are totally different

("even" notes are not used in the scale)

4. Situation in UPOV concerning the Possible Use of Molecular Techniques in the DUS Examination

- Use of biochemical and molecular markers in the examination of Distinctness, Uniformity and Stability (DUS)
- Frequently Asked Questions in molecular techniques (FAQ)
Question: Does UPOV allow molecular techniques (DNA profiles) in the DUS examination?

- It is important to note that, in some cases, varieties may have a different DNA profile but be phenotypically identical, whilst, in other cases, varieties which have a large phenotypic difference may have the same DNA profile for a particular set of molecular markers (e.g., some mutations).
- In relation to the use of molecular markers that are not related to phenotypic differences, the concern is that it might be possible to use a limitless number of markers to find differences between varieties at the genetic level that are not reflected in phenotypic characteristics.

On the above basis, UPOV has agreed the following uses in relation to DUS examination:

(a) Molecular markers can be used as a method of examining DUS characteristics that satisfy the criteria for characteristics set out in the General Introduction if there is a reliable link between the marker and the characteristic.

(b) A combination of phenotypic differences and molecular distances can be used to improve the selection of varieties to be compared in the growing trial if the molecular distances are sufficiently related to phenotypic differences and the method does not create an increased risk of not selecting a variety in the variety collection which should be compared to candidate varieties in the DUS growing trial.

The situation in UPOV is explained in documents TGP/15 ‘Guidance on the Use of Biochemical and Molecular Markers in the Examination of Distinctness, Uniformity and Stability (DUS)’ and UPOV/INF/18 ‘Possible use of Molecular Markers in the Examination of Distinctness, Uniformity and Stability (DUS)’.

THANK YOU