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DUS TESTING: PHENOTYPE VS GENOTYPE

*prepared by the expert from ASSINSEL*

## Discussion paper

**DUS Testing: Phenotype vs Genotype**

The interpretation of the UPOV Convention by ASSINSEL and by the large majority of the members of the UPOV Technical Committee is that DUS testing of new plant varieties must be based on phenotypic characteristics, according to article 1(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<sup>1</sup> 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.

The wording "expression of the characteristics resulting from a given genotype" is the very definition of the phenotype. If one has a purist approach, the use of characteristics other than phenotypic should be preceded by the revision of the Convention.

**1. The consistent position of ASSINSEL**

In 1999 ASSINSEL has confirmed the positions adopted since the early 1990s in adopting the revised "Consolidation of ASSINSEL Position Papers on Protection of Biotechnological Inventions and Plant Varieties" (No.A.99.87) and the revised "ASSINSEL Position on Characteristics for DUS Testing".

In essence these documents state that:

- characteristics for DUS testing should be first morphological but with the possibility of additional "phenotypic" characteristics, mainly physiological. It is preferred that, as far as possible, distinctness be recognizable in the field by an expert;
- Electrophoretic characteristics must not be used alone for establishing distinctness. They should not be used at all for populations and synthetic varieties of cross-pollinating species.
- There are good grounds to keep the two notions of distinctness and essential derivation separate and to achieve this it would be useful to use different tools to assess varieties regarding the two notions. Assessment of essential derivation could be based on variety origin, breeding methods, heterosis, appropriate phenotypic and/or molecular characteristics.

It must be noted that, at the moment, no PBR office is granting PBR solely on the basis of electrophoretic characteristics.

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<sup>1</sup> Underlined by the author

## 2. The technological evolution

When the UPOV Convention was first drafted at the end of the 1950s, molecular markers were not known and even in 1991, when the 1991 Act was adopted, they were not widely used except for a few crops. On the occasion of the ASSINSEL Congress in Nairobi in 1993 many participants were of the opinion that molecular markers "would not work" for tomato.

In fact the situation has changed dramatically and we know now that molecular markers are available for many crops and that they will become available for all interesting crops if necessary in the near future. In addition the technology is evolving very rapidly, becoming much faster and more accurate every day and the cost is dropping drastically.

Molecular markers are now a very practical tool for variety identification. Should we use them for DUS testing?

## 3. Molecular markers for DUS testing?

Without prejudice to the interpretation of the UPOV Convention (phenotype vs genotype), what are the issues to consider if molecular markers would be utilized for DUS testing?

### 3.1 Distinctness

As already said molecular markers are a very good tool for identification. But identification is not distinctness. The difference, in the meaning of the UPOV Convention, is the concept of minimum distance.

The 1978 Act states: "The new variety must be clearly distinguishable by one or more important<sup>1</sup> characteristics from any other variety... ."

The 1991 Act states: "The variety shall be deemed to be distinct if it is clearly distinguishable from any other variety... ."



In fact, as the word "important" had never been defined except by a tautology (important means important for distinctness), we can accept the requirement of the 1991 Act as valid in any case.

That concept of "clearly distinguishable" has been developed by people having in mind the morphological description of the variety and the concept of minimum distance developed by experts over the past decades. We must admit that despite the fact that the UPOV Convention has been implemented since 1968, date of entry into force, the definition of the minimum distance is still under discussion, but in practice the system works quite satisfactorily giving a perimeter of protection large enough to plant breeders.

If we are to use molecular markers for assessing distinctness and if we apply the UPOV Convention requirement "clearly distinguishable", then, one marker would be enough to declare a variety distinct from another one. The perimeter of protection would be nullified. The breeder would have to make use of the concepts of essential derivation and dependence in every case (cf infra).

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<sup>1</sup> Underlined by the author

So, before using molecular markers for distinctness, if we want to keep some efficiency to the title of protection, it is essential to define a new concept of minimum distances. That could be based on:

- the number of markers needed to declare distinctness, irrespective of their quality (thresholds)
- the quality of the markers (importance, but how to define importance)
- a combination of both.

In addition we would have to solve the problem of easy plagiarism if we were to use molecular markers for populations and synthetic varieties of cross-pollinating crops (frequency).

### 3.2 Difference between distinctness and essential derivation

Whilst having no experience yet about the criteria essential derivation assessment will be based upon, it is very likely that, at least for some crops (most of the crops?) thresholds measured by molecular markers will be important. So we would have two kinds of thresholds: one for distinctness and one for essential derivation. The risk of mixing up the concepts of distinctness and essential derivation will become obvious. Is it desirable? One could imagine that the new situation would lead to many legal suits.

### 3.3 Uniformity and stability

Distinctness is one of the three technical criteria requested for granting PBR. Two others, equally important, are uniformity and stability.

If molecular markers are used to assess distinctness they will also have to be used all along the cycle of maintenance breeding, for each generation. That will be a completely new approach, but will probably not raise any particular technical difficulties. However, it would probably be much more expensive.

The situation will probably be more worrying regarding stability: would a mutation in one marker be considered as a loss of stability? Should we have to define "sub-thresholds" somewhere between identity, distinctness and essential derivation for assessing stability?

### 3.4 Transitional period

If we are to use molecular markers for DUS testing in the future, we have to be aware that we will have to imagine a completely new system with weak links, or no link at all with the present system. So we have to think about a transitional period so that the rights of the breeders in the present system will continue to be well protected during the duration of protection of their varieties, even after the implementation of a new system. It is not very easy to imagine what procedure could be put in place. Maybe it would be the transfer of all the old titles into the new system, based on molecular analysis?

## 4. Conclusion

Without prejudice on the necessity/possibility to amend the UPOV Convention (definition of the variety) the use of molecular markers, which becomes an essential tool in plant breeding, for DUS testing, would raise many important issues.

It is necessary to address the following questions:

- thresholds for distinctness

- evolution of the concepts of distinctness or essential derivation
- thresholds for stability
- transitional period.

This discussion paper is probably not exhaustive and other issues may arise during the discussion.

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