Experiences of Members of the Union in Measures to Improve the Efficiency and Effectiveness of DUS Testing

Tools for the management of variety collections

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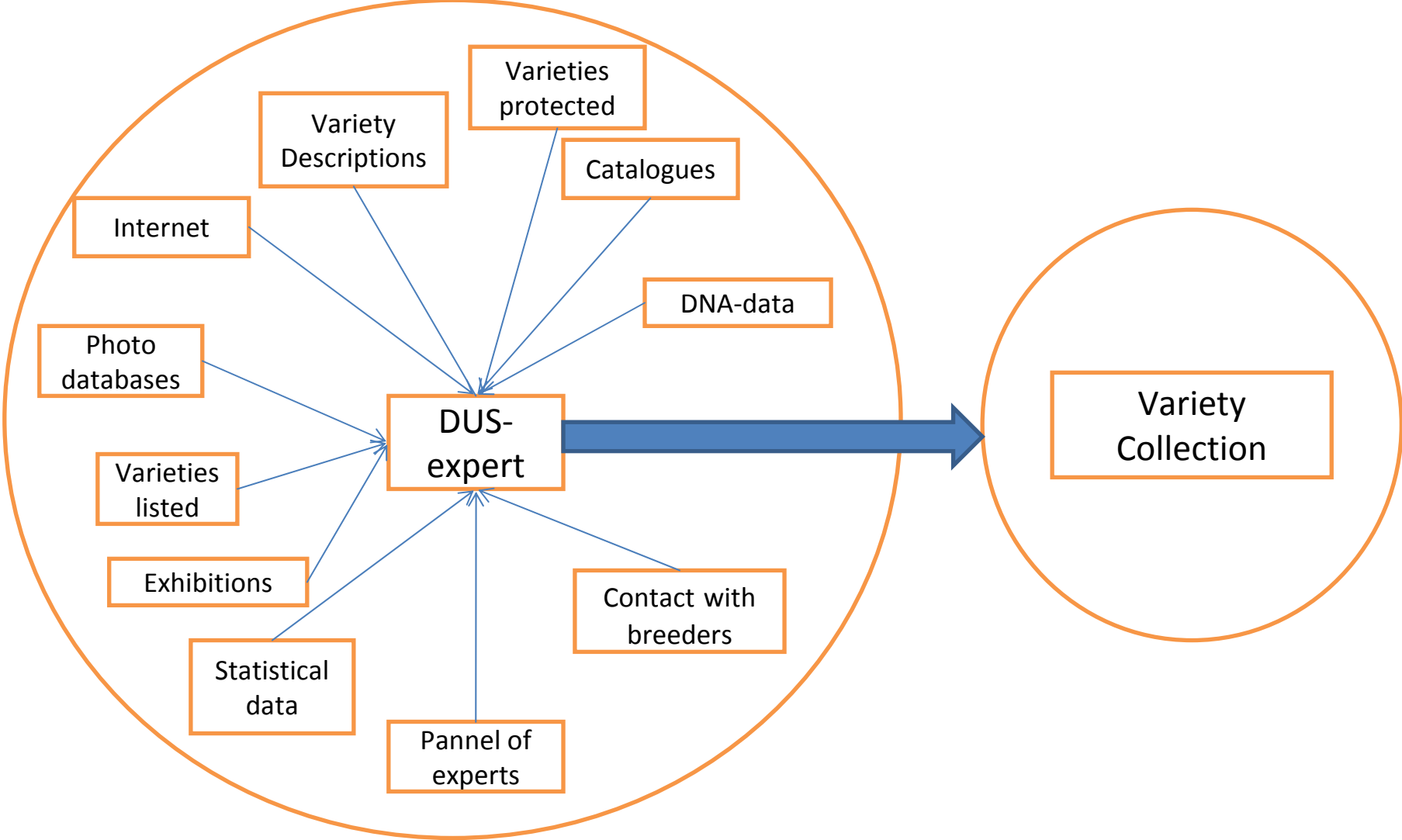## The Netherlands

Geneva, March 26, 2012

How to go from common knowledge to a reliable growing trial

- TGP/9/1

- 1.1 Article 7 of the 1991 Act of the UPOV Convention establishes that a "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."
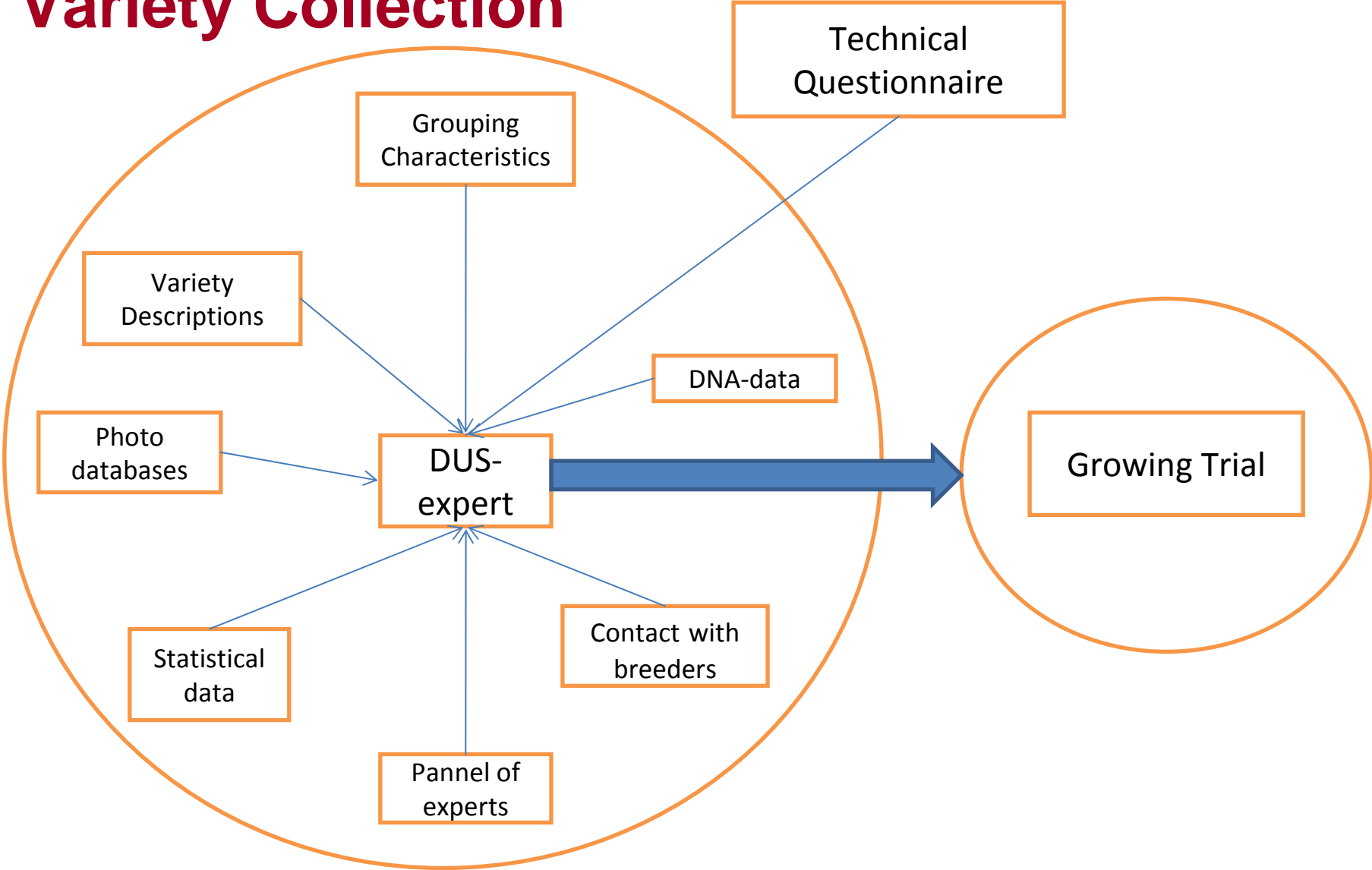
From common knowledge to variety collection

- It is clear that the list of varieties of common knowledge (CK) can be very large. Therefore, the number of varieties of CK that need to be included in trials with a candidate variety needs to be reduced. That process knows the following steps:

- Step 1: Making an inventory of the varieties of common knowledge;

- Step 2: Establishing a ("variety collection") of varieties of common knowledge which are relevant for the examination of distinctness of candidate varieties according to document TGP/4 "Constitution and Maintenance of Variety Collections" ;

- Step 3: Selecting the varieties from the variety collection which should be included in the growing trial or other tests for the examination of distinctness of a particular candidate variety.

Common Knowledge

Variety Collection

Grouping Characteristics

Technical Questionnaire

Variety Descriptions

DNA-data

Photo databases

DUS-expert

Growing Trial

Statistical data

Contact with breeders

Pannel of experts

Combining morphological and molecular distances in the management of the reference collection of potato

DUS testing of potato

Potato varieties are mostly distinct (and uniform):

- Tetraploid, heterozygous
- Parental cross resulting in unique seedlings
- Seedlings: vegetatively propagated (fixed genotype)
- Lightsprout test: > 80 % distinct
- Uniformity is usually no problem

Limitations in DUS potato testing

- Limited (living) reference collection:
  - World (common knowledge): over 4000 varieties
  - EU catalogue: 1400 varieties
  - NL operational collection: 350 varieties
- Limited coverage of database
  - morphological descriptions (EU coverage: 30-40 %)
  - photodatabase (EU coverage: 30-40%)
- Limitations due to:
  - quarantine regulations
  - distribution of bulk samples (tubers)
  - maintenance – annual, technical (diseases), economical
- Variation of morphological data:
  - diverse origins of variety descriptions
  - see: www.upov.org: TWA/34/13 – add 2 (2005)
  - quality and origin of tubers.
  - year-, location- and observer-effects
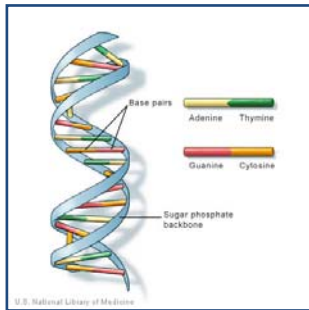
Reference collection of potato

- Collection of living plant material
- Database with variety descriptions
- Photodatabase

- Limited coverage and (partly) unreliable

- Can DUS testing of potato be improved by expanding the reference collection with DNA profiles ?

Reference collection of potato

- Expanding the reference collection of potato with DNA profiles:

- Relationship between morphological data and molecular data ?

Morphological distance

Material:

- 183 varieties

  - Validated variety descriptions:
  - Field trial and lightsprout test in 2010.
  - Individual characteristics observed (TG/23/6)
  - All visual observations (VG)
  - Scored by DUS expert
  - Validated DNA profiles available

Morphological distance

Frequency distribution of pair wise comparisons

close up of lower end (most similar pairs)
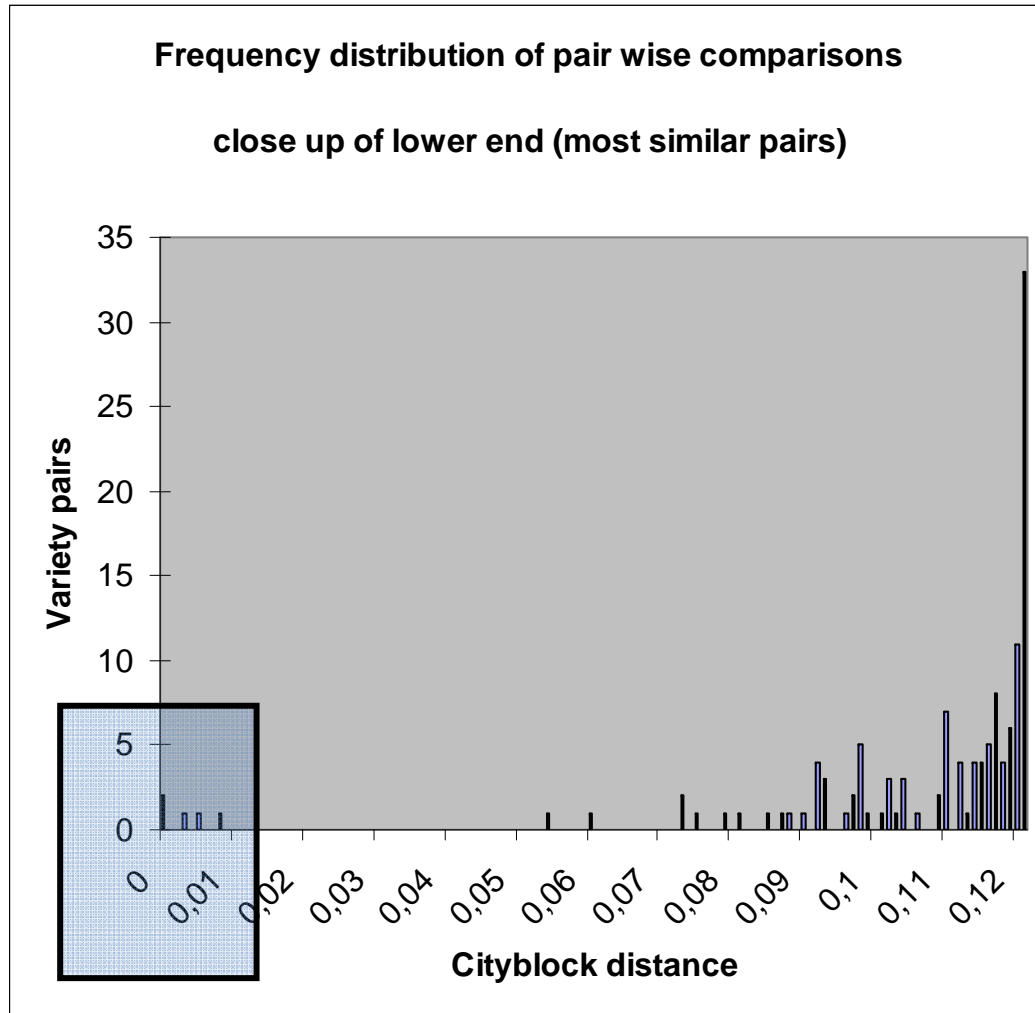
- Cityblock distance:

- Lightsprout and field characteristics

- 183 varieties

- 16.653 combinations

- 5 pairs (7 varieties) nearly 0

- (0 = similar; 1 = different)

Molecular distance

- SSR database (NL/GB) of 900 varieties in total

  - samples collected from (NL/PL/DE/GB) reference collections
  - samples obtained from breeders/maintainers

- Over 200 varieties with samples from more than 1 source
- Most varieties analysed in 2 labs (NL and GB)
- Many varieties 2 profiles per lab (GB)
- In case of anomalies/doubts: variety re-sampled
- => in total almost 3000 profiles scored

- For more details, see: BMT/11/9 and BMT/11/10

Molecular profiles (900 varieties)
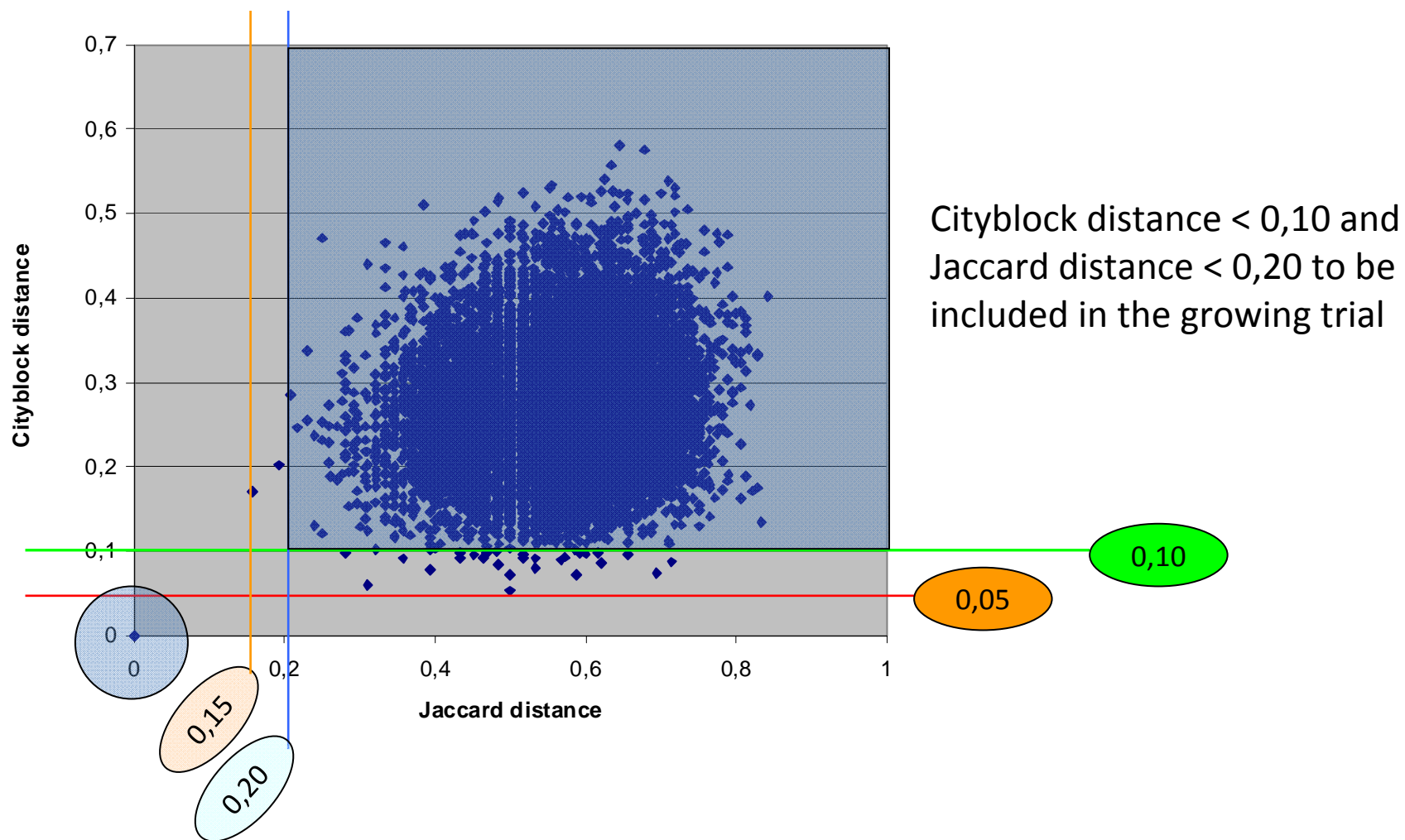
STM5148 (20-251) 13.9% unique
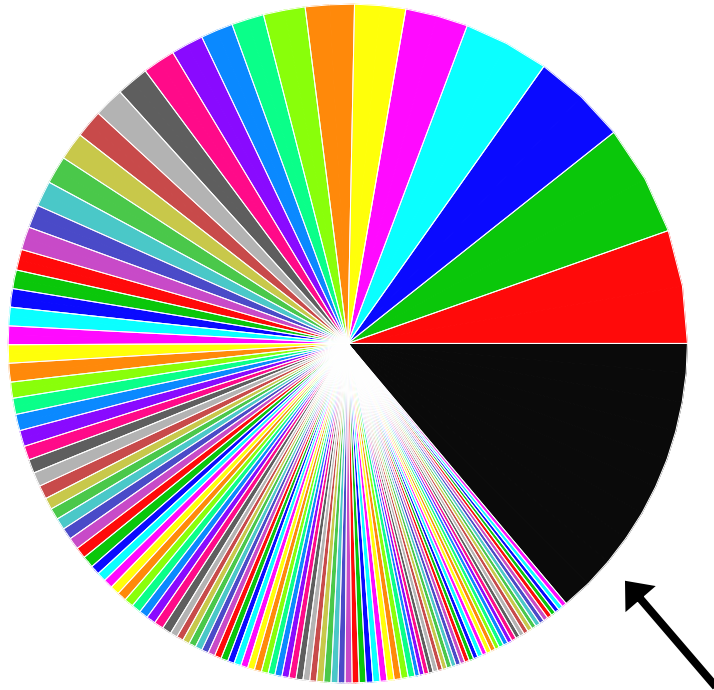
STM3023 (4-14) 0.1% unique
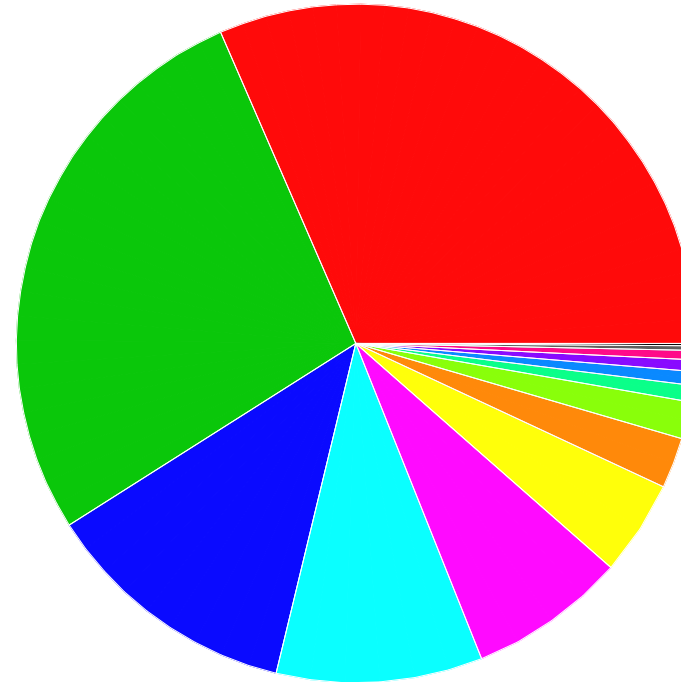
black slice:
combined unique profiles

Combining Morphological and Molecular distances

Cityblock distance < 0,10 and Jaccard distance < 0,20 to be included in the growing trial

High-lighted area: above distinct plus thresholds
low risk for wrong decisions on reference varieties to be excluded from the growing trial
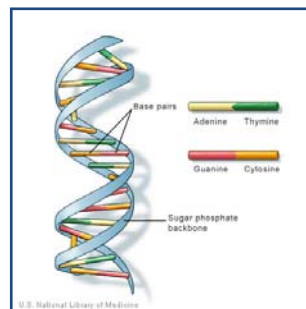
Proposed model for potato:

- Variety collection consisting of:
  - Living reference collection
  - Variety descriptions (locally validated)
  - Lightsprout Photo database
  - SSR database.
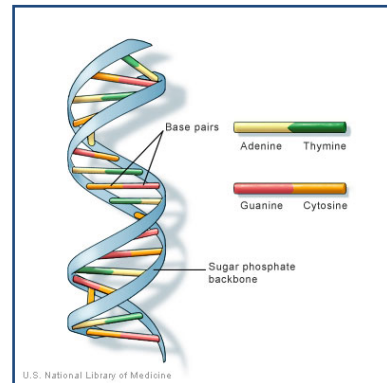
Proposed model for potato:

- **DUS testing based on morphological observations:**

  - **First year:**
    - start of season: lightsprout test (including photograph) and DNA profiling
    - main season: morphological observations of field characteristics
  - **End of first year:**
    - DUS decision based on morphological data (threshold for distinctness)
    - Supported by information from DNA database to check for potential 'missing' close varieties
  - **Second year testing continued for selected candidate varieties only:**
    - candidate-reference pairs below distinct plus level (cityblock distance < 0,1)
    - including reference varieties selected from DNA database (Jaccard < 0,2).

Proposed model for potato:

- Reduced testing period compensated by added value molecular profile:

  – Significant expansion of reference collection (potentially expanded with SSR databases of cooperative DNA labs)

  – Detection of most similar reference varieties (Jaccard distance < 0,2)

  – Morphological observation supported by information from molecular profile.

  – Spin-off for identification purposes (based on original identity sample)